# Communicating the Sciences of Disaster Risk Reduction:

## media stories surrounding the Canterbury earthquakes of 2010-2011

Vivienne Bryner

A thesis submitted for the degree of Doctor of Philosophy at the University of Otago, Dunedin, New Zealand

February 2016

# Abstract

Communication of disaster risk reduction (DRR) should be participatory, democratised and scientifically robust according to ideals enshrined in the United Nations' International Strategy for Disaster Reduction Hyogo Framework for Action and Sendai Framework 2015. The mass media are a vital pathway for transferring knowledge about DRR. This thesis explored the media communication of science for DRR in New Zealand. A methodology was developed for comparing survey results with academic and mass media content about earthquakes (Chapter 3).

A review of communication of DRR under the above communicative paradigm identified seven key elements of 'best-practice' communication ('7Ts'), and yielded sixteen features ('16Cs') of 'well-regarded' communication (Chapter 4). This thesis focused on assessing communicated content in terms of three of the features, *considerateness*, *completeness* and *comprehensiveness* (Chapters 5, 6 and 7).

*Complete* and *comprehensive* understanding of DRR is shown to involve the range of stakeholders involved in DRR, consideration of the natural, built, social and economic environments, and recognition of the disciplinary diversity of sciences that contribute to DRR knowledge. A framework was developed to classify all DRR actions according to twelve DRR-communication topics. Other frame sets that may be used singly or collectively to analyse for completeness were also presented.

*Considerate* science communication engages the community and asks what they need to know. Communication that is well-regarded is 'effective', 'ethical' and exhibits 'best-practice'. Survey and in-depth interview of 493 New Zealanders showed citizens concur with, but also extend what is already known from the research literature of wider global community expectations of communication.

Framing analysis was used to analyse four DRR-related data sets quantitatively for completeness, as per frames described in Chapter 3. Media content, survey and interview results, DRR-related research knowledge, and authorities' pre-earthquake advice were analysed. This enabled the framing of topics communicated in the mass media before, during and after the Canterbury earthquakes to be compared and contrasted with current

understandings from DRR-related research. The media items were geoscience-, hazard-, event- and consequence-focussed, containing only limited mention of how individual and community vulnerabilities might be reduced. Areas for potential improvement were suggested for the 155 earthquake-related story types identified in New Zealand online print, television media and women's magazines. The content-related recommendations combined existing natural hazard and disaster media research findings with what survey respondents indicated they needed (Chapters 5-7).

Greater acknowledgement of scientific uncertainties, and more discussion of the risk cost-benefit trade-offs being made on behalf of citizens, as well as the reasoning behind other related decision-making, was requested by survey respondents. Less emphasis on probability by journalists and scientific or expert sources, when discussing risk, seems warranted, as do a greater emphasis on disaster causes, recovery, and concepts of self- and community-efficacy in DRR. Given that audiences had difficulty gaining broad perspectives in DRR, I conclude more evidence-based information from a wider range of social and physical sciences is needed. Communication should focus on resilience, on solutions rather than problems, and recognise the importance of community innovation, adaptation and leadership in preparation, avoidance and mitigation.

# Acknowledgements

This thesis is dedicated to the many people who have contributed to my PhD journey.

In particular, I thank my supervisors, most especially Prof Jean Fleming, and also Dr Virginia Toy and Prof Richard Norris for their support. The Darfield earthquake meant a change in direction from my original research proposal – but no perceptible change to their belief that I could contribute meaningfully to the communication of the sciences of DRR.

To the hundreds of people who gave their time as survey and interview respondents – thank you! Your willingness reflects a genuine community-wide desire to improve seismic risk reduction in NZ.

My family's contribution to data collection for this research has been considerable. I am so grateful to you Enid, and also to Leonore and Tony and on occasion Britt for your assistance.

This research would not have been possible without a University of Otago PhD scholarship, and a stipend from the Earthquake Commission (EQC). Funding received from the Division of Sciences, Geology and Zoology Departments and the NZ Federation of Graduate Women enabled attendance at the International Disaster Risk Reduction Conference in August 2012. The opportunity to present and discuss my research there was invaluable, as it was at NZ conferences, workshops and other meetings, to which EQC and GNS funded travel. Thanks to Dr Richard Smith and Prof David Johnston for their assistance with this.

Although they have not been official advisors there are two people who warrant particular mention for their very different contributions to my research. Prof Bruce Glavovic, a man of colourful intellect and conversations encouraged me to look at a wide range of research literature at the interface of science, society and DRR. Prof Brian McAdoo's infectious Skype smile has always encouraged.

To the wonderful M. Sci. Comm. students who I was lucky to get to know in 2010 and 2011 - your creativity and talent were a much-enjoyed foil to my 'drier' research, and an inspiration for my future.

To my friends, including those I have made as I moved to Dunedin, then back to Chatto Creek, to Lawrence and then to Wellington - particularly Stephen and others who have accepted my working full-time and being constantly ‘distracted’, and despite that flown with me, brought me flowers, and made me chai lattes - I am so grateful for your support. I will have more time for and with you now. Craig, and Helen (for her proof-reading) - the best neighbours one could hope to have; you know I couldn’t have completed without you.

I still feel deeply for those Cantabrians who were forced from their pre-quake lifestyles into existence living and limbo for far longer than they imagined, and for those who lost loved ones in the earthquakes in 2011. I have particular admiration for those who have turned adversity into personal and social triumph.

I also admire those thousands of people across New Zealand who worked longer hours than ever since September 4, 2010, in various attempts to speed Christchurch’s recovery; including the reporters and journalists who brought us their stories.

Those stories, the ones that surround the Canterbury earthquakes have taught me so much. This thesis is one way of sharing what I’ve learnt with you.

# Table of contents

(This table provides chapter and section headings. For an extended table of contents to a third level (subheading) see Appendix 2. The subheadings have been written so as to capture key findings of this research, so reading them provides a quick overview of the thesis.)

-blank-

# List of figures

-blank-

# List of tables

(Page numbers for Appendix Tables are given at the beginning of each Appendix (for locations see Table of Contents on p. v.)

-blank-

# List of acronyms

ACC – Accident Compensation Corporation (NZ)

AFR – Alpine Fault Rupture

BCM – business continuity management

CAENZ - Centre for Advanced Engineering (NZ)

CBD – central business district (NZ)

CCC – Christchurch City Council

CDEM – Civil Defence and Emergency Management (NZ)

CDHB – Canterbury District Health Board (NZ)

CERA – Canterbury Earthquake Recovery Commission (NZ)

CRI – Crown Research Institute (NZ)

CSR – corporate social responsibility

CTV – Canterbury Television building (Canterbury, NZ)

DBH – Department of Building and Housing (now part of MBIE – see below)

DFDP – Deep Fault Drilling Project (Alpine Fault)

DIPs – deliberative inclusive processes (that support public participation)

DRM – disaster risk management

DRR – disaster risk reduction

ECAN – Environment Canterbury (Regional Council) (NZ)

EECA – Energy Efficiency and Conservation Authority (NZ)

EEW – earthquake early warning

EM – Emergency Management

EMS – Emergency Services

EPB – earthquake-prone building

EQC – Earthquake Commission (NZ)

ESR – (Institute of) Environmental Science and Research

GIS – geographical information systems

GNS – (Institute of) Geological and Nuclear Sciences (also IGNS)

IOT – Indian Ocean Tsunami

IT – information technology

JCDR – Joint Centre for Disaster Research (NZ)

LIM – Land Information Memorandum (NZ)

LINZ – Land Information New Zealand (NZ)

MBIE – Ministry of Business, Innovation and Employment (NZ)

MCDEM – Ministry of Civil Defence and Emergency Management (NZ)

MCE – maximum credible earthquake

MP – Member of Parliament

NZ – New Zealand

ODT – Otago Daily Times (NZ)

NGO – Non-government organisation

NIWA – National Institute of Water and Atmospheric Research (NZ)

NOAA – National Oceanic and Atmospheric Administration (US)

NZSEE – New Zealand Society for Earthquake Engineering

NZWW – New Zealand Women's Weekly magazine

PGA – peak ground acceleration

PGC – Pyne Gould Corporation building (Canterbury, NZ)

PSHA – probabilistic seismic hazard assessments

PTSD – post–traumatic stress disorder

PTWC – Pacific Tsunami Warning Centre (United States)

PUS – public understanding of science

RS – remote sensing

RSNZ – Royal Society of New Zealand

SAR – ‘search and rescue’ (also ‘synthetic aperture radar’ damage assessment)

SDC – Selwyn District Council (District Council) (NZ)

STS – science and technology studies

STUFF – Fairfax Media NZ news website  - stuff.co.nz (NZ)

TA – territorial authorities (local and regional Councils)

TVNZ – Television New Zealand

UC – University of Canterbury (NZ)

UNISDR – United Nations International Strategy for Disaster Reduction overseen by the United Nations Office for Disaster Risk Reduction

URM – unreinforced masonry

USAR – urban search and rescue

USGS – United States Geological Survey (US)

WDC – Waimakariri District Council (NZ)

WHO – World Health Organisation

# 1 Introduction

## 1.1 Communication and science are essential for disaster risk reduction

*Disaster = energy + misinformation*
Brian Turner as referenced in (Denis, 1995)

The simple equation above serves to underline the fact that information and its transfer (communication) are well recognized as vital components in averting disaster, deficiencies in either may contribute to disaster (Denis, 1995; Havidán Rodríguez & Dynes, 2006; UNISDR, 2009a).

Science and communication are both essential in disaster risk reduction (DRR).

What is DRR? DRR is an issue that it's easy to be passionate about, because if done well, it saves lives and livelihoods. DRR involves understanding not only the risk, and the cause of disasters, but perhaps more importantly, the ways that we can mitigate and prepare for disasters, thereby reducing people's exposure and vulnerability to hazards such as earthquakes.

Meanwhile, science communicators *"examine the mediation function [between science and society] to understand how it works, to measure the effects, and to improve it*" (Gascoigne et al., 2010, p. 4).

DRR-related science communication is therefore valuable in reducing disaster risks.

## 1.2 Introducing this research and this thesis

The aim of this research was to contribute to existing practical suggestions for improving the communication of the sciences of DRR. The research described and discussed in this thesis has reviewed academic research publications, and analysed the content of those publications and media coverage before, during and after the Canterbury earthquakes.

This introductory chapter introduces key aspects of the extensive literature reviewed for this research. These are followed by presentation of the research question, and an overview of the research approach and methodology. The chapter concludes with a brief summary of what each chapter of the thesis contains.

## 1.3 Earthquake disasters and DRR – the problem and the solutions

### 1.3.1 Earthquake-triggered disasters are wicked problems

One of the most complex issues or ‘wicked problems’ (Churchman, 1967; Rittel & Weber, 1973) facing societies relates to the problems posed to human communities by natural or environmental hazards such as climate change or earthquakes (O'Brien, O'Keefe, Gadema, & Swords, 2010).

Disasters triggered by earth processes, called natural hazards, are an environmental issue, affecting the natural environment. Disasters caused by earthquakes affect the built environment, damaging buildings, infrastructure and contents. Disasters are also an economic issue, affecting national and regional economies, businesses, and individual livelihoods, as well as affecting large monetary shifts globally due to the distribution of aid, and insurance and reinsurance funds. Disasters are a social issue affecting not only whether people live, but how, and the degree to which their lives and lifestyles are affected when hazard events occur. Disasters are often a global public health issue, from both a physical and mental perspective. Disasters are, at the same time a legal and governance issue (UNISDR, 2015). This includes legislation and enforcement not only of building safety codes but other policies that protect lives as well as livelihoods and lifestyles.

Earthquakes, like other natural hazards are an inevitable part of life on Earth. At times earthquakes are virtually indiscernible either because of their small magnitude, or because they occur far from human communities. At other times, rather than having a very localized and minor effect on communities, the effects are large-scale with globally undesirable consequences that result in some of the planet’s deadliest disasters (IFRCRCS, 2005). Earthquakes account for the majority of deaths from natural hazards (OECD, 2008).

Earthquakes contribute significantly to global disaster statistics not only in terms of lives lost but also physical damage to human built environments, resultant loss of functionality and amenity, consequential economic loss, and psychological effects. For example, in 2010 earthquakes accounted for almost one third of global insured losses (Bevere, Rogers, & Grollimun, 2011).

Between 1900 and 2014 177 million people were directly affected by earthquakes, 2.5 million people killed and $US764 billion damage caused in 1,244 events (EM-DAT, 2014). Between 2004 and 2014 216 events affected 77 million people killed 422,000 and caused USB$423 damage globally. In New Zealand eight major earthquake events in the period

1900-2014 affected 620,186 people, killing 459 at a calculated cost of US$24billion (EM-DAT, 2014). Earthquake (and tsunami) are considered the most potentially damaging and disruptive of all New Zealand hazards (ODESC, 2007).

A series of earthquakes in New Zealand in 2010 and 2011, including the M7.0 Darfield earthquake on September 4 2010 and the M6.1 Lyttleton (Christchurch) earthquake on February 22 2011 affected more people and accounted for far greater economic losses than any other earthquakes in New Zealand history. Surrounding these New Zealand events were three major global earthquake events, in Haiti (12 January 2010), Chile (27 February 2010), and Japan (11 March 2011). The degree of loss of life, injury, damage and disruption in those 5 events alone highlight the need for society to further improve ways to reduce the unwanted effects of future seismic events (details in Table 3.8).

### 1.3.2 Introducing a set of solutions – disaster risk reduction (DRR)

> *Timely, accurate and sensitive communications in the face of natural hazards are demonstrated, cost-effective means of saving lives, reducing property damage, and increasing public understanding. Such communications can educate, warn, inform, and empower people to take practical steps to protect themselves from natural hazard.*
>
> Principles and Recommendations of the Roundtable on the Media, Scientific Information and Disasters (Cate, 1994, p. 14)

While earthquakes themselves cannot be prevented, their damaging effects can be, at least in part. Concepts and practices have been developed to identify, assess, evaluate, resolve and reduce disaster risks (UNISDR, 2009a, 2009b). Those concepts, practices, solutions and strategies are collectively known as disaster risk reduction (DRR). The knowledge and technology base potentially applicable to reducing disaster risks has grown dramatically in recent years, so that through a concerted co-operative international effort, it is possible to save many lives and reduce human suffering, dislocation and economic losses (Rattien, 1990b). Variations in DRR concepts and practices have been shown to account for a difference in fatalities between earthquakes of similar magnitude (K. Smith, 1993).

DRR is often referred to as either a means of reducing vulnerability or building resilience (UNISDR, 2005, 2009a, 2009b). Vulnerability is often related to social inequality (Brunsma & Picou, 2008). The wide range of options in DRR relate to opportunities to reduce communities' vulnerability to disaster risks before, during or after disasters occur. Researchers often conceptualise four phases of opportunity to reduce vulnerability and build resilience (Coetzee & van Niekerk, 2012; Mamula-Seadon, 2009; Moehle et al., 2009). In New Zealand these phases are often referred to as the '4Rs' of DRR (Mamula-

Seadon, 2009). The phases are 1) reduction relating to opportunities between disasters, 2) readiness, which relates to the planning and preparation before disasters 3) the *response* associated with a disaster event, and 4) the recovery from disasters.

The range of existing DRR solutions is wide. The implementation of some solutions, such as planning, policy development, legislation and compliance are the primary responsibility of governments in partnership with all other stakeholders (UNISDR, 2015). The state, beaurocracy, and the market are well-recognised influences in DRR (Gamper & Turcanu, 2009). Other practical DRR solutions, structural mitigation and preparation- or adaptation strategies that are the result of innovations have the potential to be adopted by businesses, communities, households and individuals (UNISDR, 2009a, 2009b).

Science, and communication, and the people involved in them are other vital aspects of DRR. The observation by Solana, Kilburn, and Rolandi (2008, p. 308) that *"since the mid-1970s alone, most of the casualties from [volcanic] eruptions have been the result of poor communication and consequent delays in initiating mitigating procedures"* illustrates that science and communication are important to a variety of natural hazards, not just earthquakes.

### 1.3.3 Science plays a critical role in DRR

Science plays a critical role in DRR. Information and knowledge play a central role in the function of contemporary society, in particular in the way that societal issues are resolved (Kajtazi & Haftor, 2011). Data and information form the evidence-basis for individual and collective attitudes, judgments, decisions and actions. Science, in Western societies, is an extremely valued form of knowledge. Knowledge gained through scientific method is evidence-based information that is considered to make significant contributions to the solving of society's problems (Lubcheno, 1998).

As Vogel stated:

> *Science … has always been in a position to play a potentially significant role in detecting and defining global environmental problems, framing and shaping the public and policy debates around them, helping to identify socially and ecologically appropriate solutions, and informing the social learning process.*
>
> (Vogel, Moser, Kasperson, & Dabelko, 2007, p. 360)

Nowadays there is more science in society and more society in science in general (Cerroni, 2006, 2007) and this also applies to DRR. The role of science and technology in all four phases of disaster, readiness, response, recovery and risk reduction is internationally recognized (ICSU, 2008; UNISDR, 2009a; Xu, Gong, & Li, 2008). The knowledge and technology base potentially applicable to the mitigation of natural hazards has grown so dramatically in recent years that scientists (and this includes engineers) believe it would be possible, through a concerted co-operative international effort, to save many more lives and reduce human suffering, dislocation and economic losses (Rattien, 1990b).

DRR solutions are recognized as being informed by many physical and social science disciplines (Alexander, 1997; R. Smith, 2009). DRR relates to the wise management of four 'environments', natural, built, social and economic (Cardona, 2004; MCDEM, 2005b; UNESCO-IOC, 2009). So a range of information from environmental science, engineering, emergency medicine, and economics, sociology and other social sciences, psychology, pathology, public health and political science, information sciences (including communication studies), geography and geology, assist in identifying the problems, and possible solutions. Integrated knowledge across this wide range of disciplines, including the social sciences, is recognized as important for successful DRR, as is its communication (Alexander, 2007; Rattien, 1990b; D. Sarewitz & Pielke, 2001; UNISDR, 2009a).

### 1.3.4 A 'culture of DRR' is needed and achievable through communication

Concerns about the lack of public support for DRR, and in particular seismic safety are by no means new (Meltsner, 1978). Despite significant scientific progress in DRR, many communities remain vulnerable to disasters, and massive disaster losses continue to occur at preventable, and societally unacceptable levels. Many advocates of DRR believe that to reduce those vulnerabilities, to ensure greater survival, and reduce losses, a significant shift in social norms, a 'social movement', toward a 'culture of DRR' is required (Barakat & Ward, 1995; Bendimerad, 2004; Kasapoğlu & Ecevit, 2004; Mileti, 1999; Schlehe, 2010; Shaw, Shiwaku, Kobayashi, & Kobayashi, 2004; Solberg, Rosetto, & Joffe, 2010; UNISDR, 2015; F. G. White, Kates, & Burton, 2001). 'Social movements' are described in Wilson (1973). Such cultural transformations, or movements require social learning through a mass transfer of knowledge amongst the members of society (Zeng, Chen, & Liu, 2008). Communication is conceptualized as the human survival tool to achieve this.

### 1.3.5 How communications are framed creates 'DRR culture'

A 'culture of DRR' is created by information and its communication (Zahran, Peek, Snodgrass, Weiler, & Hempel, 2001). Culture, ideology, and framing are closely interconnected. They are conceptually related because they deal with the content and process by which meaning is attached to objects and actions. 'Culture' refers to the shared beliefs and under-standings, symbols, and language of a group or society. 'Ideology' is a set of beliefs that is used to justify, challenge, and/or interpret the social world. 'Frames' are the specific metaphors, symbolic representations, and cognitive cues used to assess a social condition and to suggest alternative modes of action (Taylor, 2000). How mass media communications about DRR are 'framed' creates 'expectations' relating to DRR (McClure, White, & Sibley, 2009) creating what might otherwise be termed 'cultures' of disaster, of risk, and of risk reduction (Schencking, 2008). DRR awareness, understanding and engagement are thus achievable through communication

Communication is considered vitally important in the solving of complex societal issues in general, and communication is, and has long been one of the key DRR strategies (Cate, 1994; Drabek, 1979; Lombardi, 1997; Rohrmann, 2003b; UNISDR, 2005). Communication plays a number of roles in DRR, in technical communication systems, disaster site communications, organizational communications, communication associated with scientific development and policy formation, and in publicly communicating key aspects about all of these so as to raise awareness about of DRR and facilitate participation in DRR (Cate, 1994; UNISDR, 2009b). This thesis relates to all of the above. It is about communication in the public sphere with the aim of raising awareness about, understanding of, and engagement in DRR.

Public awareness about DRR is defined as;

> *the extent of common knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards ... [and] is a key factor in effective disaster risk reduction.*
>
> (UNISDR, 2009b, p. 23)

DRR involves problems, solutions and choices (Tierney, 1989) all of which need to be communicated.

### 1.3.6 It is critical that solutions, not only problems are communicated

One of the ways to resolve any issue is through raising awareness of the issue or problem. Another is through raising awareness, or communication of possible solutions to the problems. Solutions-focused risk assessments, rather than traditional risk assessments that have been focused on quantifying the problems (Finkel, 2011), need to be communicated.

Awareness, understanding of, and agreement about solutions is said to lead to social learning and social change (O'Brien et al., 2010; Zeng et al., 2008). DRR awareness and related social learning (understanding) and social change is achieved through advocacy by officials, experts and other community leaders, through community participator actions, and through development of knowledge (UNISDR, 2009b). The way any social change is framed will influence the degree of participation (e.g. Taylor, 2000). Awareness, social learning and social change is highly dependent on and triggered by the dissemination of the knowledge and information actions through educational, and mass media channels (Bandura, 2001; Cate, 1994; UNISDR, 2009b).

### 1.3.7 Mass media are a key site for social change, DRR and science communication

The mass media are a source of public affairs, health and science knowledge (Schramm & Wade, 1969). The mass media are also acknowledged as a key site for public sphere communication and social change in general and in relation to DRR (A. Hall, 2011; Jalali, 2002; Miles & Morse, 2007). Disaster, risk, and disaster risk reduction are issues constructed in complex ways from public opinion, the statements and actions of leaders and policy- and decision-makers, the status of expert scientific opinion, and in particular, media representations of these (Hornig, 1993).

> *Media [are to] take an active and inclusive role at the local, national and global levels in contributing to the raising of public awareness and understanding and disseminate accurate and non-sensitive disaster risk, hazard and disaster information, including on small-scale disasters, in a simple, transparent, easy-to-understand and accessible manner, in close cooperation with national authorities; adopt specific disaster risk reduction communications policies; support as appropriate, early warning systems and life-saving protective measures; and stimulate a culture of prevention and strong community involvement in sustained public education campaigns and public consultations at all levels of society, in accordance with national practices.*
>
> (UNISDR, 2015, p. 23)

Many researchers with an interest in DRR focus on communication and in particular mass media communication, because this communication is fundamental to the social process of understanding hazards, disaster and risk, and the possible activities in reducing risk (Lombardi, 1997). There are three types of communication that are commonly referred to in relation to communication of DRR-related issues; science communication, risk communication and crisis communication. Amongst a variety of definitions for science communication is one by Gascoigne (2010) that describes risk- and crisis- or even 'DRR-communication' equally well, if the word science or scientific is replaced with risk, crisis, or DRR.

Science communication is described as a field of study that;

> *deals with the diffusion, propagation and appropriation of scientific knowledge in different context, for different purpose, with different effects (intended or unintended), and the paradigms employed qualify these processes.*
>
> (Gascoigne et al., 2010, p. 4)

The context in this thesis is DRR. Research in the communication of the sciences of DRR is compelling in that it involves multiple contexts, purposes, effects and paradigms; and as a result many challenges.

### 1.3.8 No existing term adequately describes communication of DRR

The term DRR-communication is used throughout this thesis even though it breaks the rules of good science communication. The term DRR-communication has no existing meaning even to academics and contains an acronym that would be meaningless to most citizens. However I have found no reasonable substitute, and wanted to make a clear distinction between risk communication that is only communication of threat-, and communication also that encompasses components of risk assessment and risk management and community resilience.

The UNISDR, the body that provides an international strategy for disaster risk reduction, promotes the communication of DRR. However no definition of what DRR-communication could, should or does encompass is included in the UNISDR's booklet of definitions and terms relating to DRR (UNISDR, 2009b). Figure 1.1 shows areas of DRR-related communication research. That research does not have a definition for DRR-related communication either.

Substituting 'risk-management-communication' would frame the communication needed as being only about solutions and furthermore would frame DRR as an official undertaking rather than individual or community one. Similarly the rarely used term 'resilience-communication' (Longstaff & Yang, 2008) would suggest communication only of the solutions. DRR is not only about 'crisis' or 'disaster' so the terms crisis- or disaster communication do not fully suffice either. The term 'risk communication' was not chosen as it is considered that 'risk communication' perpetuates the very problems-focus that Finkel (2011) suggested must be avoided. This is discussed further in sections 2.7.1 and 2.7.2.

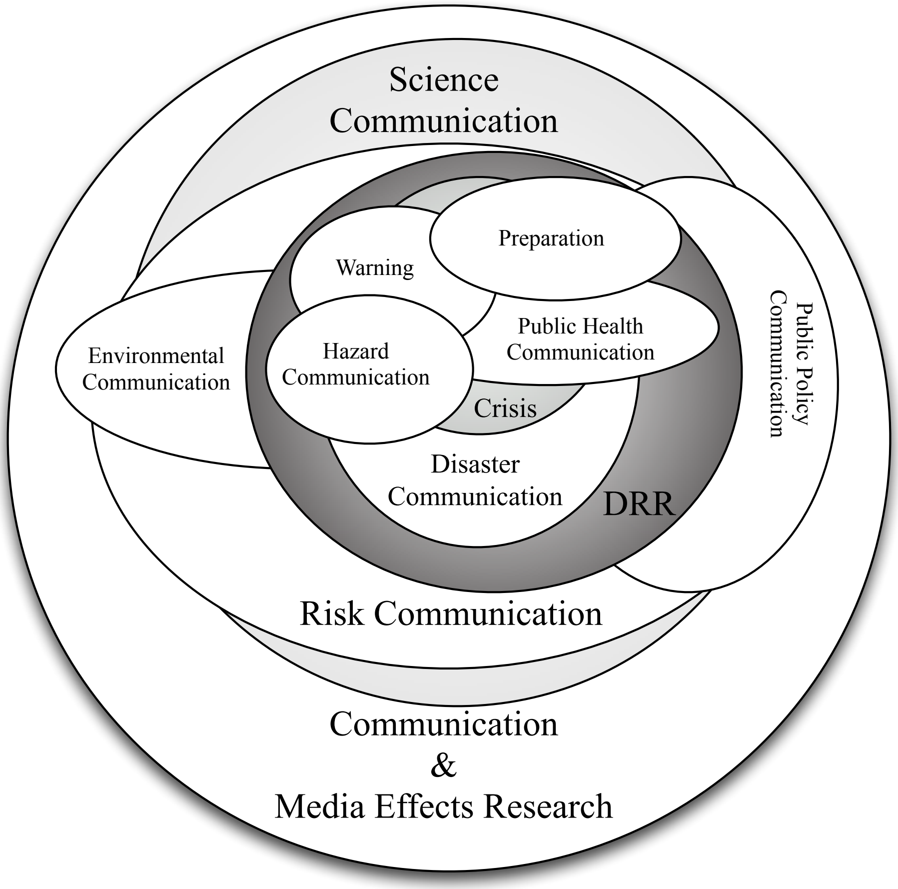



**Figure 1.1: Relationship of DRR-communication to other communication research**
DRR-communication, the subject of this research (shaded grey) is shown as a subset of other communication research. Communication research areas that are subsets of DRR-communication lie within the grey area. Note that the bodies of research relating to DRR or recovery communication are so small that researchers do not refer to them separately.

### 1.3.9 Science communication is important in democracy and DRR

Some of the challenges in DRR-communication relate to communication in general, some arise due to the nature of science-, risk-, DRR solutions and their communication, and others to the nature of risk. A further set of communication challenges relate to the communication of the issue itself, DRR. Contributing to the way all of these challenges and their potential and real solutions are perceived in New Zealand and many countries are over-arching principles of democratization.

That all citizens - scientists, policy and decision-makers, and 'lay-public' alike - require knowledge to be communicated is a fundamental premise under principles of deliberative and participatory democracy (Gastil, 2008; Habermas, 2001). Einsiedel (2008) noted a 'participation explosion' in relation to the research in, and practice of science communication. This is also variously referred to as 'stakeholder engagement', 'citizen involvement', 'multi-stakeholder dialogue', 'local community consultation', 'public participatory process, or 'deliberative inclusive practices' (DIPs). Finkel (2011) made reference to a 'distributive justice paradigm'. Quarantelli (1996b) noted the increasing influence of democratization and rise in citizen activism in the 1990s. Gamper and Turcanu (2009) explained that, and why, DRR already benefits, and would benefit even more, from increased citizen participation in DRR. Principles of DIP are espoused and promoted at the highest international levels.

In relation to DRR such ideals are presented through the United Nations International Strategy for Disaster Risk Reduction (UNISDR). The Hyogo Framework for Action (HFA) 2005-2015, and it's successor instrument the Sendai Framework for Disaster Risk Reduction (Sendai Framework) are action plans to achieve DRR (UNISDR, 2005, 2011b, 2015). Both the HFA and Sendai Framework are founded upon ideals of dialogue, and open and free information exchange between research disciplines and all sectors of society as well as the combined participation of civil and scientific communities (UNISDR, 2010; 2015). Such ideals permeate academic, policy and legislative frameworks at all levels of governance in democratic societies (such as New Zealand) so that the UN, national, regional and local government stress how fundamental the following are to all aspects of DRR: a) the informed participation of all stakeholders, b) the widespread and consistent availability of current and accurate data c) information monitoring, processing, sharing and dissemination (Djalante, Holley, & Thomalla, 2011; UNISDR, 2005 relevant sections of New Zealand's Resource Management Act, 1991 and Civil Defence and Emergency Management Act 2002). Empowerment, informed decision-making and full engagement of communities are guiding principles of the Sendai Framework (UNISDR, 2015).

These ideals for an enabling environment for DRR are reliant on communication that is at least 'bottom-up' rather than 'top-down' or beyond this to what Irwin (2008) terms 'third order'. The ideal of engaged communities, whose views are canvassed and integrated with those of science, requires increased transparency and inclusivity in decision-making (Faulkner & Ball, 2007). To become 'everyday analysts' citizens require communication that contains evidence-based information to support solutions-focussed decision-making (Finkel, 2011; Palen, Vieweg, & Anderson, 2011). Communications should therefore be designed to empower citizens, and foster leadership, and self- and community efficacy in formulating questions and decision-making, rather than promoting only organizational, institutional or 'command post' solutions to issues such as DRR (R. L. Heath, Jaesub, & Lan, 2009; Quarantelli, 1975, 1981; Waymer & Heath, 2007).

### 1.3.10 Ethics and ethos should underpin definition of 'effective' DRR-communication

This research was premised on the assumption that a way to ensure the success in advocating for a social movement such as DRR, is by employing communicative practice that considers ethics and ethos, the collective and individual needs of a range of stakeholders. DRR's altruistic issue-specific goals of reducing human suffering and loss do not exempt those communicating DRR from being bound by the same communicative ideals as any other issue.

In order to be able to critically analyse, measure and discuss communication one must first establish just what is viewed as exhibiting 'best-practice' or what 'effective' science- risk- or DRR-related science communication is. Before this, though, in order to establish what well-regarded communication is, clarity about the aims and goals of DRR science communication is required.

Historic goals will be associated with out-dated concepts and models upon which to base analysis and discussion. Establishing a basis for communication that has been and is currently well regarded was possible through perusal of risk communication and communication literature as is discussed in more detail in Chapters 2 and 4.

Scholars make reference to the need for 'ethical' or 'just' science- or risk communication (e.g. Bradbury, 1989; Steelman & McCaffrey, 2013). Hornig (1993) emphasised that media accounts of risk need to meet citizen needs regarding ethical considerations. However there is only a relatively small body of literature dedicated to the discussion of ethics in science- or risk communication (e.g. B. B. Johnson, 1999; Morgan & Lave, 1990; Rowan, 1994a, 1994b; Thompson, 2012; Valenti, 1998; Valenti & Wilkins, 1995).

There are increasing suggestions that scientists need to be trained in the ethical implications of their science and the way they communicate it (e.g. Likens, 2010). Thompson (2012) similarly suggests risk communicators need to consider ethics more often, as the ethical frameworks in which issues are conceptualized affect the way related communications are shaped. In particular Nisbet (2010) refers to the lack of a strong ethical framework to parallel the communicative ideology in public engagement. This would fit with Faulkner's definition of 'effective communication' as communication that meets "*the information needs of both communicator and recipient*" (Faulkner & Ball, 2007, p. 76)

The key elements of an ethical risk communication framework are outlined in Cronin's (2003) summary of a presentation by bioethicist Professor Donald Evans of the University of Toronto. These elements include the need to consider and/or be; 1) respectful of autonomy (self-determination and/or empowerment), 2) beneficence (what the benefits are and who benefits), 3) truthfulness (providing the whole story), 4) dignity (the needs and situation being considered), 5) non-maleficence (doing no harm) and 6) justice (whether the communication reflects fairness and principles of justice). It is these concepts that lie at the heart of what is referred to throughout this thesis as *considerate* communication.

#### 1.3.11 DRR-communication needs to be considerate, complete and comprehensive

This research identified two key components of DRR success and measures and discusses DRR-communication against these.

Communication that is underpinned by ethics was termed *considerate* in the previous section, and is the first component. Communicators of science and risk have a choice as to whether the objective of their communications is (however altruistically) to motivate specific behaviours or to motivate citizen-chosen behaviours through provision of data, information, knowledge and advice supporting negotiated decision-making (cf. Irwin's (2008) third order risk communication, or Bielak et al's (2008) 'knowledge brokering'. The latter approaches are *considerate*. When Rowan (1994b) proposed five goals for risk communication she did not discuss how these could be achieved. There is no literature since that collectively discusses how these goals may be achieved in relation to communicated content. Part of this research involved identifying sixteen key features of considerate communication; how audience needs are considered (Chapter 4).

The second key component to successful DRR-communication identified in this research was that communication should be *'complete'*. Completeness is related in this research to seven elements of a strategy that are necessary to fully describe the issue (in this case DRR) topics (explored and described in Chapter 4). Completeness relates to *what* is said, and in particular what the DRR content is. This latter part of completeness has equivalence with the third component emphasised in this research *'comprehensiveness'* (D. Sarewitz & Pielke, 2001; Singer & Endreny, 1994).

A holistic understanding of DRR is a key feature of DRR success (Chapter 2). Integrated approaches to solving societal problems that are risk-, and DRR-related are in favour at the time of writing. It is widely recognized that transfer between stakeholders of 'relevant' scientific data, information, knowledge or wisdom are required. However just what is 'relevant' is rarely articulated.

Comprehensiveness had not been the focus of much science- or risk communication research. Singer and Endreny (1987) looked decades ago at a limited form of comprehensiveness; whether information about likelihood, costs and benefits and annual mortality had been provided in media content. However just what 'all the issues' or 'all the options' (what is relevant) to be communicated was not articulated. Consequently this was a critical gap to fill in this research. *Comprehensive* DRR-communication became a focus of this research, and a methodology that focussed on assessing aspects of comprehensiveness of content in relation to DRR was developed (as will be discussed in section 3.1.2). Essentially though *complete* communication provides the perspectives of all of the stakeholders in DRR about a *comprehensive* list of aspects of DRR (e.g. covers knowledge from all phases of the DRR cycle, all of the scientific disciplines, and all environments as introduced in sections 1.3.2 and 1.3.3).

## 1.4 Summary of this study of DRR-communication

To summarise the key points from the previous introductory sections, DRR is a wicked problem, the solutions for which are informed by evidence-based information from a range of scientific disciplines. Citizens individually and collectively require the fundamental aspects of this knowledge to be communicated in order to recognize the need for increased engagement in DRR and to support DRR-focussed decision-making. The mass media are considered a central channel for communicating the sciences of DRR to citizens. This research is premised on the assumption that what is in the mass media has a significant collective effect on how individuals and society in general consider earthquake, risk and the options available in earthquake-related hazard mitigation and risk reduction. Communication ideology and ethics indicate that 'good' communication will be 'considerate' of citizen needs. This suggests that effective communication that meets citizen needs will be achieved by aligning DRR topic knowledge with citizen information requirements.

### 1.4.1 The aim of this research was to contribute to existing practical suggestions for improving the communication of sciences of DRR

The aim of this research was to contribute to existing practical suggestions for improving the communication of the sciences of DRR.

This was to be achieved by analysing, and building mostly upon earthquake-communication-related examples, and in particular the New Zealand experience preceding and during the Canterbury earthquakes of 2010 and 2011.

Turner referred to wishing to provide a

> *basis upon which the media, scientists, and public officials can collaborate to provide a more realistic, dependable, and stable pattern of communication concerning the earthquake threat and community preparedness.*
>
> Turner (1982, p. S27)

The intent of this research was similarly, to provide practical recommendations. These are outlined in chapters 5, 6 and 7 and summarised in Chapter 8. The recommendations cover all phases of DRR. The recommendations are potentially of interest and value to all involved in communication of science, risk and disaster risk reduction, whether by medias, scientists, officials, or other DRR advocates.

### 1.4.2 There were a primary and secondary research question

The primary research question was:

Q1 - “What does review of existing scholarship, surveys, interviews and stories in the mass media reveal of how communication of earthquake science might be improved, so as to lead more directly to disaster reducing outcomes?”

The secondary research question was:

Q2 - “What theoretically robust and well-regarded ‘ethical’ strategies and recommendations could the mass media and their sources employ to improve earthquake-related DRR-communication?”

### 1.4.3 The approach was to examine both communicative ideals and DRR goals

Research undertaken for this thesis has explored and examined the communication of the sciences of DRR in terms of both communicative ideals and DRR goals. It has also examined a variety of bodies of knowledge about natural hazards, disasters, the factors that contribute to disasters, and potential DRR solutions.

### 1.4.4 Four different types of data were compared and contrasted

Throughout the research four primary sources of data were compared and contrasted;

A) Past research into communication in the public sphere about science, disaster, risk and risk reduction.

B) Current scholarly understanding of disaster, risk and risk reduction, and in particular earthquake-related disaster, seismic risk and seismic risk reduction.

C) What was communicated in the New Zealand mass media in the period April 2008-2012 in relation to earthquake-related disasters, seismic risk and seismic risk reduction; and

D) What New Zealand residents consider that citizens need to know about earthquake-related disasters, seismic risk and seismic risk reduction, as well as what should be better communicated in the mass media about these topics.

## 1.5 Overview of methodology

### 1.5.1 There were seven stages to the research

This section shows how the research questions fit with the methodology. The primary research question was explored in seven stages of frame analysis, applied to data gathered through four methods (literature review, survey, interview and media analyses) as listed below. Stage 1 iv) is when the secondary research question was specifically addressed.

1. Review of existing scholarship to:

    i) establish contemporary DRR goals and ideals;

    ii) explore current and historical framing of 'effective' or best-practice science- and risk communication, and associated models, in order to better understand communicative ideals and their impact on communication challenges and solutions;

    iii) summarise the framing of already-identified problems in science- and risk-communication that are likely to have relevance to DRR-communication; and

    iv) synthesize existing strategies and recommendations in science- and risk communication that have relevance to DRR-communication.

2. Interview of various societal actors in DRR to establish multi-citizen framing of societal needs in DRR-communication.

3. Survey to identify:

    v) how well a range of NZ citizens thought disasters, risk and risk reduction were communicated prior to the Canterbury earthquakes;

    vi) what earthquake-related, evidence-based DRR-science a range of New Zealand citizens think it is important to know and improve the communication of; and

    vii) why audiences want to hear about those topics, i.e. what DRR goals they hoped to be achieved.

4. Content (framing) analysis of scientific research to:
   - viii) identify what earthquake-related science there is to be communicated if one considers DRR holistically;
   - ix) discover relative disciplinary presence in earthquake-related DRR research and natural-hazard and disaster-media-communication-research;
   - x) explore scientific framing of key topics in DRR; and
   - xi) explore relative disciplinary framing.
5. Content (framing) analysis of mass media news stories to explore media framing of DRR by identifying:
   - xii) what DRR topics have been communicated in the mass media;
   - xiii) the scientific disciplines present in the mass media;
   - xiv) whether the hazard-related science was linked to possibilities in DRR; and
   - xv) who the sources present were (and how these linked with xi-xiii).
6. Reflection on what points 1-5 reveal of how communication of earthquake science communication might lead more directly to disaster reducing outcomes.
7. Blending the results of 1-6 to compile sets of conclusions and recommendations for DRR-communication.

The New Zealand setting and earthquakes in Canterbury in 2010 and 2011 were used as a basis for stages 2-5. How the results of these stages of research are presented in this thesis is shown in section 1.6.

### 1.5.2 The research involved a mix of methods

This study, as is the case with many interdisciplinary studies, involved a mixed-methods approach. The intent was to achieve a comprehensive investigation of the research question within a wide social context. Maintaining a 'conceptual openness' (cf. Möllering, 2011) was a research strategy. Above all, importance was placed on the twin goals of successful DRR and 'effective' communication. A mixed-methodology was applied along multiple, but converging lines of inquiry (cf. R. K. Yin, 2009). Data was gathered from a wide body corpus (Table 3.5 and Table 3.6) using three primary data gathering methods: 1) literature review, 2a) survey, 2b) interview 3) gathering of various content including media articles for content analysis, as is discussed in further detail below.

### 1.5.3 Literature reviewed was drawn from many disciplines

This research began with an exploration of the contemporary notions of best practice in both DRR and its communication. Research relating to the communication of DRR has predominantly explored DRR through the lens of risk communication. However DRR-related communication also lies at the intersection of science communication, health communication, crisis communication, communication about hazards, the environment and public policy studies, as shown in Figure 1.1. Subsets of the aforementioned research have examined media content, communication effects and media effects in relation to aspects of DRR. In particular there has been significant research into the communication of warnings, household preparedness and disaster response (crisis). There is however no field of research that has been dedicated to exploring those aspects together, let alone the wider range of possible DRR solutions. In this sense 'DRR-communication' while existing as a theoretical concept, has rarely if ever been researched. Nor have there been many studies of natural hazards from the perspective of science communication. This is perhaps because science communication is a relatively new field of research.

Nevertheless the communication of natural hazards, disasters and risk are topics that are by no means under-researched. What is uncommon, however, is to find studies that synthesize the research, across disciplines and across research methodologies. For example even the UNISDR publication "Disaster through a different lens; behind every effect there is a cause" (UNISDR, 2011a), which provides valuable examples for media wishing to improve their communication about disasters does not convey the breadth of DRR topics to be communicated, and the range of disciplines that contribute to understanding them. In focussing on cause that publication takes an important step away from communication of consequence, but does not show how DRR solutions can be communicated more effectively.

The currently-favoured integrated approaches to DRR (see section 1.3.3 and section 2.2.18) require synthesis research and methodologies that emphasise the common origins, dynamics and outcomes of disasters (L. A. Johnson & Hiyashi, 2012; Tierney, 2007).

The research reported here is such synthesis research. Being synthesis research this study has needed to draw concepts and understandings, and gather ideas and recommendations from a wide a range of disciplines that conduct research into aspects of science-, and DRR-related communication.

These include communication, media-effects, and science and technology studies, cognitive and behavioural psychology and disaster- and risk-research. At the same time, to ensure a broad understanding of DRR itself has required review of literature from the range of disciplines that inform DRR research, and in particular earthquake-related DRR research.

This has required review of articles drawn from sociology, geoscience, earthquake engineering, health sciences, disaster research, emergency management, and more - as is explored in more detail in Chapters 2 and 3. This research drew from literature relating to a range of hazards and disasters but with an emphasis on earthquakes, related risks and disasters.

Concepts and ideas from the aforementioned communications and DRR-science research literature are also blended throughout the results chapters 4-7.

### 1.5.4 Analysis was qualitative and qualitative using a narrative-based framing methodology

As discussed in section 1.3.4 DRR culture and framing are closely interconnected. The way knowledge is communicated, the different perspectives presented, and the way the communication is understood, interpreted, and acted upon, is a result of frames and framing (Chong & Druckman, 2007a, 2007b). Framing analysis is a method that has been increasingly applied to quantitative and qualitative content analyses, including science-, risk- and policy-communication and media research (Evans & Hornig Priest, 1995; Giles & Shaw, 2009).

The four sets of data (A-D) listed in section 1.4.3 were analysed both qualitatively and quantitatively using a narrative-based framing methodology; a type of content analysis. A constant comparative method within and between data-sets using a grounded theory approach (Boeije, 2002) was applied to identification of important factors in DRR-communication, frame identification and code development. This method allowed existing theory and strategies in science- and risk communication to be synthesized (the results of which are presented in Chapter 4). A narrative-based framing methodology (described in Chapter 3) was then applied. The methodology allowed cross-comparison of earthquake-related DRR-science frames in academic research papers, and the frames in current usage in New Zealand mass media.

## 1.6 Structure of the thesis – presentation of results

Key concepts and definitions from DRR research, science communication and risk communication and media-communication research not already discussed in this chapter are presented in Chapter 2. A list of acronyms used though out the thesis is presented on pages xvi-xviii, and glossaries are provided in Appendix 1.

A summary of the problems and challenges identified in science-, risk communication and media communication are presented at the end of Chapter 2.

The research methodology for this study is presented in Chapter 3. Chapter 3 also contains observations and findings from this research related to the research methodology.

Communication strategies and recommendations from previous studies are the focus of Chapter 4. Historic findings about problems in communication are turned into recommendations for improving communication. The strategies and recommendations are distilled into a summary strategy for science- and risk communication aligned with an ideas/recommendations mnemonic for aspects of well-regarded, 'effective' or 'best-practice' science- and risk communication.

Chapters 5, 6 and 7 blend insights from analysis of one or more of the datasets, and DRR-issue-specific recommendations for communication are presented[1]. The recommendations may be employed as indicated by one or a combination of scientists and experts, the media and policy- and decision-makers.

Chapter 5 presents observations, conclusions and eight recommendations regarding DRR-related story types in the media, and how the sciences of DRR were portrayed. Chapter 5:

1. Provides an overview of the media stories and their changes over time.
2. Presents 155 quite distinct media story types identified from this research.
3. Shows that these story types may be grouped in a way that blends what is already known of science-issue framing over time with the four DRR-phases to develop a DRR-science-media-issue-cycle; this is a way of pictorially showing the proportions of story groups across that time cycle.

[1] Each section or subsection either a) introduces a problem or problems identified from previous literature and uses the results of this research to add to the discussion on that topic, or b) presents a new perspective and blends this with the results of literature analysis, some frames identified in the New Zealand mass media on the topic of earthquakes, before, during, and/or after the Canterbury earthquakes that illustrate the issue, and multi-stakeholder comment relating to those frames, gleaned from survey and interview.

4. Identifies which sciences and which scientists from which institutions were present in the New Zealand earthquake-related media in 2008-2012.
5. Discusses what analysis of media headlines and speech acts on television revealed about the framing of the role of science and scientists in DRR-communication.

Chapter 6 compares and contrasts the scientific disciplines represented in earthquake-related academic literature with what was presented in the media, discussing each of twelve disciplinary groups in turn. Seventeen recommendations specific to the portrayal of DRR-related scientific disciplines, and scientist and expert sources in the media are made.

Chapter 7 presents the collected conclusions from previous studies, and makes a further 75 conclusions/recommendations. The chapter begins by exploring the overall comprehensiveness of media coverage in terms of the four phases of the DRR cycle, the 12 DRR topics, and the four environments. Exploring these frames identifies where improvements might be made in relation to communication of:

1. Attributions of responsibility for implementing DRR-solutions.
2. Risk identification topics. This is, in essence framing of the problem. Topics included are an understanding of the background characteristics of hazards and vulnerabilities, the identification or initial observations of short- and long-term consequences in disaster and the causes of disasters.
3. Risk management solutions. This is the communication of the physical avoidance and mitigation options, planning and other preparatory actions possible, actions possible in response, and recovery.
4. Risk assessment topics. The discussion considers the communication of evaluations of problem salience and related options and choices. These are predictions or forecasts and associated warnings (assessments of exposure, vulnerability, likelihood and possible severity of consequence), assessments in disaster response (needs assessments), recovery assessments, and evaluations of the success, failure or lack of implementation of risk management solutions.

Chapter 8 summarises the conclusions and makes overall recommendations for improved DRR-communication.

# 2 Conceptual frames in DRR science communication

## 2.1 An introduction to framing

### 2.1.1 What and how information is communicated affects terminology, attitudes to issues, and possible solutions to those issues

This chapter explores historical, and contemporary concepts relating to science, communication, and DRR. The intention in the first section is to introduce or reintroduce the reader to the fact that what and how information is communicated is central to a) science, b) communication, c) media stories, d) awareness of, and attitudes to issues and possible solutions to those issues, e) individual and societal decision-making and actions, and f) social change.

What is understood and what is perceived as of being of relevance or important and therefore communicated about an issue varies depending on the way it is 'framed' (section 2.1). Frames also affect judgements and actions. 'Framing' of risk, of science in society, of DRR research and indeed communication changes over time and varies with different peoples' or groups' perspectives.

The way communication has been understood has changed significantly over the past decades (section 2.2). These paradigm, or frame changes have had significant impacts on the way communication of science and risk, and DRR has been studied, analysed and practiced.

The way that the issue of interest in this research (DRR) has been framed has also changed over time. Current understandings of terms relating to DRR are presented in section 2.3. The DRR cycle, stages of risk management, the characters (stakeholders) in DRR processes are also described. Stakeholders include scientists, other experts, the media and those involved in governance (policy- and decision-makers) as described in section 2.3.5.

Frames affect perceptions and responses to risk and DRR. The implications of risk perceptions and other perceptions on achieving DRR actions are discussed in section 2.4. The discussion is in the context of published knowledge and best practice in DRR and so introduces the concepts of vulnerability and resilience and their assessment.

Changes to DRR goals are discussed in section 2.5. The media's central role in the communication of DRR and media effects is outlined in section 2.6.

Problems in communicating science and risk may be framed in relation to who identifies the problems and who is blamed for the problems, or categories of problems. Categories of problems are identified in section 2.7.

### 2.1.2 Scientists communicate data, information, knowledge and wisdom

Communication is vital in solving societal issues (Chapter 1). Communication at the science-society interface involves four components according to Wisner and Wise, (IFRCRCS, 2005). Where complex problems such as DRR are to be resolved, data, information, knowledge and wisdom (DIKW) all need to be communicated (Figure 2.1.).

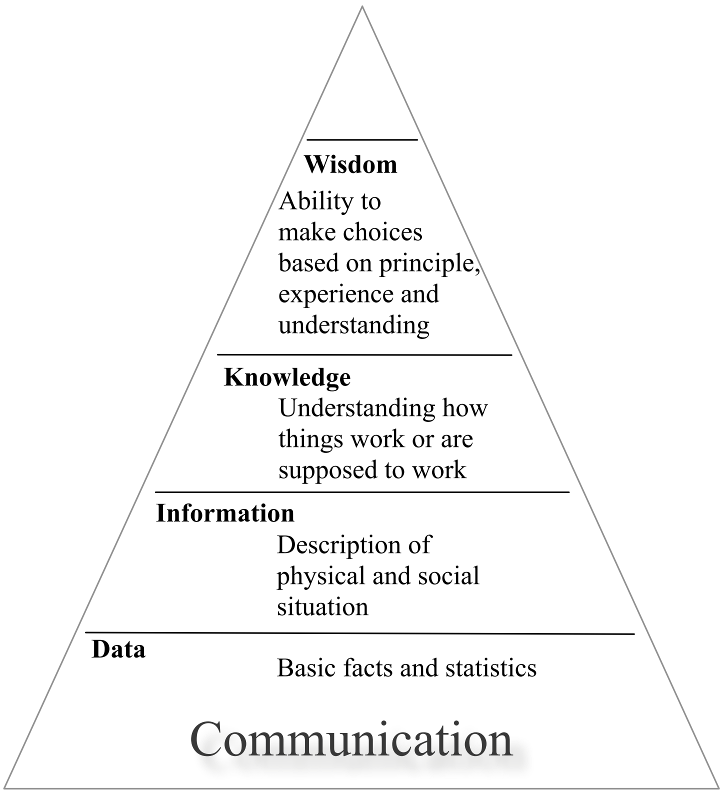



**Figure 2.1: DIKW model of communication at the science-society interface**

This model shows the data, information, knowledge, wisdom (DIKW) hierarchy (after Ackoff, 1989; IFRCRCS, 2005; Rowley, 2007).

Marincioni (2007) referred to these parameters respectively as basic unorganised facts, organised data, understanding of information and choices based on understanding, experience and principle.

The DIKW model fits with four central notions of information identified by Kajtazi and Haftor (2011). One of the notions is that data are the quantifiable aspects of information (Kajtazi & Haftor, 2011). Information may be defined as data plus meaning that guides human thinking, planning and consequent actions (Kajtazi & Haftor, 2011). Knowledge may be equated with what is fundamentally 'known' about the world. Wisdom, or 'expert opinion' in contrast is a blend of the objective and subjective. Ackoff (1989) suggested that wisdom is the exercise of good judgment in the use of knowledge. For example in DRR objective data, information and knowledge including the results of technical risk assessments should combine with the subjective values underlying assessments of threats and risk-reducing actions, and any decision-making that follows (see section 2.4.3).

When scientists move from presenting data to presenting knowledge and wisdom in the form of interpretations and advice, they may be presenting 'angles' or value judgments that in hindsight may prove to have been unhelpful or interpreted in ways that were not foreseen. These value judgments whether implicitly or explicitly are the facets of communication sometimes referred to as 'frames' (Entman, 1993). Wisdom thus depends on the way information and knowledge is framed. The challenge in scientific research and its communication is in selecting frames that assist in solving problems rather than exacerbating them.

### 2.1.3 Framing of knowledge affects understanding, interpretation and actions

The term 'framing' is used in this thesis in its broadest sense; relating to both 'what' and 'how' information is communicated (cf. Cacciatore, Scheufele, & Iyengar, 2016).

Framing affects the way knowledge is communicated the different perspectives presented, and the way the communication is understood, interpreted, and acted upon (Chong & Druckman, 2007a, 2007b). Frames are the building material required for both individual sense making and social understanding.

At an individual level, framing provides the elements to achieve 'awareness' or 'understanding' of issues, and to guide processing of information and decision-making (Entman, 1991). At a social scale, frames have been shown by research in political communication and sociology to affect the shaping of public opinion on a variety of topics (Lecheler, de Vreese, & Slothus, 2009; Nisbet, 2010). Frames influence individual and collective perceptions, expectations, learning, enjoyment, attitudes, choices, opinion (individual and public), engagement with issues, and effect or motivate changes in behavioural intentions and actions (Carragee & Roefs, 2004; Funkhouser & Maccoby, 1971, 1974; Gamson, 1989; Gitlin, 1980; Hallahan, 1999; Kalyango & Eckler, 2010).

The following definition is frequently cited:

> *[to] frame is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or ... recommendation.*
>
> (Entman, 1993, p. 52)

In his more recent definition of framing (Entman, 2004, p. 5) refers to selection and highlighting of *"facets of events or issues"* and making *"connections among them so as to promote a particular interpretation, evaluation, and/or solution".*

Frames are variously defined as socially based, abstract, generalised or standardised knowledge structures or 'rhetorical bridges' on which selection, emphasis and presentation of information is dependent (Gamson, 1989; Gitlin, 1980; Goffman, 1974; Kuypers, 2009a; Leach, Scoones, & Stirling, 2010; Schön & Rein, 1994; Tannen, 1993). Frames are the 'schemata of interpretation' (Goffman, 1974) 'conceptual metaphors' (Lakoff & Johnson, 1980; Leff & Sapir, 1977) or 'story frames' (Tuchman, 1978) that guide observations, interpretations, mental organization, perceptions, value judgments and actions. Interpretative frames, metaphors and story frames can be heuristics or short cuts that enable people to understand, interpret and evaluate information and form preferences, even when they lack knowledge.

### 2.1.4 Salience of issues leads to frame selection and reconstruction

Selection and salience are two key concepts in framing theory and in attitude and behavioural change (Lecheler et al., 2009). The *salience* of issues and accessibility of beliefs or information (the *selection*) affect perceptions, opinions and behaviour change (Hastie & Park, 1986).

Selection is required to negotiate, to make sense of and evaluate the large volumes of complex information available nowadays (Kuypers, 2009a; J. Weber, R. & Word, 2001). As human beings in complex environments we can only process so much information at once. We choose to focus on, select or frame, certain aspects and then condense, distil or screen others out to achieve common understandings (Gamson & Modigliani, 1989a; Kuypers, 2009a; O'Connell & Mills, 2003; Schön & Rein, 1994; Weick, 1995). As part of that *selection* some elements of complex information are omitted or ignored while other aspects are emphasised or highlighted and thus made more visible (Gamson & Modigliani, 1989a; Huckin, 2002; Kuypers, 2009b; B. Scheufele, 2006; C. O. Stewart, 2005). What we select may be due to physiological differences in the way we observe, measure and are able to record or remember, or a wide variety of cultural, and other social factors. Those other factors including the *salience*, importance or relevance to us (Weick, 1995).

Frames influence the construction, presentation or representation and interpretation of data and information concepts (Price, Tewksbury, & Powers, 1997). These deconstructions and reconstructions may then be used to further decode and encode information in a cycle of successive distillation and construction (Browne, 2009; Stocklmayer, Gore, & Bryant, 2005).

### 2.1.5 Models, paradigms and media stories are frames/social representations

At every level of society, frames are used to convey particular perspectives that influence the choice of methods, knowledge and expertise to be applied to issues, the setting of agendas, defining of goals, posing of questions, the prioritisation of issues, and the characterization of options to attempt to resolve them (Leach et al., 2010; A. Stirling, 2008a).

Scientists' models and paradigms are frames; simple reductionist tools to aid understanding and sense making (Ravetz, 2003). The media choose specific frames to discuss societal events leading to frames becoming repeated "*narratives of social reality*" (Hajer, 1995, p. 62). These narratives become 'social representations' (Moscovici, 1988), appealing to and entrenching cultural codes and myths (Hilgartner & Bosk, 1988).

### 2.1.6 Stories, discourse, narrative and rhetoric are framing products

The social products of communication and framing are variously referred to in the communication research literature as discourse, narrative or rhetoric, or more simply, 'stories'.

*Discourse* is said to be both a reaction to events and the formation or construction of subsequent discussion (Holm, 2012). For example Holm refers to disaster discourse as

> *The ensemble of cultural forms – cognitive schemata, scientific concepts, narrative plots, metaphorical images, rhetorical questions, and other devices - that frame how we see disasters [or what aspects are absent, so that society] remains blind to them.*
> (Holm, 2012, p. 52)

*Narratives* involve a complex and integrated framing of human consequences, meaning and emotion of events, blame, responsibility and causation (Boholm, 2003). In turn the communication of motives, intentions and uncertain choices in class, religious and cultural narratives determine how societies deal with issues like natural disaster (Asante, 2011).

Discourse and narrative might be described as the collective product of the communication of individual and collective knowledge and wisdom.

*Rhetoric* meanwhile has associated connotations of argument, public relations or 'spin', a lack of transparency or provision of information that is less than complete (Kuypers & King, 2009).

While some communication scholars make some very clear distinctions between stories, narratives, discourse and rhetoric, there are many examples in the scholarly literature examined in the course of this research where the terms are utilized interchangeably. Regardless of the term used, *stories* and narratives *"occupy an epistemologically privileged position in making sense of the socially constructed world"* (M. D. Jones & McBeth, 2010, p. 334).

### 2.1.7 Frames are conceptual, character-based and/or issue-specific

Frames may be conceptual, generic or contextual and issue-specific (de Vreese, 2002; Semetko & Valkenburg, 2000). Jeanneret (2008) refers to a mix of social movement (political and ideological frames) and disciplinary frames. Disciplinary frames may also be called issue-specific frames. There are a multitude of competing frames that relate to what is idealised in DRR, science, and the communication of science in general, as well as specifically in relation to risk and risk reduction. The most prevalent frame-sets are summarized in Table 2.1.

Idealised DRR or 'best-practice' frames will delimit what is possible in scientific inquiry about DRR, the role of science in DRR, risk acceptability and risk reduction discourses, including political debate and policy options for risk management and societal 'culture' toward DRR generally. Thus the topics of science- and risk communication themselves, as well as the issues they seek to address, have been, are and always will be subject to framing.

### 2.1.8 There are ten ways issue and event frames operate

The ways frames operate can be summarised into ten groups.

Frames can involve, influence or justify (1) goal definition; (2) problem identification (consequences or 'situations'); (3) attributions of blame and responsibility for issues; (4) diagnoses of cause; (5) perceptions, interpretations and assessments of the significance of consequences or issues, linking cause and effect; (6) treatment of recommendations or actions; (7) responsibility for enacting the solutions; (8) judgments and/or (9) outcomes or actions, strategies or interventions taken (Hallahan, 1999; Hendriks, 2005; Kuypers, 2009a;

Leach et al., 2010; Nisbet, 2009, 2010; Porto, 2007a; A. Stirling, 2008a). In addition frames influence (10) evaluations of a character's legitimacy, in any debate about any of the aforementioned aspects (Entman, 2004).

Frames thus shape how issues and events are diagnosed, perceived and interpreted, character is evaluated and responsibility for problems and their solutions is attributed (Carragee & Roefs, 2004; Iyengar, 1991).

**Table 2.1: Generic, character and issue frames and their influence in DRR-communication**

Generic, character and issue frames and their influence in DRR science communication. Social actors are defined as groups of like-minded people who share similar characteristics (Wellman & Berkowitz, 1988).

| Frame types | Influence perception/evaluation/measurement in DRR science communication |
|---|---|
| Generic frames | |
| Communicative conceptual | Communication models/paradigms |
| Communicative 'best-practice' | Communicative success (effectiveness) |
| DRR 'best-practice' | DRR failure/success and cause/contribution |
| DRR-communication goal | DRR-communication failure/success/cause |
| Generic character frames | |
| General roles of media and all social actors in public communication | Characters, roles and contribution to problems and solutions in general |
| General role of media and all social actors in DRR | Characters, roles and contribution to problems and solutions in DRR |
| Science and scientists (experts), policy and decision-makers, media and citizen roles in society relating to science-, risk - and DRR-communication | Characters, roles and contribution to problems and solutions in science-, risk- and DRR-communication |
| Issue-specific character frames | |
| Responsibilities for DRR | Roles and responsibilities to achieve DRR outcomes |
| Issue frames | |
| DRR topics | DRR problem definition, causal attribution and solutions and DRR outcomes |

### 2.1.9 Frames are rarely neutral

In promoting certain understandings, evaluations and preferences above others, frames are rarely neutral (Entman, 1991, 1993; Gamson, 1989; Porto, 2007a). However, while frames assist in the shaping of perspectives through which citizens view the world, social constructionists argue framing is neither inherently bad or good (Hallahan, 1999).

### 2.1.10 Framing affects science, disaster, risk, DRR and their communication

Interacting political and philosophical ideologies influences the framing and direction of science- and risk related research and the goals of science- and risk communication. These ideologies may also influence such things as hazard assessment, risk management decision–making and disaster discourse (Cox, Long, Jones, & Handler, 2008; Rojecki, 2009; Stefanovic, 2003).

Framing that is considered particularly relevant to DRR and its communication includes:

- research paradigm shifts in disciplines including science, risk and communication that have converged in the past decades (Bradbury, 1989; S. Miller, 2008)
- changes to issue specific (DRR-specific) terminology
- changes to DRR-specific goals and aims (see section 2.5)
- how the media are framed and implications for DRR (see section 2.6); and
- how the problems in communicating DRR are framed and who is attributed the responsibility for those problems (see section 2.6).

Changes to DRR-specific terminology are important to understand as these changing frames affect a) research attention which in turn affect authorities' assessments as well as b) the citizen understanding and perceptions that much research has linked to DRR behaviours. Current framing or 'definition' of some key issue –related concepts, namely hazard, disaster and risk, are presented in section 2.3. The links between those terms and authorities' assessments and citizen risk perceptions are described in section 2.4.

First, however, the research paradigm shifts are discussed. These paradigm shifts are important to communication and this research as they have influenced and continue to influence a) the way in which scientific research is conducted, b) the way science's role in society is perceived, c) communicative ideals, and therefore d) the way science- and risk-issues are communicated (Jasanoff, 1998; A. Stirling, 2008b).

## 2.2 Frame changes result in altered science- and risk communication paradigms

### 2.2.1 Changes to models of science- and risk communication have altered perceptions of scientists' role in researching and resolving issues

What is valued in the communication of science, risk, crisis and DRR has changed significantly in the past few decades. The changes have occurred because the way scientific research is conducted impacts on what is known about DRR and how it is practiced. Similarly communicative ideals have changed the way communication is measured and practiced. The communicative model chosen and followed greatly influences the framing of expectations of science's role in society (Ziman, 1992). This in turn influences science and scientists' role in the identification of risk and finding solutions to risk problems (DRR).

The following three sections summarise the changes to models of science- and risk-communication models and what this means for how science- and risk communication has been, is, and might consequently be practiced.

### 2.2.2 Strategies for solving complex societal issues have changed

Table 2.2 shows how science- and risk communication and by implication DRR-communication have been, and are now, idealized.

Over the past decades there have been significant changes to the way science and scientific knowledge are understood (Calsamiglia, 2003) and to risk, risk analysis and assessment (Otway 1987). These have had implications on news and communication (various in Porto, 2007), and DRR-related science-practice interactions (Vogel et al., 2007). In particular science communication models, risk communication perspectives and strategies for solving complex societal issues have changed (Barclay et al., 2008; Bauer, Allum, & Miller, 2007; Fischhoff, 1995; Trench, 2008; Vogel et al., 2007). On reflection, the changes to these models and perspectives align, as shown in Table 2.2.

### 2.2.3 Science is accepted as less complete, risk as having subjective components

To summarise the changes shown in Table 2.2 scientific knowledge is increasingly recognized as being incomplete, provisional and contingent (J. Gregory & Miller, 1998; Latour, 1987; Mulkay, 1991; Wynne, 1991). Risk-related social issues like DRR are increasingly accepted as complex, contested, and contextual, and not fully solvable by past approaches to knowledge acquisition or models of research. This is because the issues are considered to be trans-scientific, and dependent on the acceptability[2] or tolerability[3] and distribution of risk (Bradbury, 1989; Funtowicz & Ravetz, 1993). Bradbury (1989) emphasized that risk decision-making should take into account political, social and ethical considerations alongside technical and scientific aspects.

In broad terms, looking at the end-members of Table 2.2 there are two ways communication of science and risk, and strategies for solving complex societal issues have been, and are discussed in academic literature. There are those who refer to 'effective' communication practices that promote the *"communicative authority of science"* whilst others call for negotiation and co-creation of meaning (Trench & Bucchi, 2010, p. 4). To summarise, over time science- and risk communication goals have tended to become broader in scope, more solutions-focussed, and more 'democratised'. This section discusses why science- and risk communication goals are often referred to as having shifted from 'top-down' to 'bottom-up'.

### 2.2.4 Communication was top-down, technocratic and is now bottom-up, democratic

Historically the tendency has been to frame science- and risk communication as a one-way transmission from expert sources to target audiences. This has frequently been referred to as 'linear' or 'top-down' communication. The transmission of knowledge in this type of communication is a progression from research through dissemination of findings, to adoption of recommendations based on science and scientific views (Bucchi & Trench, 2008; Dornan, 1990; Pidgeon, Hood, Jones, Turner, & Gibson, 1992).

Since the late 1970s risk communication messages have been designed to educate, and persuade the receivers to accept the information as accurate, respond logically, and change their behaviour to act in accordance with the scientific view (Valenti & Wilkins, 1995). Under such 'traditional' paradigms it was assumed that only the scientists had and could communicate the facts. Those facts were assumed to speak for themselves, with a further assumption that those same facts would and should be interpreted in similar ways by 'rational' citizens (Nisbet 2010). This was one of two clearly defined positions in the communication of risk, the 'rationalist perspective' (Hornig, 1993).

---

[2] Risk acceptability – whether all potentially impacted are willing to accept the risk assuming there are no changes to risk management. While risk acceptability or tolerability and risk management involve scientific evidence about, and technical estimations of 'real' risk from science, they always contain value judgments at the same time. After the trade-offs have been made and any risk reduction measures applied the level of risk that remains is termed residual risk. Residual risk is the risk that remains once risk assessment trade-offs have been (Pidgeon, 1998). Risks can never be eliminated, only reduced. Ideally residual risk is acceptable risk to the community in question (ECAN, 2008a).

[3] Risk tolerability – whether risk can be lived with so as to secure certain net benefits. To achieve this the risk will not be negligible or able to be ignored and must be kept under review so that it may be reduced further if possible.

**Table 2.2: Comparison of science communication models, problems, and risk perspectives, and strategies for solving complex societal issues**

Science-communication models after Trench (2008), risk perspectives after Fischhoff (1995) and Barclay et al. (2008, Fig. 1) and strategies for solving complex societal issues after Brugnach, Dewulf, Henriksen, and van der Keur (2011, Table 1 p. 80). Shows similar trends with time in terms of flow, communication and science-communication style e.g. from science literacy through to science in society (Bauer et al., 2007), from top-down to bottom up, or first- to third order communication (Irwin, 2008).

| **Science Communication Models** | | | | | | **Risk Communication Perspectives** | | | | | **Strategies for solving of complex societal issues (e.g. DRR)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (after Bauer et al, 2007) | (after Trench, 2008 Table 1) | | | | (after Irwin, 2008) | (after Fischhoff, 1995; Barclay et al 2008 Fig 1.) | | | | | (after Brugnach et al, 2011) Table 1 | |
| | **Base** | **PCST models** | **Ideological or philosophical association** | **Orientation of science to citizens** | | | **Risk communication examples** | **Challenges** | **Flow** | | | **Framing of assumption/outcome** |
| Science literacy | Dissemination | Defence | Scientism | They are hostile | First-order | Informing Audience | Get the numbers right, tell them the numbers, or explain what is meant by the numbers | Information may be available but ignored, suspicion and lack of trust, dealing with uncertainty | One-way communication | Top-Down | Oppositional Modes of Action | The powerful dominate and impose their frames on others or ignore others' frames |
| | | Deficit | | They are lacking in knowledge and need to be educated to understand the 'facts' | | | | | | | Rational Problem Solving | There is one, 'true' scientific frame, invoked by experts to be adopted by all, other frames are disregarded |
| | | Marketing | Technocracy | They can be persuaded to understand/act through a 'marketing' type approach | | | Tell them what has been decided or done, tell them what to do | | | | Persuasive Communication | There is one frame that can be made to sound like the best story and is adopted or imitated by the target audience if convinced by the persuasive message. The target group adopts or imitates the communicated frame. |
| Public Understanding of Science | Dialogue | Contextual | Pragmatism | We see their diverse needs and explain our findings in context | Second order | | Give them information e.g. about estimated risk magnitudes and/or show them that they've accepted similar risks in the past | Need to understand tolerable risk, and clearly communicate uncertainties | Two-way dialogue | Bottom-Up | Dialogical Learning | Willingness of actors to engage in interactive process of joint discovery and exchange (to listen and question) to achieve mutual understanding and develop new shared or connected frames. |
| | | Dialogue/ Consultation | Constructivism | We ask their views and they talk back | | Empowering Audience | Find out what their concerns are, and show them it's a good deal for them | | | | | |
| Science in society | Conversation | Engagement | | They are sufficiently engaged to take on the issue | | | Let them interpret risks, include their concerns in risk assessments, make them partners | Needs, multi-hazards approach, and significant analytical, empirical effort needed | | | | |
| | | Participation | Participatory Democracy | They and we shape the issue | | | Help them interpret risk without interjecting bias | | Iterative circuit all stakeholders involved | | | |
| | | Deliberation | | They and we set the agenda | Third Order | | Let them decide (make risk evaluations) on their own | | | | | |
| | | Critique | Relativism | They and we negotiate meanings | | | Assist them in interpreting the results and finding ways they can affect the decision | | | | Negotiations | Willingness to negotiate to achieve a mutually beneficial and meaningful agreement |

- blank -

Two different positions in the communication of risk have been referred to as technocratic and democratic communication (Otway, 1987; Rowan, 1994a). While the technical approach uses enquiry and scientifically derived knowledge, the democratic approach is concerned predominantly with justice (Fiorino, 1989). One is "*fundamentally manipulative*" intended to persuade people to accept policies or technologies and associated risks, and encouraging *"passive compliance with the intentions of those providing the information"* (Otway, 1987, p. 127). The other supports the needs of the audience rather than those of the communicator, providing information to assist people in forming their own beliefs and practices for example reducing seismic risks.

In outlining various strategies for the solving of complex societal issues (such as DRR), and linking this to communicative framing, (Brugnach et al.) similarly distinguished between

> *rational problem solving and persuasive communication that deal with frame differences by attributing superiority to one particular frame, and negotiation [that] deals with frame differences by exploring how solutions can better embrace the interest of all.*
>
> (Brugnach et al., 2011, p. 83)

Bauer et al. (2007) related studies of science communication to 'divides' between the general public and the scientific community. They described three paradigms of science communication, namely 'science literacy', 'public understanding of science' (PUS) and 'science and society'. These are part of the continuum of 'top-down' through 'bottom-up' communication and beyond (see Table 2.3). In summary technical or top-down communication is conceptualised as education or instruction of the ignorant. The goals of top-down communication were the motivation of specific attitudes, judgments, behaviours and actions promoted by particular experts or expert groups. Bottom-up communication has very different goals and ideals as discussed below.

### 2.2.5 Bottom-up communication helps citizens make informed decisions

The purpose of science- and risk communication under contemporary models shown in Table 2.2 is to ensure that citizens are able to understand the decisions being made on their behalf that are based on risk-related science, or to be able to make informed decisions for themselves (S. J. Cronin, Petterson, Taylor, & Biliki, 2004; Fischhoff, 1995; Funtowicz & Ravetz, 1993; Otway, 1987).

**Table 2.3: Characteristics of first- , second- and third-order thinking on risk communication**
after Irwin (2008).

| | First order | Second order | Third order |
|---|---|---|---|
| **Main focus** | Public ignorance and technical education | Dialogue, engagement, transparency, building trust | Direction, quality and need for sociotechnical change |
| **Key Issues** | Communicating science, informing debate, getting the facts straight | Re-establishing public confidence, building consensus, encouraging debate, addressing uncertainty | Setting science and technology in wider cultural context, enhancing reflexivity and critical analysis |
| **Communication style** | One-way, top-down | Two-way, bottom-up | Multiple stakeholders, multiple frameworks |
| **Model of scientific governance** | Science-led, 'science' and 'politics' kept apart | Transparent, responsive to public opinion, accountable | Open to contested problem definitions, beyond government alone, addressing societal concerns and priorities |
| **Sociotechnical challenge** | Maintaining rationality, encouraging scientific progress and expert independence | Establishing broad societal consensus | Viewing heterogeneity, conditionality and disagreement as a societal resource |
| **Overall perspective** | Focusing on science | Focusing on communication and engagement | Focusing on scientific/political cultures |

Bottom-up communication involves an interactive negotiation or dialogical exchange of information and opinion among individuals or within a wider cultural context that results in empowerment of risk-bearing groups in society (Beck, 1992; Bradbury, 1989; Ann Fisher, 1991; S. Miller, 2008; Pidgeon et al., 1992). Under bottom-up communication justifications for science- and risk communication are less 'Marxist', as Freudenberg et al. (1996) termed communications that direct behaviour. However today communications are still said to generally vary from 'utilitarian' (getting the trade-offs right) to 'Kantonian', placing people in position where they can make their own decisions (Thompson, 2012).

The goal for 'Kantonian' communication is not to achieve successful persuasion but transfer of information that generates reflection, debate and discussion (Bucchi, 2008). It is assumed that all involved in this type of risk communication are capable of making informed decisions about risk and their responses to it (Valenti & Wilkins, 1995). Rather than being ‘ignorant’ citizens are seen as capable of applying active and mature reasoning and knowledge to shape issues and agendas as well as involved in the creation of understanding and meaning (Brugnach et al., 2011; Trench, 2008; Trench & Bucchi, 2010). It is assumed that scientific knowledge is good, is communicated with greater transparency and accountability, and knowledgeable citizens make intelligent or ‘better’ choices, with consequent benefits for democratic societies (C. Smith, 1996; Stenekes, Colebatch, Waite, & Ashbolt, 2006; Trachtman, 1981).

Overall, the goal is to create an environment for open and unbiased consideration of the best available information (cf. Kahan, 2010) and a citizenry that is engaged in the issue (in this case DRR). Dryzek (2000) and Glavovic (2012) referred to ‘non-coercive communicative interaction’ that is more than tokenism and promotes reflection on values, preferences and interests as being the first stage of deliberative processes that promote DRR. Bielak et al. (2008) referred to ‘less ‘science-push’ and ‘more policy pull’, and to ‘knowledge brokering’.

### 2.2.6 ‘Third order’ communication is beyond ‘bottom-up’

‘Third-order’ communication takes science- and risk communication beyond bottom-up. Communication that idealizes the application of contextualised and reflective science in society goals has been referred to as ‘second order’ and ‘third order’ by Irwin (2008). Key differences between each of the types of risk communication as proposed by Irwin (2008) are shown in Table 2.3. Irwin’s (2008) third order risk communication is concerned with the ethics and goals of communication and the communication of multiple and contextualised perspectives. So much for the theory; is bottom-up or third-order communication happening in practice?

### 2.2.7 The rhetoric of bottom-up communication is not always applied

Specific mention of participation or deliberative inclusive processes (as introduced in section 1.3.8) is not necessarily made by scholars writing about science-, risk-, natural hazards, crisis- or other aspects of DRR-communication. There have however been references for decades to the need for open and reflective communications supporting the democratisation of risk, and communication that is dialogical, multi-directional, resolves conflict, or is a negotiated process (e.g. Einsiedel, 2008; Kitzinger & Reilly, 1997; Pimbert, 2001; Plough & Krimsky, 1987; D. Sarewitz & Pielke, 2001). Partnered approaches in science-, risk- and crisis communication are mentioned (R. L. Heath et al., 2009; Seeger, 2006). This two-way communication is recognised by some as required to achieve better understanding of societal needs, capabilities and limitations (Kivikuru, 2006; J. Wang, 2010).

However, in practice while there is widespread rhetoric of the ideal of 'bottom-up' rather than 'top-down' science- and risk communication that rhetoric often occurs in parallel with discussions of social marketing strategies (e.g. Walters & Mair, 2012) to 'assist citizens' in achieving 'accurate risk perception' and 'appropriate risk reduction behaviours'. Top-down thinking and statements continue to permeate even the recent natural hazards, risk- and crisis-, perception, media and communication literature. For example, to Lindell and Perry (2004, p. 3) *"one important function of risk communication is, explicitly or implicitly, to promote appropriate protective behaviour by those to whom the information is directed".*

This research aimed to bring bottom-up thinking, not only rhetoric, to DRR-communication, starting with an understanding of how definitions are frames that affect DRR.

## 2.3 Issue framing: defining disaster risk reduction and related terms

### 2.3.1 How terms are defined is a form of issue-framing

How we define terms is a form of framing that affects the subject of the definition. This is important in DRR as the quote below explains.

> *How a disaster is ascertained, named, defined and assessed involves historically sanctioned processes of representation and translation … asking the question of how we [make sense of disaster] may disarm us by forcing us to acknowledge our complicity in making, defining, and producing suffering, damage, and disasters in the way we do.*
>
> Abbas, 2005 on Perera (2010, p. 33)

This section introduces terms and concepts that are fundamental to understanding the problem (the issue of DRR) and therefore in communicating it.

### 2.3.2 Key DRR-related definitions in this thesis are primarily from UNISDR

In any discipline there is debate and discussion relating to theoretical perspective and definitions. Definitions are constantly redefined over time with new knowledge and insights. The number of possible perspectives and definitions are multiplied in any inter- or multi-disciplinary study such as this one. For example there are many contrasting definitions of hazard, risk, and disaster arising from different disciplinary approaches to their study.

To overcome this variability, definitions employed in this research, where possible, are those agreed upon by the UNISDR.

The UNISDR has recognized how crucial common lexicons are and has employed international expert panels to reach definitions that were subject to rigorous interdisciplinary and international debate. The resulting definitions were presented in a booklet on DRR terminology (UNISDR, 2009b).

Where definitions of the UNISDR differ from those utilized in DRR-related research, policy or legislation in New Zealand this is discussed in the following sections. Where it is useful the definitions are illustrated with examples that inform understanding of earthquake, seismic risk and seismic risk reduction and DRR in New Zealand in general.

### 2.3.3 DRR; protective action, resilience building, risk or vulnerability management

Disaster risk reduction (DRR) is:

> *the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse effects.*
>
> (UNISDR, 2009b)

DRR is sometimes referred to as 'risk management' or 'disaster risk management' (e.g. Alexander, 2008; Maskrey, 2011) or a risk management choice (Keey, 2000; Paton, Bajek, Okada, & McIvor, 2010). DRR and disaster risk management (DRM) are interchangeably referred to in the literature as strategies, policies and, or practices, with one the subset of the other (UNISDR, 2009b, 2015).

DRR is also framed as a way of coping with an uncertain future (Levy, Rokusek, Bragg, & Howell, 2009). DRR actions are typically referred to as 'hazard adjustments' or 'protective actions' when individual, or citizen actions are being discussed (Neuwirth, Dunwoody, & Griffin, 2000). Some focus on and refer to 'vulnerability management' (e.g. S. N. Williams, 2008) others to 'resilience-building' (Berkes, 2007; Glavovic, 2012).

### 2.3.4 Key groups in communication and DRR; citizens, experts, government, media

Social issues (like DRR) and their communication, risk and science in society are most often discussed and analysed in terms of the perspectives of four key societal groups. The groups are variously referred to as 'stakeholders', 'social actors', 'characters', or 'sources'. Business, risk- and environmental-management literature would tend to refer to the *stakeholders* who have particular interest in issues. Social scientists refer to *social actors* (Van Leeuwen, 1996; Wellman & Berkowitz, 1988), communications researchers to *characters*, and media researchers to *sources*. A *source* is any person, or institution interviewed or quoted directly or indirectly in a story (Hornig Priest, Leu, Duhé, Klipstine, & Fisher, 2006). As this research has drawn from each of the aforementioned disciplines the terms *characters, stakeholders, sources* and *social actors* are used interchangeably throughout the thesis.

The four key groups typically referred to when discussing communication of issues are: 1) media - journalists, editors, producers 2) scientists/experts 3) governments/authorities or officials - the policy and decision-makers whether political or administrative, and 4) citizens (Hampton, 2009; Kornelis, De Jonge, Frewer, & Dagevos, 2007). These group names are used throughout this thesis, both in terms of DRR and its communication.

The sources of DRR-related information and those all affected by DRR may also be referred to in terms of four social actor or stakeholder groups. Although the group names used may vary in different literature depending on the issue, they are essentially the same. For example Kondo, Yamori, Atsumi, and Suzuki (2012) refers to a tetrahedron of ‘reality stakeholders’ in disaster where citizens are referred to as ‘victims/residents’ (see Figure 2.2).

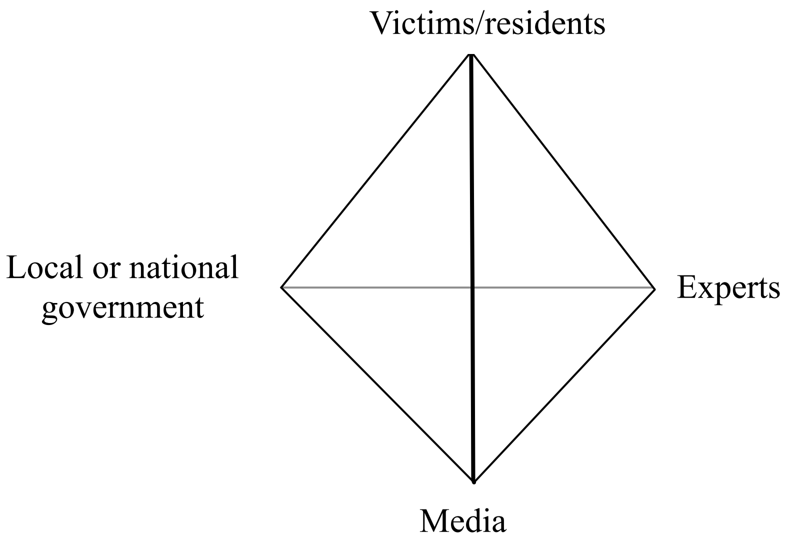



**Figure 2.2: Four stakeholder groups in DRR**
The four basic stakeholder groups shown were adapted from Figure 5 Kondo et al. (2012).

Scientists and policy- and decision-makers are sometimes referred to as elites (Haynes, Barclay, & Pidgeon, 2008). Citizens are often referred to as ‘the public’ or ‘the lay public’. Journalists and their sources are also sometimes referred to in the literature as ‘senders’, ‘primary definers’ (S. C. Hall, Critcher, Jefferson, & Roberts, 1978) because of their role in suggesting or justifying particular ways of considering issues and actions. Any personnel used to gather information for communications, and any sources quoted or interviewed are referred to as ‘frame sponsors’ (Gamson, 1989).

Advocates, and industry or business, are two other groups that are mentioned. Gascoigne (2008) referred to scientists as advocates. In a similar vein Hannigan (1995) referred to scientists as ‘issue entrepreneurs’. Individuals with roles as scientists, policy- or decision-makers, media or public may use these for the sake of advocacy. DRR advocates may belong to any one, or a combination of the above four groups.

Tuchman (1978) asserted that individual and social reality was a co-construction of all social actors or stakeholders. Those communicating DRR are often perceived to employ a strategy in their choice of frames. Different social actors are said to produce narratives which frame systems and characters and their roles and responsibilities in different ways, promote particular goals and justify particular views and pathways to achieve them (Hendriks, 2005; Leach et al., 2010). The aforementioned groups have differing inputs into framing of problems, solutions and communication of both problems and solutions. The stakeholder groups:

a) are involved in identifying problems, issues or causes

b) have differing roles and responsibilities in generation and implementation of solutions; and

c) are involved in different ways in both the communication of the issue and communication about solutions.

### 2.3.5 Disaster (crisis) involves widespread losses and impacts that exceed resources

The terms 'disaster' and 'crisis' are used interchangeably both in the literature and in this thesis. To R. L. Heath et al. (2009) a crisis is the manifestation of a risk.

An event is deemed to be a disaster when it causes a

> *… serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.*
>
> (UNISDR, 2009b)

There are dozens of other definitions of disaster in academia, and within institutions that are tasked with dealing with the consequences of disaster. Many of these definitions are discussed in (R. Perry, W., 2006). EM-DAT (2014) defines an event as a disaster if at least one of the following criteria is fulfilled. Those criteria are a) ten or more people reported dead b) one hundred or more people affected c) a declaration of a state of emergency and or d) a call for international emergency assistance. Past definitions of disaster have tended to involve a generally agent- or hazard-centred approach (R. Perry, W., 2006). R. Perry, W. (2006) suggested there is a tendency for earth-scientists to still favour such a hazard-only viewpoint. For this reason disasters are sometimes conceptualized as 'unnatural'.

In social science disciplines however, an intersection of hazard with human community has long been recognized. Under the currently accepted paradigm, disaster is a social phenomenon, the result of the intersection of society and the natural world. Reflecting this paradigm is the following commonly referred to 'equation' of disaster research attributed to Burton, Kates, and White (1978):

Equation 1: Burton's (1978) equation defining Disaster

$$Hazard + Human\ Community = Disaster$$

A hazard event will not result in a disaster in the absence of a human community (R. Perry, W., 2006; Ploughman, 1997; Quarantelli, 1988). See section 2.3.8 for a discussion on the aspects of human communities that contribute to disasters. The concept of *'disaster as opportunity'* for positive human action in response and recovery is discussed in Schencking (2008) and in section 2.5.6.

### 2.3.6 Hazards may trigger harm or loss of what humans value

According to UNISDR (2009b, p. 17) a hazard is

> *a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental change.*

Hazard thus describes a phenomenon, or in a broader sense a physical peril or threat that *could* cause harm to or loss of what humans value (Hohenemser, Kates, & Slovic, 1983; Slovic & Weber, 2002). The terms 'natural' and 'environmental' remain in use in relation to hazards despite the contemporary view being that the disasters triggered by natural or environmental hazard events are typically created by the interaction of these 'natural' agents and human components (Faulkner & Ball, 2007). Not all natural hazard events will lead to disasters – either because there is no human community nearby, or because the magnitude or severity of the hazard event is not sufficient to disrupt a nearby human community. Earthquake-related (seismic) hazards are described in Appendix 3.

### 2.3.7 Human communities, not only hazards create disaster

Hazard events become disasters not because of the event alone, but due to the activities, actions or inaction of human communities - governments, communities and individuals (R. Perry, W., 2006). It is therefore as important to understand how such aspects of human communities contribute to disasters, as it is to understand the hazards themselves. For example, the Haitian tsunamis of 2010 were at least in part anthropogenic, the result of excess coastal sedimentation due to deforestation (McAdoo & Paravisini-Gebert, 2011).

Disastrous effects or consequences result from:

> *the interaction between physical environments (i.e. hazardous events), the built environment (e.g. infrastructure such as roads, bridges and buildings), and the social environment.*
>
> (Havídán Rodríguez, Díaz, Santos, & Aguirre, 2006, p. 481)

The social environment mediates and therefore alters the effects of hazard events for different groups of society (Havidán Rodríguez & Dynes, 2006). Within the social environment cultural, social, demographic, economic and political factors interweave to reveal a complex fabric of vulnerability and resilience to disaster (Alexander, 2006; Anbarci, Escaleras, & Register, 2005; Blaikie, Cannon, Davis, & Wisner, 1994; Milch, Gorokhovich, & Doocy, 2012). Humans do not have control over seismic hazard, but they do have control over these social aspects, their vulnerability (D.A. McEntire, 1998) and by implication resilience. Vulnerability and resilience are defined in sections 2.4.5 and 2.4.6.

### 2.3.8 There are many quite disparate definitions of risk

> *Whoever controls the definition of risk controls the rational solution to the problem at hand. If you define risk one way, then one option will rise to the top as the most cost-effective or the safest or the best. If you define it another way, perhaps incorporating qualitative characteristics and other contextual factors, you will likely get a different ordering of your action solutions. Defining risk is thus an exercise in power.*
>
> (Slovic, 1999, p. 699)

The framing of risk has significant implications on risk communication. Definitions of risk have long been considered controversial (Fischhoff, Waton, & Hope, 1984). Key differences in the way risk are presented at some length here, as these differences are key to achieving DRR, or not achieving it. If only part of the problem is identified, as the discussion will show is the case in some of the definitions, the issue will neither be assessed nor managed (reduced).

As was introduced in section 2.2 there is general acceptance nowadays both that people do not necessarily share the same view of significance and causes of risks, and that broad concepts of risk need to be both part of technical assessments (see UNISDR 2009 p25-26) and communicated (Hampel, 2006; Pidgeon, 1998). However this was not always the case. Different disciplines define risk differently and there have been changes in the understanding of risk over time presenting a significant challenge for risk communication (Hampel, 2006).

That defining risk continues to be both a contentious and problematic matter is perhaps best illustrated in the following discussion, where even UN definitions arising from different international collaborations vary. The following 'equations' relate to technical risk assessments that reduce risk to as few variables as possible.

Quantitative geo-scientific definitions of risk often refer to the *"probability of occurrence within a specified period of time and within a given area of a potentially damaging phenomenon"* - UNDRO definition after Varnres, 1984 in Crozier, McClure, Vercoe, and Wilson (2006, p. 144), see also Panza et al. (2011). One might write this as:

Equation 1: An equation representing UNDRO's definition of risk

$$Risk_{(geoscience)} = Hazard\ Occurrence\ (severity,\ location,\ time)\ x\ Probability$$

In contrast risk, according to UNISDR (2009b, p. 25) is "the combination of the probability of an event and its negative consequences" – the chance or likelihood, of an event and it's potential losses. The definition may be summarized as follows:

Equation 2: UNISDR's equation defining risk

$$Risk = Probability\ x\ Consequence$$

The probability might relate to a hazard event occurrence or the probability of injury, illness, or death associated with a hazard (e.g. Hohenemser et al., 1983).

The above binary risk equation does not consider many contextual elements of risk. The equation does not identify that consequences will be dependent on the nature of, and exposure to hazard and hazard effects. Nor is there reference to the nature of the human communities potentially affected by hazards (cf. definition of disaster section 2.3.6).

*Exposure* is *"people, property, systems or other elements present in hazard zones that are thereby subject to potential losses"* (UNISDR, 2009b, p. 15). Dwyer, Zoppou, Nielsen, Day, and Roberts (2004) suggests that exposure relates to the assessment of the likelihood of an entity (whether social, environmental, political etc.) being affected to some measure (e.g. geographical area, population, industry, business etc.).

Exposure is however included in the following risk equation referred to by other UN bodies UNDP (2004) and UNDRO in 2002 (Alexander, 1997) as well as researchers from non-physical sciences (e.g. Dwyer et al., 2004; F. G. White et al., 2001).

Equation 3: UNDP and UNDRO's equation defining risk

$$Risk = Hazard\ x\ Exposure\ x\ Vulnerability$$

Vulnerability is defined in section 2.4.5.

In the relatively recent New Zealand context, risk as defined by Centre for Advanced Engineering in Christchurch, New Zealand (CAENZ) is another variant. The definition is *"the possibility of physical or social or financial harm, detriment or loss when exposed to a hazard"* (Rohrmann, 2003a, p. 24). This definition significantly extends the geo-scientific definition above to include exposure and highlight that some of the potential harms and losses (consequences) may occur to built, social and economic environments. However the CAENZ definition does not consider vulnerability, or resilience. This is considered a deficiency given contemporary understanding of the relevance of vulnerability and resilience to disaster (see below).

Reference to the vulnerability and exposure of human communities to hazards is though embedded elsewhere in UNISDR thinking. The UNISDR definition of *risk assessment* in the same document as the *Probability x Consequence* equation occurs, refers to the analysis of

> *exposure and vulnerability including the physical, social, health and economic and environmental dimensions; and evaluation of the coping capacities in respect to likely risk scenarios*
>
> (UNISDR, 2009b, p. 26)

This might be written as:

Equation 5: An equation created to represent risk extrapolating from UNISDR's definition of risk assessment:

$$Risk = Exposure\ x\ Vulnerability - Coping\ Capacity$$

This definition brings in the more recent addition of measurement of coping capacity, or resilience (see section 2.4.6 below) to what has historically been assessment of problems only. The ways risk has been studied, perceived and assessed, including this shift to considering risk solutions is discussed in the following section.

## 2.4 DRR-related perceptions, analyses, assessments and actions

### 2.4.1 Communication, perceptions and assessments are linked to actions

The links between communication, citizen perceptions, judgements, decisions, expert assessments and achieving DRR actions are discussed in this section. Risk perception is introduced as informal or intuitive risk assessment. Some of the key differences between risk perceptions and technical assessments are highlighted. New forms of technical assessment relating to DRR; vulnerability assessments and resilience assessments are introduced.

### 2.4.2 Risk perception may be conceived as informal or intuitive risk assessment

'Risk assessment' is defined in section 2.4.4. 'Risk perception' is an umbrella term for the different views, interpretations and judgments (frames) about risk that arise from the multiple and various constructions of risk (Coleman, 1993).

The literature relating to risk perception is voluminous, as is the subset relating risk perception to risk communication and its effects; for two reviews see Kitzinger (1999) and Boholm (2003). However it is far from easy to locate clear and simple definitions of just what risk perception is (this was also noted by Wåhlberg & Sjöberg, 2000).

This research has found that whether historic or contemporary, definitions of risk perception have focussed mostly on perception of threat, exposure or consequence; in short on problems. Mileti (1982) defined seismic risk perception as the cognition (understanding) or belief as to the seriousness of threat of experiencing an earthquake and subjective probability of experiencing an earthquake.

Risk perception has tended to imply distortion (Hornig, 1993). Attention in academic studies has been on the differences between lay perceptions and expert perceptions (Bakir, 2010). Recent definitions of risk perception equate risk perception with a form of informal or intuitive rather than technical or expert risk assessment (e.g. Bostrom, Anseiln, & Farris, 2008; Rohrmann, 2003a; Tucker & Ferson, 2008a).

Risk perceptions may be thought of as a filter through which individuals make risk judgments (D. K. Perry, 1988). The filter may relate to salience and/or relevance, the tolerability or acceptability of risk. Risk assessment is defined in section 2.4.4. Tolerability and acceptability (defined in footnotes on p. 32) have historically not been considered in technical risk assessments.

### 2.4.3 Technical and individual citizen risk assessments differ

There are significant differences between technical and citizen risk assessments. Definitions and further detail relating to technical risk assessments in the context of three stages of DRR are discussed in the following section 2.4.4. Generally though, science-based or technical risk models and assessment methods are seen as 'reductive aggregative' techniques that *"reduce multiple complex dimensions to simple quantitative parameters of 'outcomes' and 'probabilities' and then re-aggregate [these] to yield a single ostensibly definitive picture of risk"* (A. Stirling & Scoones, 2009, p. 14). Examples are the risk equations given in the section above.

Scientific risk models and measures, while being powerful approaches to narrow definitions of risk, tend not to adequately acknowledge ambiguities and uncertainty and tend to tell only one story, 'justifying only one narrative' (A. Stirling, 2008b). Citizens meanwhile are concerned with a comprehensive list of aspects of risks so that reducing risk to simplistic and numerical models becomes problematic (Hornig, 1993). Purely technical approaches to risk assessment (and risk management) do not suffice in a society that cares about non-physical social or cultural consequences alongside the more easily calculable physical risks and economic implications (Keey, 2000; Renn, 1998a). Risk assessments that take into account all of these factors involve the balancing and integration of best available science with ethics, values and culturally acceptable risk-benefit trade-offs (Pidgeon, 1998) and have become more popular in recent years.

Studies of individual perceptions and technical assessments of risk have been focussed on hazard and exposure. Perceptions of consequence and vulnerability have rarely been studied, and technical vulnerability assessments are in their infancy, as is discussed in section 2.4.5.

### 2.4.4 There are three stages in DRR: identification, assessment and management

In academia and professional practice a systematic approach is used to identify, assess and manage risk.

*Risk analysis* as defined by the UNISDR is:

> *a methodology to determine the nature and extent of risk by analysing the potential hazards and evaluating the existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.*
>
> (UNISDR, 2009b, p. 26)

Technical risk assessment should include (emphasis added):

> ***review of*** *the technical* ***characteristics of hazards*** *such as their location, frequency and probability; the* ***analysis of exposure and vulnerability*** *including physical, social, health, economic and environmental dimensions and the* ***evaluation of the effectiveness of prevailing and alternative coping capacities*** *in respect to likely risk scenarios*.
>
> (UNISDR, 2009b, p. 26)

Three components or stages of technical risk assessment have been identified, namely 1) risk identification, 2) risk estimation/analysis, and 3) risk evaluation (Kates and Kasperson (1984) in Bradbury, 1989 and Keey 2000) as shown in Figure 2.3.

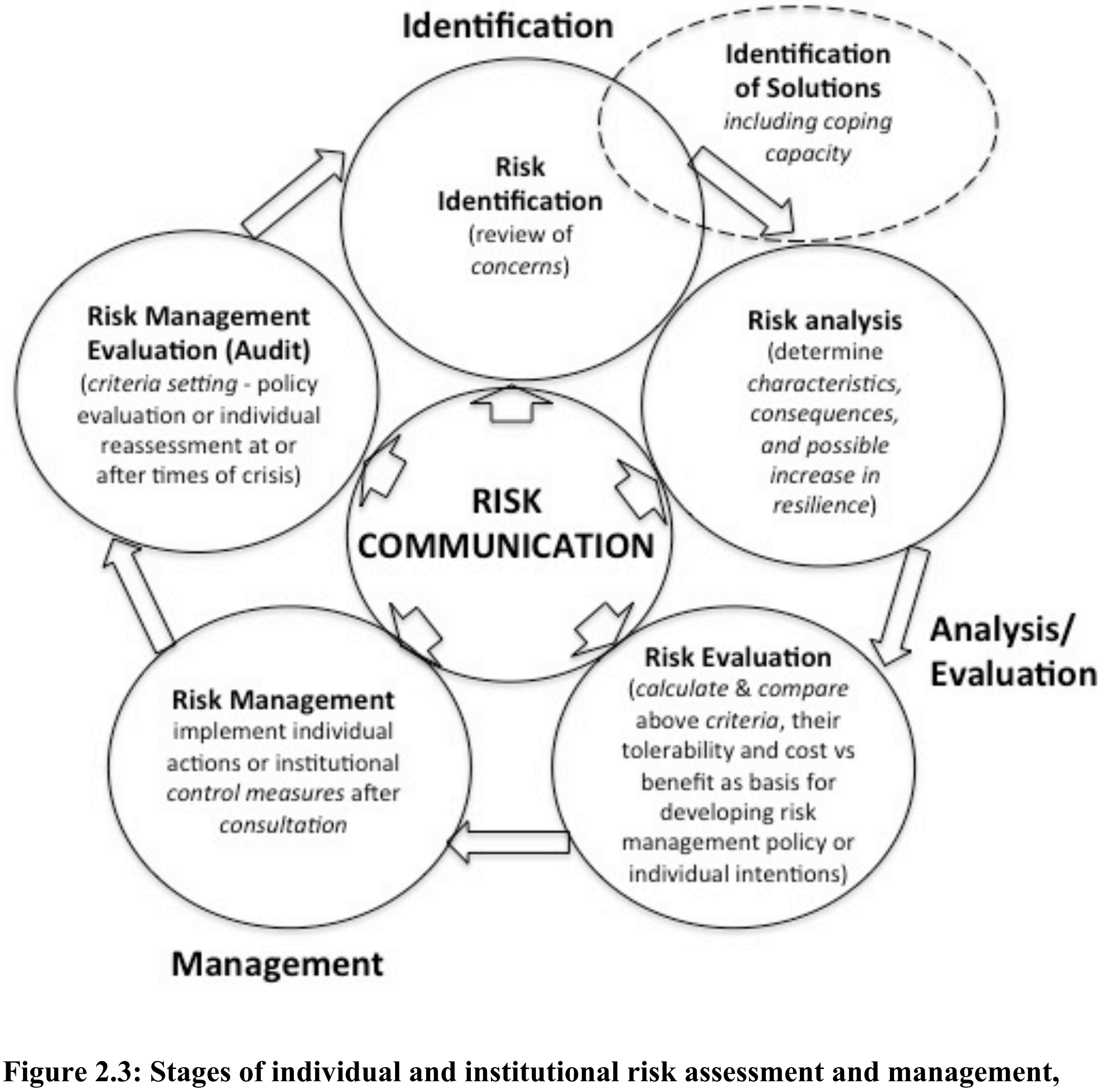



**Figure 2.3: Stages of individual and institutional risk assessment and management, and centrality of risk communication**

This cycle and stages were adapted from Figures 2.1 and 2.2 in Keey (2000). The most significant adaptations relate to the inclusion of identification of solutions, and that risk analysis may include determining possible increases in resilience (or decrease in vulnerability).

Note that the terms 'risk assessment', 'risk analysis' and 'risk evaluation' have been used interchangeably in the risk literature. The following discussion attempts to reflect this, whilst Figure 2.3 summarises the discussion and the way the terms while be used in this thesis.

*Risk identification* relates to the recognition of the existence of a hazard - a threat to people and the things they value (Keey, 2000). Risk identification may relate to individual or collective concerns. Using the risk equations presented earlier (section 2.2.8 and discussion on vulnerability in 2.2.10), risk identification should involve knowledge relating to hazard, the likelihood of any consequences and exposure and vulnerability in terms of four environments, natural, built, social and economic.

The identification of risk reduction measures is however rarely mentioned in the literature but is clearly required input for risk evaluations (see UNISDR definition of technical risk assessment above which mentions measurement of coping capacities). To remedy this 'identification of risk solutions' has been included on Figure 2.6.

*Risk analysis* according to Keey (2000) is a stock-take of risks, involving the separation of minor from major risk and 'acceptable risk' from 'unacceptable risk'. By inference there should also be a stocktake and separation for risk solutions.

*Risk evaluation*, on an individual or societal basis, also involves deciding and development of criteria as to the 'tolerability' of risk (Keey, 2000; Renn, 2006). Evaluation also involves comparing the cost versus benefit of solutions so that individual intentions or a risk management policy can be developed (Keey, 2000).

Coburn, Spence and Pomonis defined *risk evaluation* as

> *the social and political judgment of the importance of various risks by the individuals and communities that face them. This involves trading off perceived risks against potential benefits and also includes balancing scientific judgments against other factors and beliefs.*
>
> Coburn, Spence, and Pomonis (1994, p. 11)

Risk evaluations can therefore be thought of as the judgments and decision-making that stem from either expert risk models and calculations or 'informal' views about risk. Rather than being purely objective, risk evaluations are also influenced by individual psychological pre-dispositions in risk–taking, social, ethical, cultural and political factors (Keey, 2000; Rohrmann, 2003a). Other terms are also used in place of risk evaluation; for example Eiser et al. (2012) refers to 'risk interpretations'.

### 2.4.5 Vulnerability (susceptibility to harm) assessments are increasingly common

Vulnerability, according to (UNISDR, 2009b, p. 21) is *"the characteristics and circumstances of the community, system or asset that make it susceptible to the damaging effects of a hazard"*.

Reducing vulnerability is increasingly recognized as a key component in reducing disaster risks (Birkmann, 2006; Blaikie et al., 1994; Cutter, 1996; D.A McEntire, 1999; D.A. McEntire, 2011; van Ginkel, 2005; Vogel et al., 2007). This is regardless of how vulnerability is variously defined or framed (for alternative definitions see Armaş, 2008; Burton et al., 1978; Godschalk, Brody, & Burby, 2003; Susman, O'Keefe, & Wisner, 1983; F. G. White et al., 2001).

As acknowledged in UNISDR (2009b), while 'vulnerability' is commonly used to refer to an element's exposure to hazard this is not the case in the above definition. Independent of a community's exposure to physical factors, vulnerability has many aspects that relate to latent physical, social, economic and environmental factors (UNISDR, 2009b).

Vulnerability assessments are increasingly considered to be more appropriate than assessments that measure only hazard characteristics, and/or potential death and damage (Alexander, 1991, 1997; Mileti, 1999). Vulnerability assessment relating to building vulnerability has historically been assessed in terms of structural type, building use, building code, engineering assessment, economic vulnerability on direct and indirect losses and government expenditure (Dwyer et al., 2004). Social vulnerability has historically been assessed on the basis of risk perception and requires additional aspects of assessment to become more robust. Economic and environmental vulnerability assessments are in their infancy. While hazard models are well advanced as part of risk assessments, vulnerability models require further development (Faulkner & Ball, 2007; Thomasella, Downing, Spanger-Seigfried, Han, & Rockström, 2006). Current approaches and future challenges for vulnerability assessments are discussed in Fuchs, Birkmann, and Glade (2012).

### 2.4.6 Resilience is a DRR goal, and has 10 assessment indicators

Resilience is widely seen as a desirable attribute or state of being for the potentially hazard-affected because it reduces vulnerability and/or disastrous consequences (Zhou et al. 2010).

A resilient system is considered by Bruneau et al. (2003) to have reduced probability of and consequences from failures, and reduced recovery time. Norris et al. (2008) referred to community resilience as a metaphor for DRR. According to UNISDR (2005) achieving disaster resilience is a feasible goal that is critical to the survival of major cities. Resilience should therefore be thought of as a goal in DRR.

Resilience is often equated with 'coping capacity', which in turn is often equated with 'adaptive capacity' in climate change literature (Bruneau et al., 2003). 'Coping capacity' is defined as *"the ability of people, organisations, using available skills and resources to face and manage adverse conditions, emergencies or disasters"* by (UNISDR, 2009b, p. 8). According to UNISDR (2009b) coping capacity is dependent on resources and good management, as well as awareness (communication). Coping capacity contributes to the reduction of disaster risks.

Eight indicators of personal, community and institutional resilience were identified by Paton and colleagues (Paton, 2005, 2007). Those indicators are 1) critical awareness, 2) action coping, 3) outcome expectancy, 4) self-efficacy/self confidence, 5) community participation, 6) articulation of problems (and solutions), 7) empowerment, and 8) trust. Two further indicators are 9) leadership, and 10) teamwork required to achieve these (Seville, 2009).

All ten indicators may be used to measure community resilience to disaster, and, by extrapolation, the effectiveness of risk reduction efforts. A summary model of community resilience indicators and interrelationships created by Paton (2006) has been adapted by and is presented in Seville (2009). This model shows clear links between resilience and public participatory process, community empowerment and engagement as is shown in Table 2.4.

Ways of changing beliefs (perceptions) and motivating actions to improve resilience are also shown in the right hand column of Table 2.4. Such perceptions are important in DRR. The building blocks for perceptions are frames, as was discussed earlier. The links between perceptions and behaviours are discussed in the following sections. This includes not only links between what have traditionally been studied as 'risk perceptions' but also a suite of 'coping perceptions' (see section 2.4.8).

### 2.4.7 Communication may alter perceptions and behaviours (DRR actions)

The focus of attention, in relation to citizens and risk, has been on risk perception and risk-related behaviours. This means that research has largely ignored significant aspects of DRR-related communication, namely perceptions of disaster and disaster risk reduction.

Historically specific DRR actions have been framed as goals. The links between perception and behavioural change rely on communication.

**Table 2.4: Summary of resilience indicators**
Adapted from Seville (2009) to include critical awareness and allow for leadership from various levels of government and non-governmental organisations). Teamwork relates to the collaboration between individuals, communities and institutions. See Appendix Glossary Group 3 for definition of terms.

| Level of effect | Indicator name | Description of resilience indicator | Ways to improve resilience |
|---|---|---|---|
| Individual | Critical awareness, Outcome expectancy; response coping and action coping (self-efficacy) | People not only aware of the issues, but also know that things they can do make a positive difference for themselves, families, neighbours | Increase belief in (perception of) the benefits of hazard mitigation and differences they can make |
| Community | Community participation, locus of control and articulation of problems and solutions | People actively participate in their communities to identify and discuss their issues and risks and determine collective solutions | Encourage active involvement in problem articulation and collective decision-making |
| Institutional/Social | Empowerment, trust and leadership | Communities are supported by civic agencies (and other leadership) that encourage and empower initiatives where mutual trust and respect exist | Foster trust and belief in (perception of) ability to influence |

Risk perception affects individual and collective ideas and beliefs about risk, the way people relate risks to themselves, how they understand risk and perceive the likelihood of coming to harm and how concerned they are about risks; risk perceptions, risk judgments, and whether people act on their concerns (Dunwoody & Neuwirth, 1991; Sjöberg, 1998; Slovic, 1987; Wilkinson, 2001).

Links between threat-related knowledge, perceptions or beliefs and preparedness actions have been researched by many (Farley, Barlow, Finkelstein, & Riley, 1993; Lindell & Whitney, 2000; McIvor & Paton, 2007; Mclvor, Paton, & Johnston, 2009; Mulilis & Duval, 1995; Mulilis & Lippa, 1990; Paton, Bajek, et al., 2010; Paton & Johnston, 2008; Paton, Sagala, et al., 2010; Paton, Smith, & Johnston, 2005; Paton, Smith, Johnston, & Ronan, 2003). Correlations between mass media coverage, and perceptions of disaster or recovery or DRR actions have never been rigorously and empirically scrutinised in the same way that empirical correlations between hazard- and risk- (threat) perceptions and DRR (typically preparedness) actions have. However the studies that have been undertaken have shown the correlation of coping perceptions.

### 2.4.8 There have been few studies of disaster- or coping-perceptions

Perceptions and assessments of hazard, exposure and vulnerability are not the same as perceptions relating to disaster (Wijkman & Timberlake, 1988) or risk management (Eiser et al., 2012). There have been few studies of disaster perception or perception of risk solutions. There is currently no term in common academic or public use that fully encompasses the 'perception' of risk solutions or disaster perceptions. The link between authorities' perceptions, technical assessments by authorities and their behaviours and actions have also rarely been studied. Presumably though, official and expert behaviours and actions would also be affected by the presence or absence of a solution-, coping- or resilience- rather than problems/threat-focus.

### 2.4.9 Coping perceptions motivate desirable DRR behaviours

Research shows that beliefs about outcomes and efficacy of preparations better predict preparation actions for seismic events than beliefs about hazards (Lindell & Perry, 2000; Mulilis & Duval, 1995; Paton et al., 2003; ter Huurne & Gutteling, 2009).

If people perceive a threat as uncontrollable they will cope with threat by denying rather than by taking action (Mulilis & Duval, 1995). However Witte (1994) showed the value of 'coping perceptions' over fear-creating perceptions of hazard and risk. This began a discussion of the implications for risk communication that was extended in Witte (1995) and Witte and Allen (2000). The likelihood of individuals performing preventive actions has since been shown to be related not only to the likelihood of coming to harm at an individual or societal level (threat appraisal or a narrow definition of risk perception) but also to 'coping appraisal' (Neuwirth et al., 2000). Witte and Allen wrote that *"fear appears to be a great motivator as long as individuals believe they are able to protect themselves"* (Witte & Allen, 2000, p. 607).

Perceptions relating to the possibilities in DRR, and citizen involvement in DRR are referred to in relation to health risk communication literature as 'perception of coping' or 'coping perception' (e.g. Kuttschreuter, 2006; López, 2009). In social psychology research there is reference to 'action coping' (Paton, 2006) or 'coping appraisal' (Neuwirth et al., 2000). Neuwirth et al have shown perceived severity of consequences, and perceived vulnerabilities to be decreased by both social approval for current behaviour, and 'coping appraisal'. Two aspects of coping appraisal have been analysed by social psychologists – 'outcome expectancy' and self-, response- or perceived-'efficacy' (see Appendix 1 - Glossaries).

### 2.4.10 Models of information, meaning making and DRR behaviour change have become more complex over time

Researchers have proposed a number of theories to explain why individuals make specific risk judgments and actions. Attempts at modelling a path or paths from risk perception to risk reducing action have been many. The main difference between the models is that in the past they were linear whereas it is increasingly recognised that the reality is more complex. Progression b) is the risk-management practitioners' equivalent progression a) in Figure 2.4.

a) *hearing ⇒ understanding ⇒ believing ⇒ confirming ⇒ responding*

b) *risk identification ⇒ risk analysis ⇒ risk evaluation ⇒ risk management*

c) *knowledge (K) ⇒ attitude (A) ⇒ practice (P)*

d) *pre-contemplation ⇒ contemplation (upon hearing) ⇒ preparation (believing and confirming) ⇒ action ⇒ maintenance*

e) *comprehension ⇒ interpretation ⇒ confirmation ⇒ acceptance ⇒ retention ⇒ behavioural change*

**Figure 2.4: Linear progressions after communication to DRR behaviour change**

a) Mileti and O'Brien (1992)'s model of risk communication; b) stages of risk management (see section 2.4.4); c) from KAP research by Chaffee and Rosert (1986); d) trans-theoretical model of behaviour (after Prochaska & diClemente 1992 in Paek, Hilyard, Freimuth, Barge, & Mindlin, 2010); e) after Enders (2001).

Nowadays it is recognised that there is a long and complex path from perception of risk to risk reduction action, influenced by a range of individual and collective social, cultural and economic factors (Peek & Mileti, 2002; Shaw et al., 2004). An example of a contemporary, more complex model of meaning making and preparedness based on survey of New Zealand citizens is presented in Figure 2.5. Given the complexity of contemporary models the variety of problems that have been identified in relation to science-, risk- and DRR-communication is unsurprising.

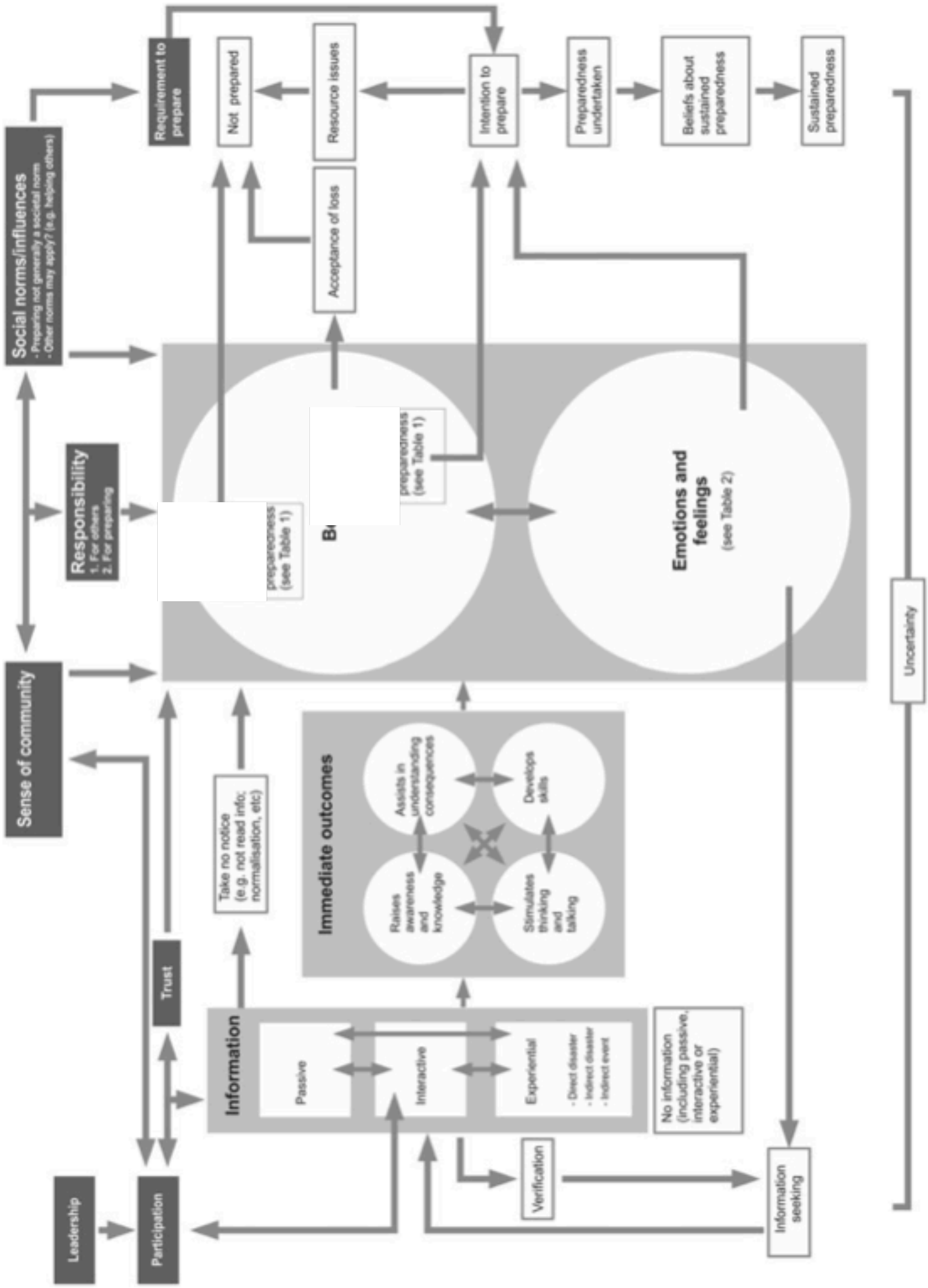



**Figure 2.5: Becker's (2012) model of information meaning-making and preparedness for earthquakes and other disasters**

## 2.5 DRR goal framing

### 2.5.1 DRR options include avoidance, mitigation, preparation and more

Resilient individuals, communities and cities will have implemented a range of disaster risk reducing solutions or actions.

The range of options in DRR that scholars variously refer to as part of DRR might be separated into subgroups, as described in the following equation. Innovation and adaptation particularly are increasingly referred to in the literature (for definitions of these terms see Appendix 1 – Glossary Group 2).

Equation 6: An equation defining reduction

*Avoidance + Structural Mitigation + Legislation + Preparation + Innovation + Adaptation + Communication + Education + Participation + Integration + Duplication + Incentivisation + Leadership = Reduction*

The subgroups of DRR options shown in the above equation would be a way of discussing DRR solutions. However for reasons explained in the following chapter there are methodological reasons a different way of grouping was developed as the basis for analysis and discussion (section 3.6.5).

### 2.5.2 The DRR-cycle has 4 phases - reduction, response, recovery and readiness

Resilience to disaster results from comprehensive risk management across a conceptual DRR-cycle (CDEM, 2008; Mamula-Seadon, 2009). Both scholars and officials have used this DRR-cycle for over 30 years. The origins of the cycle are debated but may be traced back to linear disaster phase research in the 1920s (Coetzee & van Niekerk, 2012) and Carr's disaster and sequence-pattern of social change (Carr, 1932). The DRR goal of resilience requires DRR to be achieved across this cycle.

The DRR-cycle in most common contemporary use is comprised of four phases. In the US the four phases are pre-disaster preparedness, emergency response, recovery and reconstruction, and mitigation against future hazards. In New Zealand a '4Rs' pneumonic has been developed to describe these same four phases (as shown in Figure 2.6). The 4Rs are reduction, readiness, *response*, and recovery. Of these, only *response* and recovery are separately defined by the UNISDR (see below).

While the phases are sometimes graphically shown as separate, they are typically overlapping and interwoven (Geenen, 2008; Pfiel, 2000). This has some bearing on the variable definitions as described below. For example preparedness under UNISDR definition (see Appendix 1 Glossary Group 2) includes both the reduction and readiness aspects of the New Zealand 4R cycle. The New Zealand terms and their meanings, which are discussed in more detail below are utilised throughout this thesis.

While the phases are sometimes graphically shown as separate, they are typically overlapping and interwoven (Geenen, 2008; Pfiel, 2000). This has some bearing on the variable definitions as described below. For example preparedness under UNISDR definition (see Appendix 1 – Glossary Group 2) includes both the reduction and readiness aspects of the New Zealand 4R cycle. The New Zealand terms and their meanings, which are discussed in more detail below are utilised throughout this thesis.

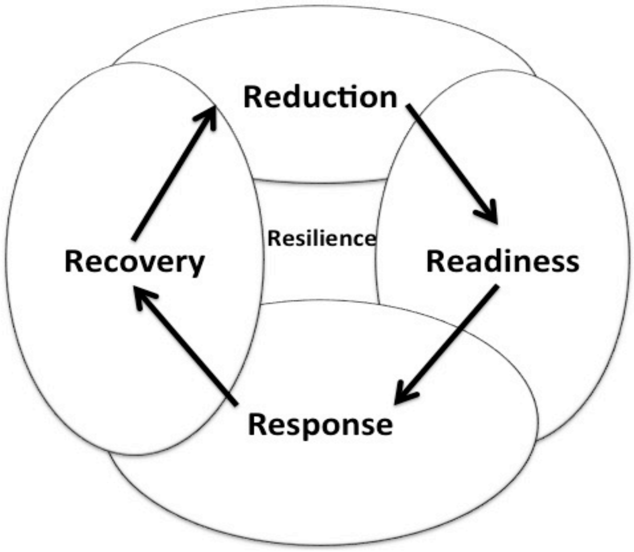



**Figure 2.6: The New Zealand DRR cycle – the 4Rs**

Four phases (the 4Rs: *response,* recovery, reduction and *readiness*) are shown (after Mamula-Seadon's (2011) version of a DRR cycle showing resilience at its centre).

### 2.5.3 The reduction phase occurs when society is not preoccupied with disaster

*Reduction* is defined in the New Zealand National Civil Defence and Emergency Management (CDEM) Strategy as:

> *identifying and analysing long-term risks to human life and property from natural or non-natural hazards; taking steps to eliminate these risks if practicable, and if not, reducing the magnitude of their impact and the likelihood of their occurring.*
>
> (CDEM, 2008, p. 15)

Two further terms often used in discussion of reduction are prevention and mitigation, described in glossary group 2 (Appendix 1). Although there may be overlaps, reduction, as defined in the New Zealand context generally occurs in periods when society is not pre-occupied with readiness, response, or recovery.

### 2.5.4 The readiness phase involves planning for quick and appropriate response

*Readiness* is defined in the comment under the definition of preparedness in (UNISDR, 2009b, p. 21) as "*the ability to quickly and appropriately respond when required*."

*Readiness* as defined in the New Zealand National CDEM Strategy 2007 as:

> *developing operational systems and capabilities before a civil defence emergency happens; including self-help and response programmes for the general public, and specific programmes for emergency services, lifeline utilities and other agencies*.
>
> (CDEM, 2008, p. 15)

*Readiness* is equivalent to preparedness as defined by the UNISDR as

> *the knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions*.
>
> (UNISDR, 2009b, p. 21)

*Readiness* includes personal, individual, business, institutional and governmental efforts (UNISDR, 2015) that result in better levels of survival when a natural hazard event occurs, and higher levels of comfort in the aftermath. For an earthquake readiness scale, focussed on individual citizen preparatory actions see Spittal, Walkey, McClure, Siegert, and Ballantyne (2006).

"Preparation" is often spoken of as if it is a synonym for readiness but is in fact a part, a set of possible actions in readiness.. A public preparedness index focussed on transfer of knowledge in the public sphere including media monitoring is provided in Petit, Fisher, Yaeger, and Collins (2011). However readiness also involves planning for recovery (Rotimi, Le Masurier, & Wilkinson, 2006; Rotimi, Wilkinson, Zuo, & Myburgh, 2009) and being 'ready' through having considered all of the other aspects of reduction listed in Equation 6 on p. 57.

### 2.5.5 The response phase involves assistance during or immediately after a disaster

Response under the UNISDR definition is:

> *the provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic needs of the people affected*.
>
> (UNISDR, 2009b, p. 21)

This is sometimes called disaster relief. In New Zealand, response is defined as "actions taken immediately before, during or directly after a civil defence emergency to save lives and protect property, and to help communities recover" (CDEM, 2008, p. 15).

The UNISDR and New Zealand definitions are effectively equivalent. The response or crisis period involves making initial observations of what has occurred, making sense of disaster, and making critical decisions (Boin & 't Hart, 2006). Summaries of best-practice for activities in response are given in Quarantelli (1988) and (Mcloughlin, 1985). Emergency management (EM) is the term used for the process of emergency coordination that occurs in response that involves such activities as communication and organization for deployment and the use of emergency resources (Wu & Xu, 2009). Nowadays individual and community actions are recognised as essential components alongside the actions of officials (CDEM, 2008).

### 2.5.6 The recovery phase relates to rehabilitation, reconstruction and regeneration

- *Recovery* is:

> *the restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors" – rehabilitation and reconstruction, and "should facilitate clear institutional responsibilities for recovery action and enable public participation.*
>
> (UNISDR, 2009b, p. 3)

Recovery is further defined in New Zealand as "the coordinated efforts and processes to bring about the immediate, medium-term and long-term holistic regeneration of a community following a civil defence emergency" (CDEM, 2008, p. 15).

Restitution was another aspect of recovery mentioned in addition to restoration, reconstruction and rehabilitation by Quarantelli (1999). Under the New Zealand's Civil Defence Emergency Management Act (2002).

Recovery activities include:

(a) the assessment of the needs of a community affected by the emergency;

(b) the co-ordination of resources made available to the community;

(c) actions relating to community rehabilitation and restoration; and

(d) new measures to reduce hazards and risks.

(MCDEM, 2005a, p. 3)

Recovery *"presents a prime opportunity for risk reduction so communities are not placed back into situations of equal or greater vulnerability after disasters"* (K. Wright, Becker, & Saunders, 2009, p. 53). The importance of the opportunity that the disaster recovery period presents to address mitigation and promote sustainability is increasingly recognised (MCDEM, 2005a; Zimmermann & Issa, 2009). The phrase "build back better" is used to refer to the practice that encapsulates new measures (d) (Kennedy, Ashmore, Babister, & Kelman, 2008; Micangeli & Esposto, 2010) and is one of four priorities in the Sendai Framework (UNISDR, 2015).

*Recovery* duration varies depending on many factors including the 'unit' (e.g. whether individual or community recovery, economic or psychological recovery) the pre-existing state and the resilience of the individual or community (MCDEM, 2005a; Noy & duPont, 2016; Quarantelli, 1999; K. Wright et al., 2009). Haas and Mileti (1977) suggested a logarithmic relationship between the emergency response phases, early recovery (e.g. restoration of power and other infrastructure or closing of emergency shelters) and reconstruction. Haas and Mileti suggested that early recovery normally takes about ten times as long as the emergency response and the reconstruction takes 100 times as long as early recovery. Large events may take communities many decades to recover from.

Disaster recovery is a process that requires planning, government and leadership, alongside local knowledge, networks and expertise (J. D. Garnett & Moore, 2010; MCDEM, 2005a, 2005b; Rolfe & Britton, 1995). Glavovic has coined 4Ls for what is necessary in achieving successful recovery: leadership, localisation, legitimacy and linkages (Glavovic, 2011). These 4Ls are briefly defined in Appendix 1 (Glossary Group2 under Leadership). Communities should be enabled to:

> *determine their own recovery destiny through inclusive and collaborative recovery planning, decision-making and implementation thus facilitating resilience to withstand future events such as earthquakes.*
>
> (Collins, Glavovic, Johal, & Johnston, 2011, p. 23)

### 2.5.7 DRR research paradigms were public health-, hazard-focussed and siloed

Approaches to hazard- and risk-assessment and risk management have historically been siloed within disciplines. One approach was hazard- and risk-identification from a geoscience perspective, another engineering and technology-based mitigation, and the third public health and safety focussed around disaster events and disaster response. For a more detailed discussion of changing DRR research paradigms, the 'changing preoccupations' or framing of DRR research (see Alexander, 1991, 1997; D.A. McEntire, 2001; D.A. McEntire, Fuller, Johnstone, & Weber, 2002; O'Brien et al., 2010; D. Sarewitz & Pielke, 2001; Tierney, 1993, 2007). McEntire et al's (2002) comparison of five 'disaster paradigms' is particularly useful in understanding the effect of framing on DRR solutions. The paradigms, namely comprehensive emergency management, disaster-resistant community, disaster-resilient community, sustainable development and invulnerable development are researched by different disciplines and focus on different triggering agents, phases of the DRR cycle, and variously suggest individual and/or public sector approaches to risk management.

### 2.5.8 Integration and collaboration are now ideals in DRR research

Integration and collaboration are increasingly recognised in the research literature as important features of DRR (Eiser et al., 2012; Leroy, 2006; Mamula-Seadon, 2009; K. Wright et al., 2009).

According to the UNISDR (2012) it is the complex and multi-faceted nature of risks that demands an *"innovative, holistic and problem oriented approach to risk and disaster management"*. That said there has been and needs to be more of a shift from hazard-related, problem identification approaches, to risk-management or solutions-focussed approaches to DRR (Ammann, 2006; Finkel, 2011; Finnis, 2004).

Integration is thus a type of holism that includes:

- a solutions as well as problem focus;
- coordination and planning of a range actions that occur in all of the four phases of the disaster cycle (I. Davis, 2011; Inyang, Galvão, & Young, 2003; Havidán Rodríguez & Dynes, 2006; Song, 2010; Trim, 2004);
- all stages; risk identification, risk assessment and risk management;
- involvement of all of the scientific disciplines involved in DRR research, and in communicating the breadth of scientific knowledge.

Greater integration of knowledge across disciplines is acknowledged as important in DRR (Leroy, 2006; Havidán Rodríguez & Dynes, 2006; D. Sarewitz & Pielke, 2001). Non-technical, perspectives and solutions, those most frequently communicated by the social sciences, need to be acknowledged and integrated into risk reduction solutions (Renn, 1998a). F. J. McDonald (2011) similarly calls for a deeper engagement of social and behavioural scientists in DRR. Leroy (2006, p. 4) refers to the need for research that "*bridges the crossing between the geosciences and social sciences"* and Havídán Rodríguez, Díaz, and Aguirre (2004) to research from 'different disciplines. Havídán Rodríguez et al. (2006, p. 481) refers to as *"the interaction between scientists (engineers and social and physical scientists) and ... end users"*.

### 2.5.9 Achieving DRR requires social (culture) change

DRR may be considered as a social process (Paton et al, 2008), a 'social movement' (Wilson, 1973) or a form of social activism with an outcome that serves the common interest in reducing the losses associated with disasters (Zoller, 2006). Brashers (2001) defines social activism as *"persuasive communication behaviours of a collective that are intended to serve the common interest"* (Zoller, 2006, p. 375).

DRR culture and DRR advocacy for change in culture are concepts that were introduced in the first chapter as being necessary to achieve DRR. Social change is required to achieve these goals. Zoller (2006) identified four types of social changes; changes focussed on individual and personal betterment, social changes designed to offset injustice or inequalities, and changes focussed on broad social changes e.g. sustainable lifestyles. Each of these types is seen as desirable changes in DRR 'culture' in academic DRR literature reviewed in this research. DRR advocacy often occurs under the umbrella of public safety. Increasingly however contemporary approaches to DRR increasingly emphasise sustainability, invulnerable development, and democracy frameworks as the basis for DRR.

### 2.5.10 DRR goals are variously framed as being about life-safety, humanitarian assistance, resilience, sustainable development, and needing to be democratic

The primary DRR goal has typically been framed as reducing the number of deaths, referred to as 'life-safety'. At the time of the Canterbury earthquakes life-safety was the basis of the New Zealand government's policy on earthquake prone buildings (DBH, 2005).

Humanitarian assistance is another goal (Bettencourt et al., 2006; Kellet & Sparks, 2012).

Contemporary approaches to DRR increasingly emphasise sustainability, invulnerable development, and social capital, community-building, co-operation and democracy frameworks as the basis for DRR. These frameworks often sit under the broad umbrella of 'resilience' or 'vulnerability management' (D.A. McEntire et al., 2002).

Mileti (1999) located risk reduction in both a sustainability and public participatory democracy paradigm.

> *A sustainable community selects mitigation strategies that evolve from full participation among all public and private stakeholders. The participatory process itself may be as important as the outcome.*
>
> (Mileti, 1999, p. 6)

Mileti set out six objectives that he considered needed to be met to mitigate hazards in a sustainable way, namely 1) maintenance and enhancement of environmental quality 2) maintenance and enhancement of quality of life 3) fostering local resiliency and responsibility 4) recognition that vibrant local economies are essential, 5) inter- and intra-generational equity 6) local consensus building where the participatory process may itself be as important as the outcome.

Vulnerability reduction and resilience building are inter-related concepts much in favour in contemporary discussions of DRR worldwide and in New Zealand (Birkmann, 2006; H. Cowan, Middleton, & Hooper, 2009; Cutter, Burton, & Emrich, 2010; D.A. McEntire et al., 2002; Vogel et al., 2007).

Both sustainability and resilience are said to be achieved through integrated planning, cooperation and regulation relating to the outcomes or consequences, as well as to efforts to build local capacity and citizen participation (Eiser et al., 2012; Mamula-Seadon, 2009; K. Wright et al., 2009). Kelman & Mather (2008) refer to this as a 'sustainable livelihoods approach'.

Reference to sustainability and livelihoods approaches to DRR were also made by Haynes et al. (2008), Twigg (1999) and Wisner, Blaikie, Cannon, and Davis (2004). Examples of DRR research locating DRR in a social-ecological or sustainability paradigm include Berke, Kartez, and Wenger (1993), Eiser et al. (2012), L. A. Johnson and Hiyashi (2012), Miles and Morse (2007), O'Brien et al. (2010), F. G. White et al. (2001), and Zhou, Wang, Wan, and Jia (2010). Disaster recovery also frequently contains references to sustainability (examples are Comfort et al., 2011; Haynes et al., 2008 ; Mainka & McNeely; Martin, Martin, & Kent, 2009; Shaw & Goda, 2004; Sun, Zhao, & Li, 2009; K. Takeuchi, 2011). According to Christoplos and Liljelund (2001) development co-operation and humanitarian assistance are also dominant frames in which risk and disaster mitigation and preparedness have been contextualised. Policy- and decisions-makers are both responsible for DRR and involved in communication about DRR in this sustainability-resilience framework.

## 2.6 Communication, the media, framing, perceptions and DRR actions

### 2.6.1 The mass media are key communication channels and a public arena

The mass media are considered key communication channels for public sphere communication (Beck, 1992; Latour, 1998). 'Mass media' is a term that refers both to institutions that produce news and entertainment for mass audiences and also to a means of public communication that reach large numbers of people. The mass media are both an information channel and a 'public arena' (H. P. Peters, 1994) or 'public sphere' (Habermas, 1989, 2001) as well as a 'communicative' space where citizens may discuss public matters and social policy issues and different stakeholder points of view are considered. The media are thus part of the democratic process linking opinion leaders such as politicians, experts and popular personalities, with mass audiences (Chong & Druckman, 2007a, p. 104).

The variable forms of mass media are viewed by many as central to communication of science and risk issues, and the environment and environmental issues (Carvalho, 2007; Dearing & Rogers, 1996; Anders Hansen, 1991; A. Hansen, 1993; Jönsson, 2011; D. Miller, 1999). As a consequence of mass medialization of science, policy and decision-makers increasingly take into account scientific knowledge published in the mass media, and respond to issues raised in the mass media (Petersen, Heinrichs, & Peters, 2010; Schäfer, 2009; Weingart & Pansegrau, 2003).

Larson (1980) referred to mass media, especially television as a 'window on the world'. The media are a way people vicariously learn about the world (Bandura, 1969, 1977, 1986). The media are also a source for information about topics that people have not personally experienced, and do not directly affect them in their working lives (Seydlitz, Spencer, Laska, & Triche, 1991; Smallman, 1997). Siebert, Patterson, and Schramm (1956) suggested that the media are responsible for explaining issues that citizens do not have expertise in. Media discourse on any topic is described by Stallings as the "*major source of raw material for public discussion*" (Stallings, 1990, p. 92). What is present in the media determines the availability of data, information, knowledge and wisdom available to citizens (Price et al., 1997). The branch of research that considers how citizens are affected by media communications is called media effects research. The key findings of media effects research, the media's influence and the media's role are discussed in the following sections.

### 2.6.2 The mass media influence all stakeholders

Researchers agree that the knowledge and information most people have learned relating to hazards, natural-hazard-related risks, disasters and disaster risk reduction, comes neither from personal experience nor interpersonal sources (Fischer, 1994; Griffin & Dunwoody, 1995; Hornig, 1990; Kitzinger, 1999; Kreps, 1980; Mileti, 1982, 1993; Nigg & Eeri, 1985; Havídán Rodríguez et al., 2004; Scanlon, 1980, 2006; Scanlon & Alldred, 1982; Scanlon, Luukko, & Morton, 1978; Singer & Endreny, 1987; Slovic, 1987; Sood, Stockdale, & Rogers, 1987; Wåhlberg & Sjöberg, 2000; Whitney, Lindell, & Nguyen, 2004; Wiegman, Gutteling, Boer, & Houwen, 1989). It has instead been *"primarily, if not exclusively learned from mass media accounts"* (Quarantelli, 1991, p. 2). Even though there are now other more direct lines of mass communication between scientists and the general public (e.g. social media, websites, You-tube etc.), the news media in particular remain the key-site for bringing events and issues to the attention of citizens.

News coverage and other mass media representations link mass audiences to events and associated issues so that the awareness, agendas and behaviours of all members of society, including public and policy-makers, are affected. This influence relates to policy agendas and legislation in general (Iyengar, 1991; McCombs & Shaw, 1972; Petersen et al., 2010) as well as to disaster and risk issues including risk management (Aykut, Comby, & Guilemot, 2012; Birkland, 1997; Carvalho, 2007; Jalali, 2002; J. F. Johnson, Bengston, & Fan, 2009; Kitzinger & Reilly, 1997; Knobloch-Westerwick & Taylor, 2008; Likens, 2010; Lombardi, 1997; Perez-Lugo, 2004; Havídán Rodríguez et al., 2004; Havídán Rodríguez et al., 2006; Havidán Rodríguez & Dynes, 2006; Wilkins, 1986).

It is important to recognise that experts might be *"enormously knowledgeable about some aspects of a risky situation ... but possess only lay knowledge of other relevant factors"* (Jasanoff, 1993, p. 92), with a degree of lay knowledge being attributable to media framing.

### 2.6.3 Media effects; what and how information is communicated in the media affects awareness, learning, mental models, salience, sense-making, perceptions, social constructions, interpretations, decision-making and action

Messages in the mass media carry the key frames that affect individual and collective understanding, interpretation and action (refer sections 2.1.2-2.1.6 and 2.4.7).

Many scholars ascribing to early models of science- and risk communication have emphasised the media's role as a transmitter or conduit of information, 'raising awareness' of events and issues, and in ‘education’ or its role in ‘public understanding’ (cf. discussion in section 2.2.4). Others have focussed not so much on the media’s information-related functions but on its power to influence perception, and or opinion or to modify behaviour, and actions.

Research on the media’s determining influence on citizens and on policy has been described as oversimplified and over-stated (Bakir, 2010; Beck, 1992; Nisbet & Huge, 2006). However that research has driven many of the recommendations made about the communication of risk.

To some, what is communicated in the mass media is conceptualised as informing individual mental models, and collectively, social constructions of knowledge, meaning and associated ‘reality’ (Park, 1940; Becker 1997). However, those who view the media within a contemporary, interactionist paradigm have media and audiences as joint producers of meaning and understanding. This is more akin to the latest (third- or fourth- order) science- and risk communication models introduced in section 2.2.1.

Media content influences perceptions of reality in general (Bandura, 1969, 1977, 1986; Fischer, 1994; Mazur, 1981; Wildavsky, 1979). More specifically it is generally agreed that perceptions of hazards, disaster, risk and hazard mitigation, and risk reduction derive in the main from mass media (e.g. Einsiedel & Thorne, 1999; Engel, Jaffe, & Scherer, 1996; Fischer, 1994; Hornig, 1990; Wåhlberg & Sjöberg, 2000; Wijkman & Timberlake, 1988; Wildavsky, 1979; Wilkins, 1986; Wilkins & Patterson, 1987; Wilkinson, 2010). Mass media are said to have a role in the social definition of events, issues and solutions to those issues (Blumer, 1969; Gamson & Modigliani, 1989a; Stallings, 1990; Vasterman, Yzermas, & Dirkwager, 2005).

Mass media messages about science-, risk- or disaster-related issues have been variously shown not only to influence individual perceptions of the degree of personal and public risk, but sense-making and learning, the interpretation of issues, mental models, social constructions, history, memory, culture and coping perceptions and individual actions and collective behavioural outcomes that arise from them (Boholm, 2003; Coleman, 1993; Curran & Gurevitch, 2005; Dearing & Rogers, 1996; Johnson-Cartee, 2005). In short the media provides the surrounding context for decision-making and action (Bostrom, Granger Morgan, Fischoff, & Read, 1994; Van Dijk, 2000).

### 2.6.4 The media influence social constructions of risk, disaster, DRR-culture and associated social change

The media are a key site in which a dynamic sense-making and a continual interactive process of construction, deconstruction and reconstruction of social reality occurs (Newhagen & Lewenstein, 1992). Through a series of choices, in selecting what events are reported on, the story plot, the sources interviewed and quoted, media communications create what Beck (1992) referred to as risk consciousness, some refer to as ‘risk awareness’, others as ‘risk identities’ (Bakir, 2010). Bakir (2010, p. 5) calls this *“mass-mediated risk culture”*. By extrapolation this holds for cultures of disaster, and DRR. The media, along with disasters themselves are recognised as catalysts for social change (A. Hall, 2011; Miles & Morse, 2007).

### 2.6.5 The media are useful in all phases of the DRR cycle

Detailed studies of the media’s contribution to society in relation to DRR are few. The ‘uses and gratifications’ function (Massey, 1995) or role of the media in DRR is not often the focus of scholarly articles about the media and aspects of DRR. In fact media utility is often ignored in many articles, particularly those that are critical of the media. Only by combining the observations of many researchers is it clear that the mass media have a variety of functions in all four phases of the DRR cycle (Table 2.5).

The media provides information that influences immediate and future habits and behaviours (Souza & Martínez, 2011). Mass media coverage may create alarm or reassure, justify or reinforce or negate existing risk-related beliefs (Wenger, Dykes, & Sebok, 1975). As a result coverage may either promote complacency or motivate action (Engel et al., 1996). The media’s role in warning of impending disaster and disaster response has been mentioned frequently (e.g. Kodrich & Laituri, 2005; Perez-Lugo, 2004; Scanlon, 2006; J. Wang, 2010). Mileti et al’s (2006) annotated bibliography presented the findings of tens of studies in relation to reactions to natural hazard warnings in the mass media. These were often contradictory.

The media influence public concerns and policy-making (Chong & Druckman, 2007a; Gamson & Modigliani, 1989b; Goffman, 1974; Iyengar, 1991; D. A. Scheufele, 2000). News stories and other mass media communication become the rhetoric upon which future media coverage and policy are based, both generally, and in relation to disasters and DRR (Sood et al., 1987).

**Table 2.5: Media's role and utility in the four phases of the DRR cycle**

This summary developed from literature mention of roles, function and utility as indicated in the table.

| Reduction and Readiness actions | Readiness – warnings outside disaster |
|---|---|
| People utilise the media to identify from others ways they might personally manage risk (H. P. Peters, 1994) | Inform, raise awareness of impending disaster and provide background information (Bakir, 2010; Wakefield & Elliot, 2003) |
| Motivating public to take responsibility for and action regarding risks (Bakir, 2010; McKay, 1983, 1996). Inform about responsibilities (Jalali, 2002) | Influence information seeking (Hart & Leiserowitz, 2009) |
| Suggest possibilities in avoidance or mitigation of potential damage caused by future disasters (Hiroi et al., 1985; Hornig, Walters, & Templin, 1991; Rattien, 1990; Wilkins, 1986), report technological solutions (Freudenburg, Coleman, Gonzales, & Heigeland, 1996) | 'Surveillance function' regarding about societal threats and opportunities (Laswell, 1948; Westerman, Spence, & Lachlan, 2009). This has traditionally been about informing citizens about hazards in their area (Wilkins, 1986; Wilkins & Patterson, 1987), region, country or the world in general. |
| Disseminate preparedness advice (Seydlitz et al., 1991) | Influence risk definitions and frameworks, or inform social constructions of risk and disaster (Blumer, 1969; Russel R. Dynes, 1998; Spencer & Triche, 1994) |
| Influence government and community DRR policies (Kitzinger & Reilly, 1997). Report on political choices surrounding risk (Wilkins & Patterson, 1987), for example intended policy and legislative changes in planning relating to hazards or advise of the activities of regulatory bodies and institutions related to hazard monitoring and risk assessments (Kitzinger & Reilly, 1997) | Alert/warn; to draw attention to short- and long-term issues/risks (Bakir, 2010; Carter, 1980; Cohen, Ball-Rokeach, Jung, & Kim, 2002; Dunal, Gaviria, Flaherty, & Birz, 1985; Griffin, Sharon, & Zabala, 1998; Hiroi et al., 1985; McQuail & Windahl, 1993; Perse, 2001; J. Wang, 2010). This alerting function may relate to warning of possible failure of institutionalized risk management, not only to hazard warnings |
| Cultural resource – histories of past events, coverage of 'events elsewhere' and commemorative coverage of previous disaster events (Eyre, 2006). | Influence public acceptability of risks (Bakir, 2010; Coleman, 1993; Sood et al., 1987)<br>Establishing the salience of identified risk (Coleman, 1993; Dunwoody & Neuwirth, 1991) |
| Directing attention to environmentally and socially vulnerable areas (Ashlin & Ladle, 2007) | Report about the causes of disaster (Hornig, 1992; Kueneman & Wright, 1975; Miles & Morse, 2007; O'Connell & Mills, 2003), 'locate errors and defects' (Rogers, 1990), and call for change (Hornig Priest et al., 2006) |
| **Response** | **Recovery** |
| Information about what triggered disaster (Kodrich & Laituri, 2005) – see also last row readiness re cause | Generally (Ammann, 2006; Besley, 2010)<br>Recording events |
| Communicating degree of disaster and relief needs (Rogers & Sood, 1980); officials and organizations utilize media searching as 'disaster management tool' (Pechta, Brandenburh, & Seeger; Perez-Lugo, 2004; Reynolds & Seeger, 2005; Seeger, 2006), e.g. use of social media to assist in monitoring disaster (Gelernter & Mushegian, 2011) | |
| Sense-making (Voorhees, Vick, & Perkins, 2007; Weick, 1995), putting disasters in context (Bolduc, 1987), interpreting disaster (see also causes) (Kueneman & Wright, 1975), counsellor (Ammann, 2006; S. Robinson, 2009a) | Reducing psychological trauma, resident counsellor in local coverage, community bonding and healing (Ammann, 2006; S. Robinson, 2009b), rebuilding of 'social arrangements' (Rappaport, 2000) |
| Service journalism impartial guidance and advice function, which also extends to the service function provided by scientist sources in the media (Eide & Knight, 1999), and to assessment of post-event adequacy (A. Burgess, 2012). Inspire charitable, helpful, pro-social behaviours (Beaudoin, 2007a; Seo, Sun, Merolla, & Zhang, 2011; Voorhees et al., 2007) | Mobilise solidarity (Ammann, 2006),<br>Citizen and city advocacy (Jalali, 2002)<br>Report on compliance during reconstruction (Souza & Martínez, 2011) |
| Convey critical information – for example about public safety, rescue and relief operations, including provisioning and logistics and governmental responses (Kodrich & Laituri, 2005; Scanlon, 2006) | |
| Active humanitarian role in disaster including efforts to generate aid in the form of cash, blood and other donations (Kodrich & Laituri, 2005) | |
| Documentary function (McQuail & Windahl, 1993; Wilkins, 1986), seen as a credible source in disasters (e.g.Kueneman & Wright, 1975; Sood et al., 1987; Voorhees et al., 2007). Record disaster events, effect on natural environment, timing and parameters (Wenger, James, & Faupel, 1980) and human reactions (Russell R. Dynes & Quarantelli, 1992; Kueneman & Wright, 1975; Wilkins, 1986). | Setting recovery expectations (Besley & Nisbet, 2011) |
| Disaster historians (Edgerton, 2000; Wilkins, 1986) | Creating collective story of how communities recover from disaster |
| Key story-tellers, creation of mediated memory | Creating collective memory |
| Creating cultures for example of vulnerability (Furedi, 2007), trauma, or suffering (Smelik, 2010) | |
| Building social capital (Lowrey et al., 2007; Massey, 1995; Nahapiet & Ghoshal, 1998), social cohesion, compassion, glue (Aldrich, 2011; Lu & Yang, 2011; Souza & Martínez, 2011) | |
| **All/any** | |
| Communicate to local, national and international communities and tourists (Kodrich & Laituri, 2005; Olofsson, 2011). Provide impressions of self- and community-efficacy in all four phases of the DRR cycle (De la Cruz-Reyna & Tilling, 2008). Provide material for analysis of political trends and strategies (e.g. image repairBenoit, 1997; Benoit & Henson, 2009)). Review of media is also used to build case study histories e.g. (Serra-Llobet, Tabar, & Sauri, 2013) or to summarise 'lessons learnt' (Wilkins, 1986). Over time 'evidence' from media stories about disaster becomes part of a disaster history (Wilkins, 1986) and becomes a resource (Paulson & Menjívar, 2012), what Mairal (2011) terms a 'narrative matrix' that is used to describe future risk; the rhetoric of future public and DRR-related policy debates (Sood et al., 1987) or used to benchmark (e.g. quality of relief efforts) when other disasters occur. Both traditional and new media positively correlate with donations, and coverage spike and drop-off matches giving (Lobb, Mock, & Hutchinson, 2012). | |

- blank –

Media use is known to be high after disasters (Quarantelli, 1996a; Souza & Martínez, 2011). The media are more a trusted source of information in disaster, than not, both in the US (Miles & Morse, 2007) and in China (Seo et al., 2011). Perse (2001) referred to the media as a site for vicarious experience. In the absence of personal experience, people may utilise media coverage of others' behaviour as cues for 'appropriate' social responses, for example to disaster (Massey, 1995; Nara, 2010; Seydlitz et al., 1991). Weick (1995) referred to the media as key sense-makers on behalf of citizens.

The media also shapes definitions of possibilities in DRR. Natural hazard and disaster researchers who referred to the media's ability to determine the relevance of issues, and in turn set the public's agenda for discussion include Barnes, Hanson, Novilla, Meacham, and McIntyre (2008), Pasquarè and Pozzetti (2007), Ploughman (1997), and Singer and Endreny (1987). Few researchers mentioned the media's potential, let alone its already significant contribution in recovery and risk reduction. It is therefore unlikely that the breadth and potential of the media's role is fully understood by many.

### 2.6.6 Recognition of both the positive and negative aspects of the media is rare

The media's useful contributions to the reporting of risk and disaster are not always recognised (Phillips, 1986).

The news media are frequently criticised for misleading reports that are sensational, perhaps because of a profit motive (Gamson, 1989) through lack of accuracy, neutrality or objectivity (Anzur, 2000; Glik, 2007), for underestimating their own negative impacts (Lowrey et al., 2007), and for being biased and distorting news by creating 'hype', gossip, misconceptions and perpetuating and spreading false rumours and 'disaster myths' (Anzur, 2000; Keen & Ryle, 1996; Ohta & Kitao, 1977; Vasterman et al., 2005; Wenger et al., 1975; Wenger, Sebok, & Neff, 1980). Natural hazard media research has often portrayed the media as conveying inaccurate, biased and exaggerated information in relation to natural hazards (A. King & Shelton, 2004; McClure et al., 2009; Nigg, 1987; Pasquarè & Pozzetti, 2007; Perez-Lugo, 2004; Rodrigue, 2004; Wenger, Sebok, et al., 1980). There is concern that initial inaccuracies or biases, even if acknowledged as inaccurate in later media reports will prevail in the audiences' mind (J. E. King, 2011; Lewandowsky, Stritzke, Oberauer, & Morales, 2005).

Only a few scholars are careful to present both the positive and negative aspects of the media in disaster. For example Vasterman et al. (2005) summarised the positive as informing, educating and communicating, the negative as in terms of ‘hype and misinformation. Scanlon (2011) discussed whether mass media are an unwelcome irritant or a useful ally in emergencies. Vasterman followed in the footsteps of Parker’s (1980) article titled “What is right and wrong with media coverage of disaster?” and Ball-Rokeach’s (2000)’s *“ally or adversary”* articles. These authors however made their comparisons only from the perspective of one topic or disciplinary approach to DRR. Kitzinger and Reilly (1997) were cautious not to suggest the mass media were *“automatic allies of the ‘democratization of risk’”;* while the media is useful for public information and political leverage, unscientific or unofficial sources were not necessarily a positive thing. Kreps (1980) suggested that the media have the potential to either positively or negatively influence DRR.

On reflection there are many instances where the media themselves are not portrayed in a balanced way. One ‘charge’ is that media place their own entertainment-related economic considerations above those of the betterment of society. Such comments are however typically not made with any counterbalancing reference to the media’s service to society and building of social capital as outlined in the previous section.

References to the media being biased, sensationalise and perpetuate myths and ‘hype’ are also made without any mention of the media’s impartial, or ‘service journalism’ functions. Moeller (2006) gives examples of reporters dispelling myths (clarifying that bodies do not create disease, persuading against adoptions, and advising that donations of cash in disaster response are more appropriate than old clothes). In Chapters 5, 6 and 7 further examples are presented where results of this research show that what one group of researchers consider are media biases are necessary for another aspect of DRR.

Research papers that express concerns about ‘agenda-setting’ and local media ‘gatekeeping’ (Waxman, 1973) typically do so in relation to agendas that are considered undesirable by their authors. There has not been discussion in relation to setting a socially desirable agenda such as that for DRR.

Many scientists see ‘oversimplification’, or a lack of theoretical depth’ in the media as a significant problem (e.g. Lan, 2009) yet the public, and communication experts see concision as desirable (see section 4.2.15 regarding the recommendation for communications to be *concise*).

The media is said to be manipulated by elites; scientific or technological, and political sources as well as business elites to promote their agendas (e.g. Nimmo, 1984). This is said to result in coverage biases against the most socially vulnerable, or promoting authorities' control in DRR, or is otherwise misaligned with DRR goals and ideals. For example Klein (2007) suggested that disaster capitalism is perpetuated through the media, and Mason (2011) that corporate interests in disaster are often not disclosed. Yet, other scholars highlight examples of corporate's altruistic assistance with raising awareness of the need for relief and provision of aid (e.g. Simon, 1997).

Some decry the media for being an intrusion in disaster response, distracting authorities from response activities (P. Hughes, White, & Cohen, 2007) and showing insensitive images of despair, distress and death. Yet research has shown that some victims and relatives of victims at least, welcome media presence (Scanlon, 2011). Countering those who claim that media frighten rather than inform and are concerned with the negative psychological effects of disaster coverage (e.g. Anzur, 2000; Bernstein et al., 2007; Bui et al., 2012; Lau, Lau, Kim, & Tsui, 2006; Seo et al., 2011), are those who refer to the media's provision of emotional support, companionship and helping isolated individuals feel connected with others in response and recovery (e.g. Beaudoin, 2007b; Fu et al., 2010; Mileti, 1999; Perez-Lugo, 2004).

The media has also been identified as being subtly anti-science/technology at that same time as it was identified as a tool of science/technology. Friedman, Dunwoody, and Rogers (1986), William R. Freudenburg et al. (1996) and Nelkin (1995) noted a tendency for science journalists to comment on the successes of science more than failures (in a way which is less than objective). William R. Freudenburg et al. (1996) then argued that the media is not as sensationalist or biased as some risk analysts might believe, and ascribe the claim as being 'availability bias' (enhanced recall of the sensationalist media).

Besley and Nisbet (2011, p. 13) suggested that scientists' perception of media coverage is 'erroneous' in that scientists with a *"strong commitment to an issue"* view even favourable coverage as slanted against goals and point of view Besley and Nisbet (2011, p. 13). Besley and Nisbet ascribed this misperception to 'hostile media effect' and 'third person effect', where members of one social group will perceive media coverage (or a message) as not affecting them but will think media coverage has influenced those socially distant from their group.

J. Garnett and Kouzmin (2009) and Tierney, Bevc, and Kuligowski (2006) criticised a failure by the media to report on critical issues and 'media narcissism'. Media coverage about media coverage was provided as an example of the latter. Given the importance of getting DRR communication right this should perhaps not be portrayed as a media failing, but as self-reflection.

As suggested by Wåhlberg and Sjöberg (2000) the reality appears to be that the media are neither fully objective nor fully biased. Perhaps, in summary the media are best considered "*a key, if sometimes misguided, part of risk communication"* (Smallman, 1997, p. 160).

## 2.7 DRR-related communication terminology and problems

### 2.7.1 Risk communication equates to communication of threat of crisis or disaster

The fact that 'DRR-communication' is not a commonly accepted term was noted in section 1.3.8. Literature review has also shown that there is considerable variation in how the terms 'crisis communication' and 'risk communication' have been applied by researchers.

Crisis communication is commonly considered to be communication by officials and experts in the response period (e.g. Arnold, 2006; Benoit, 1997; N. Chen, 2009; Fearn-Banks, 2002; J. Garnett & Kouzmin, 2009; Seeger, 2006).

For many the term 'risk communication' is synonymous with threat or warning of a crisis or disaster; with risk identification and risk assessment, but rarely with risk management.

Hazard and consequences are often mentioned by risk communication researchers, less so exposure or vulnerability, let alone risk tolerability. An exception was Plough and Krimsky (1987) who considered that risk communication not only informs individuals about the existence, nature and severity of hazards, but also the *acceptability* of hazards. Similarly, if one extrapolates from the UNISDR definition of risk (section 2.3.9) risk communication would simply be communication of *"the probability of an event and its negative consequences"*. When compared with other risk equations in section 2.3.9 such a definition clearly considers only part of the DRR problem, and none of its solutions.

### 2.7.2 Few scholars mention risk management when referring to risk communication

Some scholars do mention risk solutions as well as hazard, or threat in their definitions of risk communication. For example Covello, McCallum, and Pavlova (1989) refer to risk communication as information exchange about the nature, magnitude, significance, or control of a threat or harm. According to Mileti and Fitzpatrick (1992) the purpose of risk communication is not only to inform and warn, but also to provide protective action plans for the public to follow. Larson (1980) defined the information to be communicated about disasters as "*all forms of information that affects public understanding of, attitudes toward, preparation for, and responses to disaster"*. Atman, Bostrom, Fischhoff, and Granger Morgan (1994) suggested that risk communication is intended to assist in the making of complex decisions about risk. For Valenti and Wilkins (1995) the value of risk communication is both the facilitation of effective information processing, and debate and discussion that leads to individual and policy outcomes. McComas in her review of risk communication research spanning the period 1996-2005 refers to risk communication as an "*iterative exchange of information among individuals, groups, and institutions related to the assessment, characterization, and management of risk*" (K. A. McComas, 2006, p. 76).

### 2.7.3 The range of problems in science- and risk communication is wide

There are a wide range of problems and challenges identified in relation to communication of science, risk and disaster. The two most commonly-cited yet diametrically opposed challenges, lack of information, and information overload, are key communication concerns (Castells, 2010). As might be expected from the discussion of frame types in section 2.1.6 some of the challenges are ideological or ethical. For example a range of cultural assumptions or 'frames' influence how scientists are said to view communication of science in the public sphere. Typically one or a combination of; science illiteracy, the absence of quality science coverage, or lack of an effective science-communicator are suggested as problems in science- and risk communication (Nisbet, 2010).

Many of the problems identified are character-specific communication problems. One example is a narrative of a gulf between scientists and journalists (H. P. Peters, 2008; H. P. Peters et al., 2008). However, despite the prevalence of studies suggesting 'problems' with science- and risk- communication in the media there have been few overall systematic 'audits' of all of those 'deficits'. The following section presents an exception. Problems in DRR communication are summarised in terms of all four stakeholders in section 4.1.1.

### 2.7.4 A mnemonic for science- and risk communication problems is CAUSE

The array of problems and challenges discussed in the vast literature on risk communication are rarely distilled in a way that allows for easy discussion. An exception is Rowan's mnemonic (CAUSE) (Rowan, 1994b). CAUSE stands for Credibility, critical Awareness, Understanding, agreement about Solutions, and Enactment of effective response. A little detail about these problems is given in Table 2.6.

Many researchers identify and focus on one or two of the 'CAUSE' issues (although this mnemonic is rarely referred to). For example some academics explore subtopics such as the role of transparency or trust in communications, which fall under the heading of 'credibility', others explore 'warnings', which are part of 'awareness'. Concerns with information gaps and references to a need for 'education' are one part of 'understanding'. Many have concerned themselves with just what 'effective' response is. Very few, however,

**Table 2.6: Summary of problems in DRR communication**
Summary of literature review, using Rowan's CAUSE pneumonic as basis for presentation.

| Problems | Detail |
|---|---|
| Credibility | Emphasis on expertise/scientific process.<br>Lack of transparency and openness.<br>Manipulation (leading to bias).<br>Lack of acceptance that there are multiple viewpoints, and tolerance for opposing ones. |
| Awareness | Lack of the following:<br>'Critical awareness' and how to raise it.<br>Awareness typically considered in terms of threat, awareness of solutions also needs to be discussed.<br>Awareness of complexity. |
| Understanding | Historically the efficacy of scientific knowledge transfer has been measured in terms of equivalence with expert ideas of required knowledge rather than including citizen-identified needs. |
| Solutions | Social marketing campaigns have been aimed at educating and promoting effective solutions. |
| Enactment of effective response | Issue advocates search for evidence of the successful application of science to particular societal issues (which in the example studied here is DRR). Issue advocates have tended to measure the efficacy of learning, understanding or specific behavioural outcomes (for example as applied to DRR.<br>Communication scholars and ethicists, meanwhile consider communicative goals and practices. Of particular interest to the ethicists in modern times is whether information meets citizen information needs and persuasive intent to change attitudes or behaviours. |

have concerned themselves with communication of solutions, let alone whether there is agreement about them or not.

### 2.7.5 Problems in science- and risk communication are typically attributed to different character groups

Some of the problems in science- and risk communication are attributable to historic communication paradigms. Many of the problems are framed as character-group-specific.

For example there are four key aspects to the way other stakeholders view scientists and experts. Scientists are: 1) valued for their intelligence and knowledge but may be 2) manipulated by political forces, 3) may be communicating to seek funding or other forms of self-promotion, and are, 4) typically poor or reticent communicators.

At the same time as the media are recognised as valuable in DRR (see section 2.6.5) there is frequent criticism of the mass media, particularly in relation to the reporting of risk and disaster (Phillips, 1986). Media are said to underestimate their own negative impacts (Lowrey et al. 2007). Concerns expressed in the literature about the media (summarised from other parts of this chapter) are:

a) inaccuracy (misrepresentation)

b) biases (under- or over-representation) – prejudice, promotion of particular agendas (agenda-setting)

c) sensationalism of science- and risk issues

a) being ignorant of science- and risk issues

b) trivialising of science- and risk issues; and

c) not meeting citizen needs.

A summary of problems associated with the character groups is presented in Chapter 4 (Figure 4.1). Other issue-specific problems (in this case in DRR) are discussed in results Chapters 5, 6 and 7.

## 2.8 In summary idealised DRR science communication achieves DRR culture change

DRR has been described in this and the previous chapter as a set of solutions to risks that earthquakes and associated hazards pose to exposed and vulnerable human communities. Communication is a key part of DRR, one of a variety of ways to reduce disaster risks. The application of science is another key part of DRR. Data, information, knowledge and wisdom are required to solve social problems, but each is progressively more subjective. Data along with scientists' understanding of their context (subjective knowledge and wisdom) as well as citizens' views, need to be applied to solve issues such as DRR.

It was identified that all communications involve framing, in its broadest sense, because of the influence of the communicative goal or purpose. Frames guide observations, interpretations, mental organization, perceptions, value judgments and actions, and thus affect social opinion and social change. Framing is recognised by some as a useful tool for identifying perception gaps in the mass media. Framing is understood by others to be deliberate promotion of a particular perspective or agenda.

What is communicated affects the credibility of those involved in an issue, awareness and understanding and agreement of possible solutions, and enactment of those solutions. From these perceptions or 'associated mental models' a broad culture in this case a 'culture of DRR' is fostered. DRR culture change aims discussed in this chapter correspond with broad-based social changes; changes focussed on individual and personal betterment, changes designed to offset inequalities or injustices (vulnerabilities), and changes focussed on community resilience, including sustainable lifestyles and invulnerable development.

In this research the medium for DRR culture change considered was the mass media, since it is generally accepted that the media are a frequent source of public information about the environment, risk issues, and more specifically, natural hazards. The media has many valuable functions in DRR. Everyone gains impressions about topics they are not expert in from some form of mass media. There appears to be general consensus that mass media content is a melting pot of scientific theories, data, and information, and ideas that are individually, socially and/or politically-derived.

This research idealises contemporary communication models such as described by Irwin (2008) as 3$^{rd}$ or 4$^{th}$ order communication. That is communication that is beyond 'bottom-up' (see Table 2.4) involving conversation and negotiation.

Views of the relationship between science and its use in resolving societal issues have changed over the past decades. There have been increasing efforts to develop 'better' risk communications through improved knowledge or understanding of audiences and their information needs (Sandman, Miller, Johnson, & Weinstein, 1993; Tinker, Zook, & Chapel, 2001). Nowadays the specific cognitive and behavioural outcomes are open to negotiation. Rather than being simply advised or warned of issues and told or persuaded as to their best action, the contemporary communication focus is on citizens having information to form their own opinions (Freudenberg et al. 1996; Sandman 2003), supporting audience decision-making (Bostrom, Atman, Fischhoff, & Granger Morgan, 1994; de Marchi, 1991) and having engaged citizens who are involved in discourses that influence governance of those issues (Torgerson, 2003, p. 115). Communication that follows such 'ethical principles' has been termed *considerate* communication in this research. The communication should also be *comprehensive* and *complete* so as to enable informed, open decision-making.

DRR itself is increasingly seen as requiring research, application of that research and communication of that research that;

- is rooted in ethical principles (Chapter 1) - is socially robust, and *considerate* (as is described in chapter 4)
- integrated, in the sense of being collaborative and *comprehensive*
- is from a range of scientific disciplines
- considers social, economic, built and environmental context, not only hazard
- includes all parts of the DRR cycle, including recovery
- involves not only identification, awareness and assessment of issues and problematic consequences, but is focussed on solutions; and
- represents a sustainable development paradigm focussed on reducing vulnerability and building resilience.

Idealised DRR-communication in the context of this thesis is communication that achieves the DRR culture change mentioned earlier. This is achieved in part by being *comprehensive* in terms of the DRR content communicated. The next chapter (3) explores ways of analysing content with a view to improving communications, and a methodology for analysing comprehensiveness is developed.

# 3 Methodology and results of quantitative literature analysis

## 3.1 Considerate and complete: methodology and media

### 3.1.1 This study measured communication outputs or effects against goals

Success measures should align with to the aims and goals of the models and practices used. Neresini and Pellegrini (2008) stressed the importance of measuring or evaluating science communication against the purpose, or objectives of the communication; either the effects that it was designed to produce, or the goal that it was to achieve. Identification of goal is also the first step of a diagnostic, or problem-solving approach to risk communication suggested by (Rowan, 1994b).

In reality few scholarly articles reviewed clearly articulated the goal or goals that DRR-communication is expected to achieve. Where goals were articulated in historic research, the stated purpose was typically to raise awareness or persuade an attitude change or direct behaviour.

This research established DRR goals from review of DRR literature (chapter 2) and overarching communicative goals (from review of literature discussed in chapter 4). The next step was to establish methods to measure communication against issue-specific frames. The methods are discussed in this chapter. Where literature analysis explains or supports the methodology it is also presented in this chapter.

### 3.1.2 Developing a DRR science communication methodology involved three challenges

This research was to be strongly grounded in theory, relating to both communication and DRR. Key challenges in developing a methodology for this research were there was little previous research that 1) linked to theory or empirical studies, 2) provided methodological frameworks in either science communication or DRR that were linked to that theory, and 3) involved a methodology that drew from the insights from a range of disciplines.

Theory should be the basis of science communication practice (S. Miller, 2008). However the literature review has shown that while there are many scholarly articles that make reference to potential improvements in science- and risk communication, relatively few link the improvements back to theory or empirical studies.

Methodological frameworks that are coherent and theoretically unified and may be used to guide studies of key issues in science communication do not exist (Trench & Bucchi, 2010). Nor is literature on mass media and disasters based on systematic knowledge or theoretical frameworks (Quarantelli, 1980).

Literature analysis has shown most earthquake- and disaster-media research as having been undertaken by communication researchers. This is rather than the research having been associated with disaster research centres and/or a wide range of disciplines (Appendix 4). It is therefore unsurprising that their methods, attention and discussions do not generally link to DRR-related theory, or DRR-related goals and ideals.

### 3.1.3 This methodology was based on a range of research traditions

This research took a multi-stage mixed method research approach as was introduced in sections 1.5.2 – 1.5.4. This research drew from five different types of research approaches as described below.

Broadly speaking there has been a total of five approaches to studies of science, risk and natural-hazard communication. The three main approaches are: 1) theoretical, or philosophical reviews of communication literature, 2) media effects research; and 3) analyses of the content of mass media communications, either alone or in comparison with notions of expert knowledge. Two less common approaches have been 4) surveys/interviews of a) citizen media use, b) citizen satisfaction with communication, c) citizen information needs, and perhaps least common of all, 5) expert commentary on hazard-, risk- or science communication as it occurred in practice.

All methods except media effects research have been used in this research to generate new data and perspectives. The methods relating to both data gathering and analysis, and the rationale for code development are discussed in the following sections.

## 3.2 Data gathering method 1 - literature review and analysis

### 3.2.1 Literature reviewed and analysed for this thesis was wide-ranging

The range of literature reviewed and/or analysed for this thesis was wide ranging; from different types of communication related literature, specifically to science-, risk- and natural hazards-related mass media and media-effects research, to DRR research and more specifically earthquake-related research. The variety of communication-related literature reviewed as part of this research is shown in Figure 1.1.

More specifically, this research involved the review and analysis of five bodies of communication-related literature as described below:

1. Science-, risk- and disaster communication literature in terms of a) identification of problems in communication; and b) its provision of general recommendations linked to historical and current concepts of 'best-practice' or 'effectiveness' in communication;

2. a) Communication and media effects research (in particular framing research) in general and in relation to DRR topics; and b) social psychometric studies relating to the influence and effects of information and its communication on perceptions and actions, in general and in relation to DRR topics;

3. Previous analyses of risk- and disaster-media content relating to natural hazards, and associated disasters and risk reduction activities were quantitatively analysed;

4. Historical surveys and interviews conducted with the aim of identifying DRR information requirements of stakeholders; and

5. Expert commentary on DRR-related science communication.

Literature in science-, risk- and natural hazards-related mass media and media effects was reviewed in order to synthesise communication problems (Chapter 2) and recommendations for ways to improve communication (Chapter 4). A quite separate body of research literature reviewed was DRR research. General DRR research was used to identify key definitions and concepts as presented in (Chapter 2 and Glossary Group 2 in Appendix 1) as these gave insight into DRR goals and aims. Earthquake-specific research was also analysed as the expert knowledge so that media content could be compared and contrasted with it. However the approach in this study to this comparison was somewhat different to historical comparisons.

### 3.2.2 Historic comparisons of research and media content focussed on accuracy

One branch of research in media communication of science- and risk has used content analysis to compare available knowledge with its presentation in the media. Rosengren (1970) suggested using 'extra-media data' to reflect on differences between [an objective determination of] 'reality' and its mediated representation. Studies following this rationale were historically concerned with 'accuracy', or how scientific information is changed or distorted in the process of communication. Science information was traced from scientific papers to what is communicated in mass media (e.g. Fahnestock, 1986; McCarthy, Brennan, De Boer, & Ritson, 2008; C. O. Stewart, 2005; Veneu, Amorim, & Massarani, 2008). This branch of research has clear association with knowledge-gap approaches to communication. The scientist or authority source is set as the 'informed expert', and the expectation is that expert opinions and advice are followed. In an example from the media disaster literature Ploughman (1995, p. 308) stated that *"[objective] scientific knowledge of disasters often differs greatly in content, emphasis, and detail from the news media's interpretation and presentation of disasters."*

Nehrlich (2007) referred to similar studies in more recent years as a comparison of journalistic, scientific and societal models and metaphors. The comparison may be achieved by comparing press releases, scholarly journal articles, policy documents, reports or databases with what is in the media. This approach is relatively common in science- and risk communication analyses in general. However, review identified only six studies that compared media content analysis with DRR-related scientific knowledge, namely Ashlin and Ladle (2007), Lan (2009), (Lobb et al., 2012), (Longstaff & Yang, 2008), Singer (1990) and Singer and Endreny (1994).

This research might have conducted an audit against press releases as did McCarthy et al. (2008) Another scientist-centred approach might have been to survey scientists about any concerns they had about articles that they were sources in. However, neither 'accuracy' nor adherence to expert advice has been the focus of this research. In keeping with contemporary communicative ideals discussed in the previous chapter the emphasis has been instead to canvas the views of all social actors in relation to media content, not only the perspective of scientists.

## 3.3 Data gathering by survey and interview (method 2)

### 3.3.1 Surveys and interviews were citizen- rather than expert-focussed

Citizen survey and interview methodology employed in this research was citizen-focussed rather than expert-focussed. The background to this choice is a historical shift from expert- to citizen-focussed surveys and interviews that mirrors other shifts in communication research described in Chapter 2.

Citizen surveys in risk-related research in general have increased in popularity in recent years (Bakir, 2010). In particular the last decade has seen an increasing number of surveys and interviews to assess citizens' attitudes to risk (Bakir, 2010). Studies of natural-hazard-related-DRR-communication needs and preferences are also increasingly common. Direct surveys of information needs relating to a range of earthquakes have been part of research by Hiroi et al. (1985), Kasapoğlu and Ecevit (2004), Marincioni (2012), Oki and Nakayachi (2012), Seid-Aliyeva (2006), Souza and Martínez (2011) and J. White and King-Wa (2012).

A rare example of a study that considered citizen needs in relation to risk management options was carried out by G. Gregory, Loveridge, and Gough (1997) in New Zealand. Gregory et al asked questions relating to exposure and consequence as well as about perceptions of long-term effects and responsibilities of the authority CDEM.

One might assume a correlation between research approach and third order communication models. However, in many cases attention has remained on lower order 'awareness' and 'understanding' and on whether communications result in specific desired literacy or behavioural outcomes (cf. Figure 2.3). Direct surveys of risk perceptions remain popular. A significant proportion of the surveys of risk perception were undertaken in New Zealand. Some of the New Zealand-based studies of risk perceptions have included surveys of beliefs about earthquakes (e.g. Orchiston, 2010; Paton, Johnston, & Houghton, 2001; Ronan, Johnston, & Paton, 2001; Ross & Shuell, 1993). Surveys and interviews have still been conducted with the stated aim of discovering what 'the public' need to be 'educated' about (e.g. Bird, Chague-Goff, & Gero, 2011) or exploring recall of information and 'knowledge gaps' between an assumed scientific rationality and 'lay beliefs'.

In this research attention was on what citizens including experts, *want to know* rather than only finding out *what* the 'lay public' know. The methodology was rooted in principles of democratization of science and communication as discussed in Chapters 1 and 2. Three newer branches of communication research were drawn from in formulating the survey and interview questions; namely citizen media use[4], satisfaction[5], and information-needs[6] research. In natural hazards and disaster media research it is becoming more common to combine media content analysis with satisfaction, perception or needs surveys, including earthquake-related studies in this genre (e.g. Hiroi et al., 1985; Rodrigue, 2004; Seid-Aliyeva, 2006; Souza & Martínez, 2011; J. White & King-Wa, 2012).

The intention in using these three methods is to develop 'better' risk communications in the sense that they involve an improved knowledge or understanding of audience (Sandman, 2003; Tinker et al., 2001) or are otherwise audience-centred (Griffin et al., 1998). Assessment of what people already know, along with a determination of what missing information is most critical to their decisions should be the starting point for providing of risk-related information (Bostrom, Atman, et al., 1994).

Scientist perceptions of, and reactions to risk have however rarely if ever been canvassed and are therefore unknown (whether in New Zealand or internationally). Researcher assertions about 'correct risk perceptions', if there is such a thing, or at least the differences between 'expert' and 'non-expert' perceptions are therefore not well understood. A further concern is that surveys have related to warnings, and needs in the immediate disaster response, not on risk evaluations in recovery or about risk reduction actions outside of crises.

In contrast this research has gathered survey and interview responses from citizens and a variety of different earthquake-related-DRR-topic-experts whose attention is not only on hazard warnings and crisis management, but also on recovery and risk reduction. The detail of the respondents and the questions asked are discussed in the next sections.

### 3.3.2 The demographic surveyed and interviewed was as wide as possible

The focus in historical surveys relating to DRR topics has primarily been on targeted audiences rather than the populous in general. In contrast my research was designed to

[4] 'Media-use' research is the study of where citizens obtain DRR-related information, so that messages targeted to particular groups can be communicated via favoured channels (e.g. Griffin et al., 1998).

[5] Satisfaction research asks citizens how satisfied they are about communications, but is relatively uncommon in relation to natural hazard-related communication.

[6] Information-needs research looks in detail at what information citizens consider they require. Citizens' information needs regarding implementation, regulation, ethical considerations and cost benefit factors must be met through media accounts of risk (Hornig, 1993). Examples of recent work exploring whether the information needs of citizens are being met include Spence, Lachlan, Burke, and Seeger (2007), and Spence, Lachlan, and Ray (2008), other Hurricane Katrina related studies including Beaudoin and Thorson (2004),Beaudoin (2007b), Beaudoin (2007a), and R. L. Heath et al. (2009), and a study relating to a Taiwanese typoon (Y. Takeuchi & Shaw, 2011).

consider the needs of the citizenry as a whole, rather than separate groups. Citizens with a range of roles and responsibilities within and outside of DRR were surveyed to provide a spectrum of views (cf. Pidgeon & Henwood, 2004). The questionnaire used can be found in Appendix 5.1. Those surveyed and interviewed include representatives from civil society, business and private industry, academic and other research institutions, or are officials in the public service or hold elected positions in local, regional and national government. The demographic characteristics of the survey respondents are significantly different to that of the selected interviewees (see Tables 3.1-3.3). The interviewees are predominantly experts in aspects of DRR, albeit across a variety of disciplines (further background is presented in Appendix 5.2). Many of the interviewees were media sources during the Canterbury earthquakes (Table 3.3).

Further background about the web-based snow-ball and face-to face surveys is given in Appendix 5.3. Observations about differences between survey respondents' and interviewees' science background and relationship with DRR are presented in Appendix 5.4

### 3.3.3 The survey and interview questionnaire was designed to explore citizen needs

The questionnaire used in survey and interview was designed having considered the factors described in 3.2.1 above and Dillman's book on surveying using the internet (Dillman, 2000). In this study the approach has been to explore citizen needs, and to a lesser degree use and satisfaction with communicated content and their information needs. To address citizen needs and preferences, over 400 citizens were asked in survey and interview what they thought needed to be communicated about earthquakes, seismic risk and ways of reducing seismic risk. The questionnaire also asked what could have been better communicated with respect to the Canterbury earthquake swarm of 2010-2011.

Questions 4-7 were designed to provide a snapshot of the nature of this surveyed 'DRR public'. Question 9 asked about general demographics seeking the sort of data compiled in the New Zealand census. Question 7 asked respondents to rank twelve ways that people might be informed about earthquakes, earthquake-related disasters and ways of preparing for them. The key questions (Questions 1-3 – see Appendix 5.1 for details) asked of participants their opinions about what should be communicated about earthquakes and earthquake-related DRR and what could have been better communicated in relation to the Canterbury earthquakes. The same questions formed the basis of 29 in-depth interviews.

**Table 3.1: Survey and interview respondent demographics**
Demographics of the respondents a) gender b) ethnicity c) place of residence (n=493)

a) Gender

| | | Survey Type | | | | |
|---|---|---|---|---|---|---|
| **Gender** | **Age** | **Face to Face** | **Interview** | **Pilot** | **Web** | **Total** |
| Female | 16-25 | 37 | | 4 | 3 | 44 |
| (246) | 26-55 | 65 | 8 | 4 | 70 | 147 |
| | 56+ | 26 | | | 28 | 54 |
| | No response | | | | 1 | 1 |
| Male | 16-25 | 14 | 2 | 3 | 5 | 24 |
| (164) | 26-55 | 45 | 13 | 1 | 35 | 94 |
| | 56+ | 16 | 6 | | 24 | 46 |
| No response | No response | | | | 83 | 83 |
| Total | | 203 | 29 | 12 | 249 | 493 |

**b) Ethnicity**

| | | Survey Type | | | |
|---|---|---|---|---|---|
| Ethnicity | **Face to Face** | Interview | Pilot | Web | Total |
| NZ Maori | 18 | 2 | | 6 | 26 |
| NZ European | 109 | 21 | 12 | 139 | 281 |
| African | 2 | | | | 2 |
| American | 4 | 1 | | | 5 |
| Asian | 17 | | | 1 | 18 |
| European | 14 | 4 | | | 18 |
| Indian | 9 | | | | 9 |
| Middle Eastern | 7 | | | | 7 |
| Pacific Island | 17 | 1 | | 2 | 20 |
| Russian | 2 | | | | 2 |
| South American | 2 | | | | 2 |
| Other unspecified | 1 | | | 15 | 16 |
| No response | 1 | | | 86 | 87 |

**c) Place of residence**

| | | Survey type | | | |
|---|---|---|---|---|---|
| Place of Residence | **Face to Face** | **Interview** | **Pilot** | **Web** | **Total** |
| Auckland & North | 191 | 1 | 1 | 22 | 215 |
| Canterbury | 4 | 21 | 2 | 84 | 111 |
| Central-Lower North Island | 2 | | | 5 | 7 |
| Otago | 2 | 2 | 9 | 23 | 36 |
| Wellington | 3 | 5 | | 22 | 30 |
| Any other NZ Region | | | | 6 | 6 |
| Not NZ | 1 | | | 6 | 7 |
| No response | | | | 81 | 81 |

**Table 3.2: Survey and interview respondent education, DRR and science background**
Respondent (n=493) a) qualification b) scientist type c) DRR involvement d) social actor group. Note that scientist type b) does not split social sciences, geoscientists equate with earth scientists and engineers are building scientists. For description of science disciplines see section 3.6.4. DRR involvement c) coding was according whether there were ‘no’, a ‘limited’ or ‘some’ mention of prearations, ‘moderate’ involvement if involved in DRR at home and through work and or had involvement in another facet of DRR other than preparation. High involvement meant the respondents spent a considerable time considering or practing DRR. Note that in d) social actors (as defined in Figure 2.2) have been further separated into ‘prepared’ or ‘unprepared’. Note that a ‘prepared’ expert/scientist may only be prepared in respect of their personal household.

**a) Qualification**

| | Survey Type | | | | |
|---|---|---|---|---|---|
| Qualification | **Face to Face** | **Interview** | **Pilot** | **Web** | **Total** |
| At/didn’t complete secondary | 6 | 1 | 5 | 2 | 14 |
| Secondary qualification | 53 | 3 | 4 | 16 | 76 |
| Tertiary qualification | 91 | 10 | | 38 | 139 |
| Post-graduate qualification | 53 | 15 | 3 | 109 | 180 |
| No response | | | | 84 | 84 |

**b) Scientist type**

| | Survey Type | | | | |
|---|---|---|---|---|---|
| Scientist discipline | **Face to Face** | **Interview** | **Pilot** | **Web** | **Total** |
| Engineering | 3 | 1 | | 4 | 8 |
| Environmental | | | | 3 | 3 |
| Geoscience | 1 | 3 | | 6 | 10 |
| Geotechnical | | 1 | | 4 | 5 |
| Health | 7 | 3 | 1 | 10 | 21 |
| Multi-disciplinary | | 2 | 1 | 10 | 13 |
| Social Science | | | | 16 | 16 |
| No response | | | | 72 | 72 |
| DRR-discipline non-DRR work | 18 | 2 | | 49 | 49 |
| Non-scientist | 174 | 13 | 9 | 277 | 277 |
| Other science-non-DRR | | 4 | 1 | 19 | 19 |

**c) DRR involvement**

| | Survey Type | | | | |
|---|---|---|---|---|---|
| DRR Involvement | Face to Face | Interview | Pilot | Web | Total |
| High | 7 | 16 | 1 | 57 | 81 |
| Moderate | 27 | 9 | | 14 | 50 |
| Some | 36 | | | 24 | 60 |
| Limited | 50 | 1 | 4 | 69 | 124 |
| None | 83 | 3 | 7 | 24 | 117 |
| No response | | | | 61 | 61 |

**d) Social Actor Group**

| | Survey Type | | | | |
|---|---|---|---|---|---|
| Social Actor Group | Face to Face | Interview | Pilot | Web | Total |
| Citizen - DRR advocate | 28 | 6 | | 32 | 66 |
| Prepared citizen | 78 | 2 | 2 | 32 | 114 |
| Unprepared citizen | 69 | 3 | 8 | 10 | 90 |
| Unprepared non-DRR-related-scientist | 7 | 1 | | 5 | 13 |
| Prepared non-DRR-related scientist | 10 | 1 | | 17 | 28 |
| Expert/scientist | 2 | 1 | 1 | 14 | 18 |
| Expert/scientist – prepared | 7 | 3 | 1 | 43 | 54 |
| Expert/scientist - involved in policy | | 6 | | 8 | 14 |
| Policy/decision-maker | | 4 | | 6 | 10 |
| Media/communicator | 1 | 2 | | 12 | 15 |
| No response | 1 | | | 70 | 71 |

### Table 3.3 Interviewee identities

This table presents a brief description of the twenty one interviewees, and identification codes used throughout the thesis (see left hand column in no particular order). Note that many of the interviewees were media sources. At least 8, including Berryman, Cowan, Pampanin and Quigley, have been authors of academic papers published on some aspect of the Canterbury earthquakes. Two specific examples are Humphries, Mitchell, and McBride (2011) and Ardagh et al. (2011). The table is continued overleaf.

<table>
<tr><th>ID</th><th>Interviewee Description</th><th>Interviewee Name (where consented)</th></tr>
<tr><td>I001</td><td>Waimakariri Recovery Manager</td><td>Simon Markham</td></tr>
<tr><td>I002</td><td>Canterbury City Council Strategy Support</td><td>Richard Ball</td></tr>
<tr><td>I003</td><td>Community Board Chairperson from Canterbury</td><td>Chris Mene</td></tr>
<tr><td>I004</td><td>Canterbury Business Leader - CEO of the Canterbury Employers' Chamber of Commerce</td><td>Peter Townsend</td></tr>
<tr><td>I005</td><td>Female citizen from Otago<br>(not directly affected)</td><td>Rose George</td></tr>
<tr><td>I006</td><td>EQC Research Manager - Wellington</td><td>Dr Hugh Cowan</td></tr>
<tr><td>I007</td><td>Expert in emergency medicine involved in February 22 response.</td><td>Prof Michael Ardagh</td></tr>
<tr><td>I008</td><td>Canterbury Medical Officer of Health Science - policy interface</td><td>Dr Alistair Humphrey</td></tr>
<tr><td>I009</td><td>Wellington-based advocate for the Canterbury recovery</td><td>Francis Wevers</td></tr>
<tr><td>I010</td><td>Science Reporter - The Press</td><td>Paul Gorman</td></tr>
<tr><td>I011</td><td>Civil Engineering Academic from Canterbury, sometime media source</td><td>Dr Stefano Pampanin</td></tr>
<tr><td>I012</td><td>Geotechnical expert who has been a mass media source</td><td>-</td></tr>
<tr><td>I013</td><td>Scientist- from office of PM's Chief Science Advisor</td><td>Dr Stephen Goldson</td></tr>
<tr><td>I014</td><td>Affected citizen from Canterbury (has some experience of media and communications and tertiary science training including some earth science)</td><td rowspan="4">McCaw Family - 1 interview</td></tr>
<tr><td>I015</td><td>Affected citizen from Canterbury University student who took up geology after the quakes</td></tr>
<tr><td>I016</td><td>Affected citizen from Canterbury - Secondary school student from Canterbury</td></tr>
<tr><td>I017</td><td>Canterbury - affected public</td></tr>
<tr><td>I018</td><td>Policy advisor with a strong background in mass media</td><td>-</td></tr>
<tr><td>I019</td><td>Science Communicator - Science Media Centre, Wellington</td><td>Dacia Herbulock</td></tr>
<tr><td>I020</td><td>Deputy Mayor - CCC</td><td>Ngaire Button</td></tr>
<tr><td>I021</td><td>Ministry of Civil Defence and Emergency Management</td><td>-</td></tr>
</table>

Table 3.3 cont/-

| ID | Interviewee Description | Interviewee Name (where consented) |
|---|---|---|
| I022 | Anonymous | - |
| I023 | Opposition MP from Canterbury - appointed to UNISDR disaster recovery advisory group in 2012, and frequent media source, now Mayor of Christchurch City | (Hon) Lianne Dalziel |
| I024 | Seismologist, Manager GNS Natural Hazards Research Platform, frequent media source. Science policy interface - government advisor | Dr Kelvin Berryman |
| I025 | Non-institutional commentator in NZ mass media on earthquake prediction and risk | Ken Ring |
| I026 | Inter-disciplinary DRR researcher - Canterbury, sometime media source | - |
| I027 | Emergency Manager involved in DRR programmes, heavily involved in Canterbury response, sometime media source | John Mitchell |
| I028 | Academic Geoscientist and frequent media source. | Dr Mark Quigley |
| I029 | Canterbury-based recovery advocate (CanCERN) and post-quake media source. | Leanne Curtis |

The key questions asked of survey respondents and interviewees were designed to achieve the following:

- Assess the level of satisfaction with communication of disaster, risk and reduction. This was achieved by asking what had been well communicated leading up to and after the Canterbury earthquakes, and where improvements could have been made [Question 1]

- Determine what people think needs to be communicated and known about earthquake-related science when the purpose or goal is disaster risk reduction. [Question 2a]

- Identify citizen communication goals [Question 2b]. This was addressed by asking why they want to learn about topics they listed in their answer to the first part of Question 2.

- Discover the details of what respondents and interviewees thought could have been communicated better at the time of the Canterbury earthquakes [Question 3]. This gave a further dimension to what people want to know.

The format of Question 2 and Question 3 was deliberately open, so respondents were not prompted to answer in a particular way. However it is acknowledged that the wording of Question 1 and the fact that a science communication researcher arranged the surveys and interviews, may have given some direction. For further discussion of survey design and limitations see Appendix 5.5.

Approval for the surveys and interviews was sought from the University of Otago Human Ethics Committee and approved (number 12/032). Consultation was undertaken with the Ngai Tahu Research Consultation Committee. A combined pilot survey using both face-to-face and web-based survey techniques was conducted in May 2012. The wording of some questions was altered on the basis of responses, and an amended ethics approval sought and received. Surveys and interviews were conducted 1.5-2 years after the first Canterbury event (between June and December 2012). The results of Questions 4-9 describing the demographics and DRR and science backgrounds of the surveyed public and interviewees are summarized in Tables 3.1-3.3. The results of survey and interview in relation to Questions 1-3 are presented in the following chapters. Survey and interview responses to these questions are discussed throughout the results chapters 4-7, with some responses summarised in various tables (Table 4.3, Table 5.40, Table 7.7 and Table 7.8), and Appendix 10. Further detail and quotes from respondents are blended into sections of the Chapter 4-7 where they inform the discussion in terms of citizen expectations of DRR-communication topics.

## 3.4 Measuring DRR science content: method 3 analyses

### 3.4.1 Content and framing analyses are popular in science- and risk communication research

Content analysis aims to *"identify and record relatively objective (or at least inter-subjective) characteristics of messages"* (Neuendorf, 2002, p. 141). Content analyses may be qualitative or quantitative. Quantitative content analysis is a research method that is objective, systematic and precise (Berelson, 1952), that *"uses a set of procedures to make valid inferences from text"* (R. P. Weber, 1990, p. 9). Those procedures may be applied to micro- or macro-level rhetorical (framing) strategies that may affect how audiences interpret and understand texts (C. O. Stewart, 2005). The texts may be mass media articles, interview transcripts, or other texts (Berelson, 1952). Narrative analysis provides policy scientists with *"an orderly methodology with which to analyse the plethora of dialogue occurring in a controversy"* (Hampton, 2009, p. 241). It is increasingly accepted as a scientific methodology by which to analyse public policies (M. D. Jones & McBeth, 2010; McBeth, Shanahan, Arnell, & Hathaway, 2007). Policy analysts employ a range of content analysis types, discourse, rhetoric and framing analyses to interpret issue-related frames (e.g. Hampton, 2009; F. J. McDonald, 2011; Roe, 1994).

### 3.4.2 Content (framing) analyses are a way of understanding issue framing

Framing is a concept that has been applied to both 'what' and 'how' information is communicated (Cacciatore et al., 2016). Framing analysis is one of the dominant methodologies in communication research and was identified by Bryant and Miron (2004) as the most popular mass media theory of the 21st century. Agenda-setting, which framing has close links with, was the second most popular. Both agenda-setting and framing theory have been considered in countless studies (Giles, 2008). Both theories have been applied in different studies related to DRR science communication.

Framing analysis shares language and methodologies with rhetorical, discourse and narrative analysis (Hampton, 2009; Hardy, 2004; Kuypers, 2009b; Shanahan, 2010). All of these analysis types have been used to analyse science communication and risk communication under both a deficit model and current approaches to risk communication (Kinder, 2007; Nisbet, 2009).

Methodologically robust identification of frames that enable reliable and valid frame sets need to be developed; for example see review by Matthes and Kohring (2008).

Framing in modern research is considered and analysed in four ways; i) in relation to the frames chosen by communicators when they create messages, ii) in relation to the individual sense- or meaning-making at the time of message receipt, iii) the collective representations in the mass media that determine the available interpretations and possibilities, i.e. the frames and their prevalence or absence; and/or iv) the effects or influence of individual or socially constructed meanings or 'culture' on beliefs, perceptions judgments, decision-making, and behaviour or actions. This research considers what is known through previous research of i) - iv) to make further recommendations to improve iii) the frames available in the media.

### 3.4.3 Media Framing Analysis (MFA) may be applied to a range of text types

The framing method applied in this research is 'cultural' and 'constructionist' as described by Van Gorp (2007), mirroring many of the paradigm shifts discussed in the previous Chapter (2). The method closely resembles Giles and Shaw (2009)'s media framing analysis (MFA). MFA is a mixture of quantitative and qualitative, drawing from content analysis, discourse analysis, grounded theory, narrative analysis and close textual and rhetorical analysis. These types of analysis may be applied to any textual elements of communicated content. MFA operates at two broad levels. The first is a largely quantitative macro-analysis of a broad dataset. This is used alongside a qualitative microanalysis to illustrate the framing processes identified in the macro-analysis. The MFA method may be described as holistic as it gathers frames relating to problem definition, solutions, causal attributes and characters in media stories. Giles describes the method as a

> *flexible set of procedures that can be used to carry out a framing analysis of media material, either at the micro-analytic level – such as the analysis of a single piece of text – or at the macro-analytic level, incorporating multiple media sources across a specific time period.*
>
> (Giles & Shaw, 2009, p. 377)

The method is however not limited to analysis of media texts. MFA is as applicable to analysis of other discourse, such as the body text of journal articles, or textual narrative, story or survey responses, as it is to analysis of media material. Having established an intention to compare media texts with other text types (as is back-grounded in section 3.5.1) MFA became a more obvious analytical method. MFA has been used in this study to analyse media content, survey and interview results and academic research articles.

### 3.4.4 MFA is the framing analysis that has been applied in this research

The basic MFA procedure was adapted slightly for this research as is shown in Table 3.4.

**Table 3.4: Procedure for analysing content**

Adapted from Giles & Shaw (2009), Ashlin & Ladle (2007) and Huckin (2002). Steps in the procedure are detailed in the discussion below or in other sections as identified in the third column from the left. Results relating to the various steps are presented

| Step | Description of step | Step detailed in | Results presented |
|---|---|---|---|
| 1. | initial data collection | sections 3.5.1, 3.5.3 | - |
| 2. | screening the selected material for relevance | sections 3.5.5-3.5.14 | - |
| 3. | recording details – article or respondent (e.g. title/heading, publication type and publication date) | - | - |
| 4. | identifying the event(s) that triggered the content | section 3.6.2 | section 5.2.2-5.2.5 |
| 5. | identifying the story type(s); in particular for topics, science-, media- and DRR-stories | section 3.7.7 | section 5.3 |
| 6. | identifying the characters in the story | sections 3.6.3, 3.6.4 and 3.6.5 | section 5.2; all chapter 6 |
| 7. | identifying narrative aspects including causal/agency inferences and imagery | section 7.4 | section 7.4 |
| 8. | identifying attributions of responsibility | section 7.2 | section 6.2 |
| 9. | generalisation as applied in this study relates to the on-going linkages in terms of the on-going stories relating to DRR as a whole. | - | section 5.4; section 6.3 |
| 10. | assessing the accuracy of coding | section 3.6.11 | Table 3.16 |

Step 1 in the research in this thesis involved identifying news media stories, earthquake-research data, and natural hazard media and disaster media research relating to natural hazards and earthquakes and downloading them directly from a) the on-line print media source or in the case of magazine articles scanning issues for titles, b) research data sets using online databases from Scopus and Web of Science and c) a university library journal database. In terms of media, sources use of traditional databases such as LexusNexus was discarded upon early comparison of the corpus yielded for particular days from direct source – although a far greater number of articles are obtained from this method. Step 4 involved a) developing frameworks to b) code and then compare the headlines/titles of articles in the various datasets in terms of aspects 4-8 or c) qualitative research.

This research took a ‘census’ rather than ‘sample’ approach. Therefore in step 2 there was initially no ‘filtering’ of the text to eliminate irrelevant news stories. All ODT and television news stories, and research articles were utilised for quantitative analysis in Chapters 5-7. Within a sample the data sets are filtered so that they are manageable.

With regard step 3 (Table 3.4) placement is normally recorded for print articles in hard copy (e.g. Barnes et al., 2008). Given the source of the articles was the internet (section 3.6.8) placement was not identified in this research (cf. Jönsson, 2011).

Reader identification has not been considered in this research in quite the way that Giles and Shaw considered it. This research focussed instead on attributions of responsibility as per Porto et al (2007b)'s approach.

Analysing the frames in this research as in steps 4-8 above involved attention to omissions and inclusions (Gamson 1989). Absences, missing frames, missing sources and voices have all been identified as being as important as what is present (Stallings, 1990). In analyzing texts and news what is missing is as important as what is present (Huckin, 2002; Richardson, 2007). Huckins' method provided a way to bring a quantitative element into the analysis of huge volumes of data. Ashlin and Ladle (2007) looked at environmental storylines in relation to Asian tsunami recovery discourse and what they refer to as 'gaps' or 'imbalances'. Huckin used the term 'textual silence' instead of gaps.

While Ashlin and Ladle (2007) used quotes from texts to support what they refer to as an interpretive, evidence-based and systematic approaches to their discovery of themes in the texts analysed, Huckin (2002) recorded the presence of subtopics in a text. The former qualitatively discussed the themes in terms of the actors used to support the storyline and practices present. Huckin presented the data in a simple quantitative way showing the presence, absence and emphasis of the inventory of subtopics they identified. In this study a combination of both approaches was applied to analysing each of the aspects identified in steps 4-8. Other natural hazard or disaster-related media research identified as having considered presence, absence or emphasis of aspects of content following Huckin's method include Cox et al. (2008) and Paveglio, Norton, and Carroll (2011).

To try to avoid the creation of subjective 'researcher frames' (Matthes & Kohring, 2008) the frames sets generated for this study relate where possible to DRR theory itself. Subjective researcher frames were particularly prevalent in previous research into disaster media story topics (see section 3.7.5).

Analysing content provides a window to understanding the prevailing culture in relation to issues. In this research the issues of interest were DRR topics, how DRR was framed, and how the role of the science of DRR was framed[7]. Choices needed to be made about the issue-related content to be analysed (discussed in the following section).

[7] As discussed in Chapter 2 mass media news stories relating to earthquakes collectively contribute to social constructions of the characteristics, cause and consequences of earthquake-related disaster, seismic risk, possibilities and responsibilities in seismic risk reduction, and the role of science in DRR. The nature of those constructions influences individual and collective perceptions and behaviours including the concepts policy- and decision-makers base their conclusions and actions on.

## 3.5 Data gathering and screening for method 3 – content analysis steps 1-3

### 3.5.1 Four datasets were created; they represented research attention, authorities advice, media content and citizen comment about that content

In choosing a corpus (body of work to analyse) one must consider whether to incorporate only stories that explicitly relate to the issue, or whether to include general articles (Antilla, 2005; Ashlin & Ladle, 2007; Kitzinger, 1999; Singer & Endreny, 1994).

A process such as described and followed in Antilla (2005) and Ashlin and Ladle (2007) generates science-related articles only on a particular topic. It will not generate a body corpus that can be analysed to understand the way that issues and science are portrayed in and through human-interest and political stories.

In this research there were four overall dataset groups analysed as per Tables 3.5 and 3.6. They are representative of 1) science-, risk- and disaster communication experts summary of concerns and recommendations for DRR-related science communication 2) New Zealand citizen communication requirements and comments 3) recent New Zealand mass media attention, and 4) how 3) compares with both international expert/research attention and what New Zealand DRR advocates were communicating before the Canterbury earthquakes.

The earthquake-related-research dataset, and to a lesser extent 'authorities' 'pre-earthquake communicated advice' are two subsets of the 'science knowledge' or 'research attention' data type (shown in Table 3.5). What was, or was not in the media was determined using five datasets shown in the media section of Table 3.6.

The key issue-centric indicators used to analyse all datasets were DRR topics, scientific disciplines (including scientist source types), and social capitals (as described in sections 3.7.2, 3.7.4 and 3.7.6 respectively). Media story types were determined for the media datasets (as is discussed in section 3.6.7 and section 5.3).

### 3.5.2 The proxy for earthquake-related-research knowledge covers all disciplines

A proxy for what is known about earthquake-related DRR was needed in order to make comparisons with what earthquake-related DRR knowledge was presented in the media. DRR topics of articles and related scientific disciplines of earthquake-related research outputs were compared with the earthquake-related subject matter discussed in the New Zealand mass media in the same time period.

**Table 3.5: Description of datasets: proxy for expert knowledge (research attention), and authorities' advice datasets**

There are three datasets representing international reseach attention. One dataset is a proxy for New Zealand authorities' advice available prior to the Cantebrury earthquakes. The earthquake-research-dataset related to a subset of 20 earthquakes listed in Table 3.7. The dataset was created to be representative of earthquake-related DRR-related scientific expert knowledge from both academic journal articles and conference presentations. Natural hazard media and earthquake media articles in those datasets were mostly peer-reviewed journal articles. All research attention datasets were analysed quantitatively using codes as described in section 3.7.

| Dataset | Data/media | Data Description | Period Analysed | Analysis Type (Codes) |
|---|---|---|---|---|
| **RESEARCH ATTENTION** | | | | |
| Earthquake-related-research | 4376 unique academic journal articles and conference presentation references | Proxy for all earthquake-related research relating to 20 selected earthquake events (Tables 3.7 and 3.8 and Appendix 7). | 2008-2011 | Titles and abstracts subject to content analysis as per Table 3.4. Coded aspects of earthquake-related DRR and researcher disciplines (see section 3.6) |
| Earthquake-related-media studies | 127 journal articles (subset of 312 natural-hazard – and media-disaster studies) | Articles relating to the communication of seismicity, seismic risk, seismic disasters and seismic risk reduction | 1980-2012 | Study description, author, year hazard type, number of events, content analysis type and or survey (see Appendix Table 6.5) |
| Natural-hazard and disaster related- media content analyses | 164 journal articles | Articles relating to content analyses of natural hazards or natural hazard-related disasters | 1980-2012 | Study description, event or phenomenon, content and period of content analysed, (see Appendix Table 6.6). For a summary of mediums analysed (e.g. radio or print news) in the studies see Appendix Table 6.2. |
| **AUTHORITIES ADVICE** | | | | |
| ECAN booklets | Info booklets (ECAN, 2007a, 2007b, 2008a, 2008b) | Online pdfs – information on natural hazards and DRR in New Zealand generally and specific to Canterbury | Published 2007-2008 | Qualitative no coding |

**Table 3.6: Description of datasets: mass media content, and citizen survey and interview datasets.**
The following datasets (described in the centre column) were analysed quantitatively using codes as described in section 3.7. The length of television items was also recorded (summarised in Figure 3.2). Note that TV1's database for 2008 only had one item available on-line so is considered not to be complete.

| Dataset | Data/media | Data Description | Period Analysed | Disasters covered |
|---|---|---|---|---|
| MASS MEDIA | 'earthquake' - related | | | |
| ODT | 4836 articles (689 - 14.2% pre) | Online print media in region neighbouring Canterbury | 04 Feb 2008 to 03 Jan 2011 | See Figure 5.1 and timeline Tables 5.7-5.9 and article counts. |
| TV1 | 1407 items (91 – 6.4% pre) (1316 – 93.6% post) | Earthquake-related television items broadcast before and after the Canterbury earthquakes posted on www.tvnz.co.nz | 04 Apr 2008 to 04 Sep 2010 and then to 03 Dec 2011 | See Figure 5.2 and article counts. |
| Pre-STUFF | 775 articles | All earthquake-related articles available from the print media website www.stuff.co.nz. | 04 Apr 2008 to 03 Sep 2010 | Generally see timeline Tables 5.7-5.9. |
| 1000-STUFF | 1000 earthquake-related articles with headlines suggestive of science content or science keywords in body text | A selection of articles containing keywords suggestive of potential science content from the above online print media website. (Local/regional for Canterbury earthquakes) | 04 Sep 2010 to 03 Jan 2012 | Generally see timeline Tables 5.7-5.9. |
| Women's Magazines NEXT NZWW | 18 Next 68 NZ Women's Weekly | Hardcopies of editorials and articles from two popular New Zealand national Women's magazines. | 04 Sep 2007 – 03 April 2012 | 2010-2011 Canterbury, 2009 Samoa-Tonga, 2010 Chile, Haiti |
| CITIZENS | 470 total | | | |
| Survey | 441 responses | NZ residents' views on media communication of earthquake science | Jun 2012- Jan 2013 | 2010-2011 Canterbury only |
| Interview | 29 interviewees | Selected range of key stakeholder views communication of earthquake science | Jun-Jul 2012 | 2010-2011 Canterbury only |

The proxy created was a bibliometric dataset of academic literature across all science disciplines relating to selected international earthquake-related disasters. The dataset is all Web of Science and Scopus journal articles and conference presentation titles and abstracts relating to twenty recent globally significant earthquakes. The earthquakes selected were 17 major international and 3 significant New Zealand earthquakes that occurred in the period 2006-2011 as listed in Table 3.7. The selection basis is presented in Table 3.8. Publication dates for the articles and conference presentations selected was 2008-2011. The earthquake-related-DRR-research-outputs dataset therefore a) represented the most recent academic knowledge in the two years before, and during the Canterbury earthquakes, and b) was a similar time period to the media dataset it was compared with. It is recognised that there is much 'pure' research relating to mitigation and other aspects of DRR that is not represented in this dataset.

Other details of this dataset, referred to from here on in as the earthquake-related-research dataset are as already summarised in Table 3.5. Further details of how the dataset was generated are provided in Appendix 7.

### 3.5.3 Datasets, analytical methods and frame codes chosen for this study were influenced by previous research

Quantitative analysis of the previous 35 years of natural hazard and disaster media studies influenced the datasets, the analytical methods and the frame codes chosen for this study. Overall the method and datasets were designed to allow comparison with previous results where ever possible. Points of difference were deliberate efforts to undertake research in issue-related areas that had been missed by previous research (e.g. studies of long-term recovery).

A comprehensive, but perhaps not exhaustive, list of studies (the articles analysed) is presented in Appendix Tables 6.5 and 6.6. Those tables contain lists of the studies summarized in Appendix Tables 6.1-6.4 and Appendix Figures 6.1-6.2 that influenced the datasets and methodology used in this research.

Appendix 6.1 backgrounds the factors considered in selecting the corpus for media content analyses, including media use, time periods and number of articles to be analysed, and the degree of previous research attention.

**Table 3.7: Global events selected as representing major global earthquakes 2006-2011**
The table shows a list of global events chosen as representative of earthquakes in the period 2006 to 2011. The 'Eq #' is the earthquake number; the earthquake's number in order of occurrence over time, as listed in Table 3.6.

| Eq # | Event | Other names for event | Event Date |
|---|---|---|---|
| 1 | Kashmir, Pakistan | Muzaffarabad, Azad, Ghori, Chikar, Jammu, or South Asian | 8-Oct-05 |
| 2 | Yogyakarta, Indonesia | Java, mid-Java | 26-May-06 |
| 3 | Java, Indonesia | Java + tsunami | 17-Jul-06 |
| 4 | Pisco, Peru | Ica, or near Coast central + tsunami | 15-Aug-07 |
| 5 | Bengkulu, Sumatra | Mentawai + small tsunamis | 12&13-Sep-07 |
| 6 | Gisborne, NZ | Off east coast of North Island | 20-Dec-07 |
| 7 | Sichuan, China | Wenchuan, or '5.12' | 12-May-08 |
| 8 | Balochistan, Pakistan | Quetta-Ziarrat, Balochistan/Baluchistan | 28-Oct-08 |
| 9 | Lac Kivu, Dem Rep of Congo | Bukavu-Cyangugu, (+ fatalities in Rwanda) | 3-Feb-08 |
| 10 | L'Aquila, Italy | Abruzzo, Central Appenines/Italy | 6-Apr-09 |
| 11 | Fiordland, NZ | Dusky Sound (Te Anau) | 15-Jul-09 |
| 12 | Java, Indonesia | Cianjur, Badgung | 2-Sep-09 |
| 13 | Samoa/Tonga | few references to earthquake - most to tsunami "Pacific Tsunami" | 29-Sep-09 |
| 14 | Padang, Indonesia | Kesan Gempa, Sumatra | 30-Sep-09 |
| 15 | Port au Prince, Haiti | 'Gudugudu' | 12-Jan-10 |
| 16 | Concepcion, Chile | Offshore Bio-Bio, Maule, Centro-Sur | 27-Feb-10 |
| 17 | Yushu, China | Southern Qinghai | 13-Apr-10 |
| 18 | Mentawai, Indonesia | Pagai, off coast of Kepulauan, Sumatra | 25-Oct-10 |
| 19 | Canterbury, NZ | Darfield Sep 4 2010 + large aftershocks, Christchurch, Lyttleton, Port Hills (Feb 22 2011), Boxing Day Earthquake (26 Dec 2010), June 13 2010. | 2010/2011 |
| 20 | Sendai, Japan | Tohoku-oki, Tokai, 11/11, near the east coast of Honshu | 11-Mar-11 |

**Table 3.8: Selection basis for representative global earthquakes of 2006-2011**

Selection basis for 20 earthquakes chosen as representative of global earthquakes of 2006-2011 that might appear in New Zealand mass media content. The events might appear because of their large magnitude, large numbers of fatalities, because they were Asia-Pacific events that affected New Zealanders, or they might have been reported because they were unusual. Further details (number of persons affected and economic losses) about these earthquakes are provided in Chapter 5 (Table 5.13). The 'Eq #' is the earthquake number shown in Table 3.7 above.

| Eq # | Selection Basis (20 earthquakes selected to represent international research attention with potential to influence New Zealand mass media 2008-2011) |
|---|---|
| 1 | Second most people affected 2005-2011. Most fatalities within the three years before 2008. Fourth largest magnitude globally 2005. |
| 2 | Second most fatalities 2005-2008. Fourth most people affected 2005-2011. Fourth most fatalities globally 2009. Asia-Pacific event - New Zealanders involved. |
| 3 | Second largest 2006 magnitude - largest near large population. Tenth most fatalities 2005-2011. Asia-Pacific event. |
| 4 | Most fatalities. Most people affected and most losses globally in 2007. Damage to 80% of structures in Pisco city. One of only two South American earthquakes in this dataset. |
| 5 | Second most people affected globally 2007. Asia Pacific event. |
| 6 | Largest New Zealand event (damage losses and fatalities) in the three years before 2008. |
| 7 | Most people affected 2005-2011. Most fatalities and largest magnitude globally 2008. Second most fatalities 2005-2011. |
| 8 | Second most fatalities globally 2008. |
| 9 | Unusual - African continent event. Fourth most fatalities globally 2008. Third largest magnitude for 2008. |
| 10 | Second most fatalities globally 2009 (European event). |
| 11 | Second largest magnitude globally and largest NZ event for 2009. |
| 12 | Fourth most fatalities globally 2009, Asia-Pacific event with New Zealanders involved. |
| 13 | Globally largest magnitude and Third most fatalities 2009. |
| 14 | Most fatalities globally 2009, Asia-Pacific event with New Zealanders involved |
| 15 | Most fatalities globally 2005-2011. Third deadliest on record all-time. Third most people affected 2005-2011. |
| 16 | Largest magnitude 2010 (sixth largest in terms of energy released on global record) and third most fatalities globally 2010. Fifth most affected people 2005-2011. |
| 17 | Second most fatalities globally 2010 |
| 18 | Asia-Pacific event with New Zealanders involved globally Third largest magnitude Fourth most fatalities 2010 (April 6 Sumatra event. Second largest magnitude, no fatalities) |
| 19 | Case study (unusual - multiple damaging earthquake events). Third most fatalities globally 2011. Sixth greatest financial losses ever (fourth 2005-1011). Fifteenth largest number people affected 2005-2011. |
| 20 | Largest event 2011. Fifth largest magnitude on record. Fourth most fatalities 2005-2011 |

Studying natural-hazard- and disaster-media has become popular in recent times. The number of academic papers referring to media content and 'natural' disaster studies was approximately 3-5 per year in the 1980s and 1990s. This has mushroomed in the past 3 years. Fifteen studies identified in literature review for this research were published in 2012.

Many of the earthqusake-related media studies were of media effects, and citizen surveys and content analyses were also popular (refer Appendix 6.2).

However the value of some of these studies to DRR or science- and risk communication research is questionable for the following reasons as detailed in Appendix 6.1.

- few studies clearly articulated the communication ideology or goal
- many of the previous content analyses discussed unproven media effects (assumed benefits for DRR)
- the few studies that considered framing of natural hazards and disasters either were rooted in old communication or DRR models
- previous research was not informed by researchers with a diverse disciplinary background and studies that included both communication and DRR researchers were rare - consequently while analysis may have been robust by media analysis criteria, it was not often theoretically robust in terms of science- or risk communication, and in particular DRR theory
- few studies considered both contextual and issue-specific factors relating to DRR; and it was
- rare for a study to consider the perspective of a range of stakeholders.

### 3.5.4 There were similarities and differences between this and previous research

The discussion in Appendix 6.1 provides the detail surrounding the following summary of points of similarity and difference of this research with other research into the media communication of natural hazards and disasters and associated risk reduction.

Roughly one third of the historic media, natural hazard risk and/or disaster studies were content analyses. This is one of many studies including content analyses that focused on earthquake (Appendix Figures 6.1 and 6.2). However, this research while pivoting around the Canterbury earthquakes of 2010-2011 has also considered multiple other earthquake events. Most other similar academic studies focused on one event only.

Studies by McClure et al. (2009), Miles and Morse (2007), Mileti et al. (2006), Pasquarè and Pozzetti (2007), and Turner (1982), may be said to combine multiple elements of framing research in DRR. These are the broadest approaches to DRR framing and frames identified in this literature analysis. However they do not begin to approach the systematic analysis adopted in this research as described in the following section.

This research used framing and both qualitative and quantitative methods (as literature review showed many other natural hazard- and disaster media studies did). However this study is rare in that it put goal framing front and centre of research. Also, research is one of only a few other studies e.g. Haynes et al. (2008) that investigated both contextual and issue-specific factors relating to natural hazard-related DRR-communication from the perspective of a range of stakeholders.

In the broader context of media studies of DRR this research has most similarity with Tierney et al's (2006) sociological study of Hurricanes Katrina and Rita which identified and examined:

a) the themes and timing of disaster-related media stories

b) journalist-constructed science and DRR stories

c) what public required of science and communication of the science - sources (mass media) etc.; and

d) the relative perspectives of different actors as portrayed in media, and comparing and contrasting these with the reflections of representative actors interviewed.

Review of research articles listed in Appendix Table 6.4 and 6.5 broadly found as did Pasquarè and Oppizzi (2012, p. 152), that:

> *Research on media reporting of natural catastrophic events and geo-hazards targets three major areas: 1) How the media report geo-hazards and disasters; 2) The differences between print and broadcast coverage of the natural extreme events; 3) The ways in which media messages are received and responded to by the audience.*

This research did not look at media effects (3), but instead considered how the media reports DRR (1), makes limited comment about differences and similarities between print and broadcast media (2) throughout results (Chapters 5, 6 and 7).

Researcher decisions about the body corpus, that is which media to study, are typically influenced by a choice to focus on media that are considered the most influential, or the most commonly used in everyday life. Those who look for research novelty consider less prevalent, popular or less frequently studied media channels. Time periods influence the corpus volume. As a result the time periods analysed reflect a combination of researcher resources as well as researcher interest.

### 3.5.5 This study analysed all [earth]'quake' articles or items over four years

As briefly mentioned in the previous section this study included all earthquake-related articles written in selected New Zealand media for two years before, and two years after the first Canterbury earthquake.

The media datasets in this research contain a mix of news and current events stories, opinion pieces, column pieces and editorials. Journalists from The Press, ODT, Dominion Post wrote most articles. Guest writers wrote some articles. Some articles rather than being attributed personally, were attributed as New Zealand Press Association (NZPA) stories, or world news attributed to AP Media or Reuters.

This study differs from one that is located solely within science and technology reporting. Rather, science and technology reporting is investigated as a subset of all earthquake reporting.

Many science communication-related studies limit the corpus analysed by only selecting material that makes specific reference to science or scientists (e.g. Dutt & Garg, 2000). This is satisfactory for studies that are concerned solely with the treatment of science or scientists. However where the reason for analysis is the issue itself, an issue-focused corpus is required. Earthquake-related issue frames are not constructed solely on coverage that contains reference to science or scientists.

Unlike Fu, Zhou, Zhang, Chan, and Burkhart (2012) articles were included that related to more than the primary earthquake disaster event (in this case the Canterbury earthquakes). This is so as not to exclude articles that relate to long-term or general earthquake warnings and ideas about long-term recovery that might be gained from articles about other events.

It is common to use search words to identify a corpus (e.g. Lan, 2009; Pasquarè & Pozzetti, 2007). A body corpus focused on the keywords 'disaster' or 'emergency' (cf. B. F. Liu, 2009) would not have obtained media reports relating to all earthquake-related issues including for example research. That said the keyword 'earthquake' used in this study would have not found generic preparedness messages, or those relating to other hazards unless 'earthquake' was mentioned.

Early investigation in 2010 showed that use of the keyword (earth)'quake' in searching on-line media sites directly generated more articles than searching LexusNexus and other databases for the same media. Therefore, for completeness, direct on-line searches were used to generate the articles and television broadcast items analysed. These in the main relate to the period April 4 2008 to January 4 2012. Articles on the Stuff website relating to the damaging 2007 Gisborne earthquake, and ODT and TV1 material to May 2012 were also collected and skimmed for qualitative insights but not included as part of the quantitative analysis.

The articles were screened and any duplicates or irrelevant articles[8] discarded. Where two articles were found to have identical body text but different headlines, only one was retained with note taken of both headlines.

### 3.5.6 Articles that only briefly mention earthquakes may still have powerful effects

Articles that included only brief mention of earthquakes were also retained as part of this study. A brief mention is where earthquakes are the subject of only one or two sentences in a short articles and one paragraph in a longer article[9]. The rationale for including passing references to earthquakes was that brief mentions may serve as powerful anchors, more powerful even than long explanations. Brief mentions still serve to construct and inform people's understanding of hazards, disaster or risk, even where earthquake is not the main topic. For example a mention in business news about an opportunity in earthquake engineering may have a powerful effect, even if there is little scientific or even DRR explanation per se.

There were two types of brief mentions coded in this research. One type was of articles that contain 'brief mentions' of (as distinct from articles focused on) earthquakes and discussed in section 5.3.4. The second type is the subset of any of the earthquake-related articles or television items that contain 'brief mention's of science (discussed in section 5.5.2).

### 3.5.7 TV and print are the most commonly analysed hazard and disaster media

Television and print media are the most commonly analysed in research of natural hazard- and disaster media; many historical studies looked at both print and broadcast coverage (Figure 3.1).

---

[8] Examples of irrelevant articles are those relating to the sports team San Jose Earthquakes sports team.

[9] An example of a 'brief mention' article is "Science show now not likely to tour" (Gibb, 2011). The articles told of disruption to the tour schedule of a Dunedin science and technology show as a result of the Port Hills earthquake on February 22 2011, but only briefly mentioned the earthquake and its consequences.

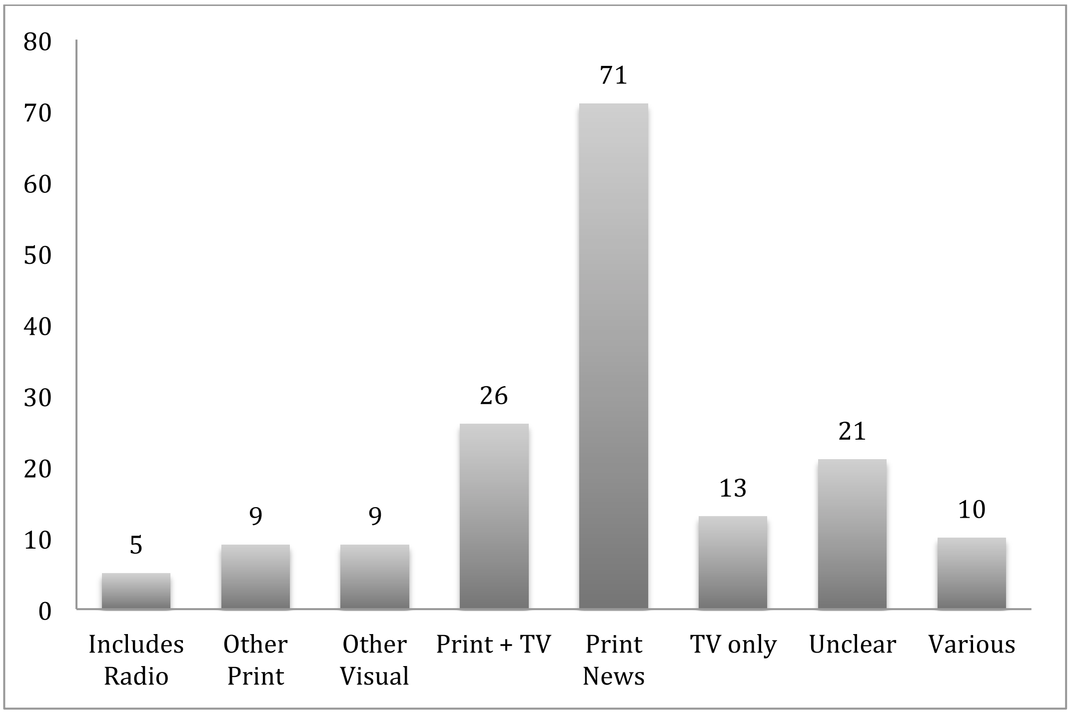



**Figure 3.1: Types of natural hazard media and disaster content previous studies analysed**

These are studies conducted between 1977 and 2012 n = 164 studies. Online versions of traditional print and television are included in those categories. The details of media analysed were recorded as 'unclear' in 10% of studies included in the dataset. These studies were typically qualitative, referring to media accounts in general and sometimes only making brief mention of content analysed. For details of the ten studies that considered a range of media types see Appendix Table 6.6.

The proportion of natural hazard and disaster media content analyses that consider both television (broadcast) and print media coverage is almost 16%. Literature review suggests that it is not though, as has been previously suggested, the differences between the two media that are the key focus of the research. Rather it would appear to be a desire to explore the two primary media channels; for example to find what key media narratives are similar in both television and print coverage.

Radio news programmes, fictional content of books and films and social media have featured less as topics of study. Researchers of DRR-related mass media content suggest that radio, televised and other film content should be examined more often (e.g. A. Anderson, 2006; Cottle, 2000; Ferreira, 2004; E. Hughes, Kitzinger, & Murdock, 2006; Spence, Lachlan, & McIntyre, 2009). Beaudoin (2007b) is one researcher who suggests that more media disaster content analysis should be of internet sources.

In keeping with the above recommendations this study analysed a rarely studied form of media content - women's magazines (section 3.5.10). Internet-based online content was also studied (online versions of print and television media is discussed in the section 3.6.9). The rationale for analysing content from the internet-based repositories of television and print media was because (with the exception of radio) television and print media are the most prevalently used by citizens in relation to natural hazards and disasters.

### 3.5.8 Media channel choices for this research were those most used by citizens

Past research indicated that from a wide range of possibilities, citizens typically use two channels, television and print media to gain information about natural hazards and disasters. Survey and interview in this research confirmed these findings as is discussed in more detail below.

Since the 1970s disaster researchers in different parts of the globe have canvassed citizens use of, and attitudes towards different media forms (Dillman, Schwalbe, & Short, 1980; Hiroi et al., 1985; Nara, 2010; Ohta & Kitao, 1977; Piotrowski & Armstrong, 1998; Singer & Endreny, 1987; Spence, Lachlan, & Burke, 2008; Spence et al., 2007; Turner, 1982; Turner & Paz, 1986; Yoshii, 1993). G. Su et al. (2008) found television, radio and newspapers (news and media campaigns) are the main channels for citizens to obtain earthquake-related disaster knowledge and coping skills. Different studies have found cultural anomalies or particularities though. For example magazines (popular science magazines not women's weeklies) and books have been referred to as the most credible sources of natural hazard information (Turner & Paz 1986). Yet this research has identified that magazines and books are not commonly referred to forms of information.

Researchers have variously argued that while certain media channels are generally more socially influential, others are more credible, or more widely utilized by certain groups of the population. Science- and risk communication researchers generally explore media use in terms of one or a combination of a) the time citizens typically spend on particular channels, b) the channels citizens indicate they have received information from or c) citizen preference for receiving information relating to the issue being researched. A variant of c) is to survey what channels of media are considered the most credible or trusted sources.

In this study citizen media use was identified through survey and interview. Results from survey of New Zealand citizens in this study confirm television and print media as the most frequently used sources of earthquake-science related information. This was as for two similar studies of citizens in the US and China and New Zealand (Table 3.9).

**Table 3.9: Comparison of three studies of the media channels used in DRR**

Note that for Wenger and Dykes (1975) percentages total more than 100 because respondents were allowed to mention more than one source of information when asked "From what sources have you obtained the greatest amount of information concerning natural disasters?" Respondents in Guobin's study were asked what their main channel of information after the Sichuan earthquake was. This study ranked the aggregated earthquake-related disaster and DRR information preference of NZ residents two years after the Darfield earthquake (Question 8 of survey).

| | Wenger & Dykes, 1975 | Guobin, 2008 | This Study (Rank) |
|---|---|---|---|
| **School age education** | - | - | 1 |
| **Electronic Media** | 74% | - | |
| Internet: website; online print news | - | 36% | 6; 7 |
| Television: documentary, news, ad | - | 34% | 2;3;5 |
| Radio | - | 4% | 9 |
| Cellular phone | - | 5% | - |
| **Other Media** | - | - | |
| Newspapers | 64% | 20% | 4 |
| Magazines | 15% | 1% | 11 |
| Discussion with others | 9% | - | - |
| Direct experience | 6% | - | - |
| Non-fiction books | 4% | - | - |
| Fiction, motion pictures | <1% | - | 12 |
| Community meetings | - | - | 8 |

Television, involving as it does, visual, as well as textual elements is considered to have a strong influence on social reality (T. Tyler, R. & Cook, 1984). Television is considered by citizens to be a more credible and expert source of information than print media, and being fast and efficient has been a primary news source, mass communication and education for decades, in general, and in relation to disasters (Altheide, 1976; Driscoll & Salwen, 1996; Paradise, 2005; Turner, Nigg, Paz, & Young, 1979; Wenger et al., 1975).

In terms of overall natural hazards and DRR knowledge radio does not show in surveys as a key source of information. Radio is however, often the only source of information for disaster 'victims', if the infrastructure that other media channels are reliant on, has been damaged. Radio is used more than television in a crisis situation (Dillman et al., 1980). Fu et al. (2010) found that in a disaster radio usage doubled from 12.7% to 29.1 %, newspapers use tripled from 5% to 14.6% and television usage dropped from 81.8% to 21.8% during a period without power, then went back up to 76.4%.

Surveys repeatedly indicate that citizens do not consider motion pictures and fiction books as being a primary source of natural hazard or disaster information (Wenger et al, 1975; Turner et al. 1979). This was also the case in the survey conducted as part of this research. However scholars who analyse film, fiction and literature, such as Weingart and Pansegrau

(2003), argue that these media are amongst the most socially influential. Quarantelli (1985) a renowned disaster researcher has similarly suggested that alongside news reporting much disaster and natural hazard risk-related belief stems from popular culture (films, novels, comic books, advertisements, songs, television and radio entertainment). Interview respondents from this study were in general particularly uncomfortable with any suggestion that they might be influenced by popular culture.

### 3.5.9 Online versions of print media and television broadcasts are the most commonly used sources of information

As introduced above this study analysed the online versions of print media news current affairs and opinion and television news broadcasts and documentaries.

In the past most content analyses have analysed print in its traditional, hardcopy form and major broadcast network news. Most disaster-related print media content analyses studied news articles, although some studies also analyzed opinion pieces. Ho and Hallahan (2004) analysed corporate advertising in newspapers and .

Nowadays, while television is still regarded as the number one medium for communicating about issues there is increasing mention of the use of the internet (Koolstra, Bos, & Vermeulen, 2006). The internet is viewed as a participatory place in the public sphere where traditional print and broadcast media co-exist with citizen journalists and citizens interested in particular issue, and all contribute to and distribute information (Habermas, 2001; J. Wang, 2010). Rather than print and television being one-way transmitters, they now, being digital, internet-based and interactive, allow citizens' involvement in the framing of social issues such as risk (Dahlgren, 2005; Mythen, 2010; Havidán Rodríguez & Dynes, 2006; J. Wang, 2010). S. Robinson (2009b, p. 809) referred to a *"co-production of collective memory"* through traditional reporters and citizen journalists. It has been suggested that younger people in particular do not read newspapers or watch television except on the internet (J. Wang, 2010).

Regardless of the demographic variation, *social media* are increasingly considered a primary channel, producing and disseminating communications about hazards and associated risks and disasters (Atwood & Major, 2000; Mythen, 2010). That said, old media, through effective use of the new media tool, the internet, are still the most commonly used source of information (J. White & King-Wa, 2012). The internet is not universally used however, or available, and particularly not to populations most vulnerable to disasters (e.g. Spence, Lachlan, & Burke, 2011).

Reflecting the rise of internet usage, ten per cent of the 162 articles reviewed have considered material sources from the internet. Examples are Conklin and Dietrich (2010), Dabner (2012), Smelik (2010) and Xiao and Li (2012). Earthquake-related content analyses that have considered online news are Balaji (2011), Kodrich and Laituri (2005), and Yingchun Li, Wu, and Zhao (2011).

### 3.5.10 Women’s magazines were also analysed; they are a recognised information source for health issues

It is rare for science communication, natural hazard-, or disaster-research to analyse the content of women’s magazines. This study was part of a growing number of studies that have studied popular culture or media other than print, television or radio.

Quarantelli (1985) noted that there is only a small body of literature that dealt with the representation of disasters in popular culture. Literature review conducted for this study showed that while in relative terms few scholars have looked at fiction, film and literature in relation to science communication, risk communication or communication of disasters or DRR, ‘other’ types of content have increasingly been examined; for example there have been studies of movies (Mitchell, Thomas, Hill, & Cutter, 2000), historical literature (Buescu, 2006), poetry (Inwood, 2011) and even graffiti (Alderman & Ward, 2008).

There seems to be little recognition in the research community that for some members of the population women’s magazines are a source of discussion regarding issues that science contributes to resolving. Yet women’s magazines (not popular science, or news magazines) were cited as the third ranked information source about health issues such as cancer prevention (Hoffmann-Goetz, Gerlach, Marino, & Mills, 1997). They are however rarely cited as an important source of information about disasters, risks and risk reduction.

Content analysis of women’s magazines in relation to any issue is also relatively rare. Examples in relation to health risks are smoking, cancer and tobacco advertising (Hoffmann-Goetz et al., 1997; Kessler, 1989; Slone, 2011). Few previous studies have been identified where there has been content analysis of natural hazard risks, disasters, or DRR issues in magazines of any type (Singer & Endreny, 1994). None of these were of women’s magazines.

This study sought to begin exploration of this under-researched area. It was rationalized that analysing women's magazine articles would provide an indication of the framing of DRR-issues and science's contribution to DRR, that those citizens who do not read online news articles or watch in-depth television are exposed to.

Having decided on the channel type a choice must be made as to which particular media to analyse. The reasons for choosing the particular media whose content was studied in this research are given below.

### 3.5.11 There were three main reasons for choosing which publications and broadcasters to analyse

Material from television, online print media and womens' magazines were chosen for analysis. The media chosen were:

1. Television New Zealand channel 1 (TV1) online content from tvnz.co.nz
2. (STUFF) online print media content from stuff.co.nz
3. Otago Daily Times (ODT) online print media content on odt.co.nz
4. New Zealand Women's Weekly (NZWW) hard-copy women's magazine
5. Next (NEXT) hard-copy women's magazine

Note that neither the NZWW nor NEXT magazine content is available on-line, so articles were identified by obtaining physical copies of the magazines from a library and perusing the contents pages of magazine issues in the time period analysed for content relating to earthquakes.

The rationale for the above choice is shown in (Table 3.10) and as follows:

1. media with the highest readership/viewership were chosen
2. the mix of local and national would allow analysis of any similarities and difference in framing between a) different media types b) media local or distal to the Canterbury earthquakes
3. same media (print and television) analysed by other researchers.

Television New Zealand's TV1 is one of two major New Zealand television news broadcasters. The Television New Zealand (TVNZ) website tvnz.co.nz, and print media website stuff.co.nz were the most popular news websites in New Zealand visited, respectively, each month by 48.5% and 52% of New Zealanders aged 18 and over

(HorizonPoll results Nationwide Poll July to August 2011). In the South Island the Dunedin-city-based Otago Daily Times (ODT) had the next widest readership. The print media publications and their websites served their surrounding regions also. In contrast the content of women’s magazines analysed in this study is considered a proxy of natural hazard, risk and DRR and DRR-science content available to those who avoid, ‘heavy’, technical or scientific writing.

The New Zealand Woman's Weekly (NZWW), published by APN and with a circulation of 82,040 in 2011, was in 2014 one of the country's most read women's magazines; read in the home and available in most waiting rooms around the country (Wikipaedia-NZWW, 2014). The magazine was described on its website as having some of the best known and loved columnists in the country, and bringing a wide variety of news, stories, recipes and helpful hints to its readers every week (NZWW, 2014). *Next* magazine was a monthly published by ACP Media. *Next* was described as being *“packed with New Zealanders' real-life stories, and expert health advice”* (Isubscribe, 2012). Although a less popular magazine than NZWW, it was selected to identify whether there are significant differences between different magazines containing similar content.

**Table 3.10: Rationale for media type analysed in this research**
This table shows the rationale for choosing to study the media datasets listed in the two left hand columns (described in Table 3.6). Sections 3.5.8-3.5.11 provide further details about the datasets.

| Website | Media | Media type | Location | Rationale |
|---|---|---|---|---|
| stuff.co.nz | Christchurch Press | High circulation print media | local/regional | local DRR science comparison with television (national) |
| | Dominion Post | | North Island (distal) | part of pre-Darfield comparison |
| odt.co.nz | ODT | | South Island (distal) | earthquake-DRR content whole time period comparison with television |
| | other minor | | distal - various | part of pre-Darfield comparison |
| tvnz.co.nz | TV1 | television | national | earthquake-research content whole time period comparison with ODT<br>DRR science comparison with STUFF (local) |
| n/a | NZWW<br>NEXT | Women’s magazines | national | Differences between earthquake-research and science content in magazines in ODT and on TV1<br>Science content comparison with 1000-STUFF- (local) and TV1 datasets (other national) |

The Christchurch Press was the local newspaper of the people affected by the Canterbury earthquakes. The on-line content of The Christchurch Press ("The Press") predominates on the Stuff website. The Stuff website also contains articles from another print media distal to Christchurch (the Dominion Post from New Zealand's capital city in Wellington, North Island. A smaller body of content on stuff.co.nz is from small local print media such as the Marlborough Express, the Southland Times, Nelson Daily Mail, the Waikato Times, and North Shore Leader.

The Christchurch Press being both the largest South Island print news media and located in Christchurch rendered it the obvious first choice for all print media analysis. However, searches on the Stuff website however do not present a date-ordered series of unique articles. It was therefore not possible to identify a dataset of 'all earthquake-related articles'. Requests to Stuff in 2011 to obtain a full list of articles within the budgetary limitations of this study were also unsuccessful.

However, searching the Otago Daily Times (ODT) website with the keyword earthquake does generate a complete data-ordered set of articles (n = 4836). The decision was therefore taken to collect and analyse the ODT content overall to assess the range of DRR-topic coverage and proportion of earthquake-related DRR-science content.

Analysis of the literature listed in Appendix Tables 4.1 and 4.2 shows that many previous media content analyses have included a mix of local and national media. It is recognised that provincial and local papers may record events that have been missed by the major papers (Wrathall, 1988). Needham and Nelson (1977) and Needham (1986) observed significant differences in the risk and disaster media content in local print media compared with large-circulation newspapers in major centres, particularly those distal to the location of an event or issue. Needham et al. used the terms 'cosmopolitan' and 'local' to refer to the different approaches or framings of issues and events.

An appreciation of what citizens might know of the sciences of DRR was gained from analysis of the 1000-Stuff, TV1, and women's magazine datasets (NZWW and NEXT). It is possible to identify what percentage of the total earthquake-related articles contain at least mention of evidence-based information and/or scientist sources in both the television and women's magazine article datasets.

The rationale for time frames of analysis for all media analysed are discussed in the following section.

### 3.5.12 Media datasets covered content before and after the Darfield earthquake to include all phases of the DRR cycle, including recovery

Decades ago Rogers and Sood (1980) suggested that it is important that pre-disaster content is analysed. Given recognition of the importance of all four phases of DRR cycle, by extrapolation this suggestion should extend also to long-term recovery, and beyond to inter-disaster content.

Material selected for analysis in this research was items and articles written or broadcast by New Zealand print or television media and posted on-line in the period 01 April 2008-31 December 2011. Selection of this long time period, although problematic in terms the volume of material to be analysed, allowed a long-term view of the mass media portrayal of disaster, and earthquake-related knowledge and its application to DRR (Table 3.11).

Where there are large volumes of articles identified this may place restrictions on the time frame chosen. Research time frames may also restrict how long after a specific recent event that media can be analysed. Few other previous media studies concerned themselves with long time frames, or analyse disaster recovery (Appendix Tables 4.1 and 4.2). Most previous disaster-media content studies are of post-event coverage lasting for a period of weeks to months[10]. For this study, the only way of commenting on coverage of long-term recovery was in relation to coverage of international earthquake events and event that occurred in New Zealand before or during the Canterbury earthquakes.

**Table 3.11: Rationale for time period over which media datasets were collected**
For detail see Table 3.6.

| Analysis period | Aspect of study | Media dataset |
|---|---|---|
| April 4 2008-Sep 3 2010 | Pre-Darfield earthquake (readiness, reduction) | TV, ODT, STUFF-PRE, NZWW, NEXT |
| Various - after Canterbury and International Events | Response | TV, ODT, 1000-STUFF, NZWW, NEXT |
| As above and below | Short-term recovery | As above but not 1000-STUFF |
| Various relating to International events and New Zealand pre-Canterbury events (e.g. Gisborne) | Long-term recovery | ODT, STUFF-PRE, TV, NZWW, NEXT |

[10] The research reported in Nigg (1982) and Turner (1982) was the most comprehensive time-wise, of any of the studies listed in Appendix Table 4.1 and 4.2; both studies covered a 3-year-period. Ashlin and Ladle (2007) covered 19 months, but only in respect of environmental coverage. While Seid-Aliyeva (2006) refers to four years' of earthquake-related articles the results are not discussed in any detail. Wilkins' (1986) justification for selection media articles from a short 2-month period was that it covered the recovery period. This is not considered valid given that disaster recovery is a long and complex process that may take decades.

### 3.5.13 Full rather than representative datasets were analysed

Numbers of research and on-line print media articles and television items that remained for analysis after screening are shown in Table 3.5 and Table 3.6. These are large full datasets rather than representative selections. The datasets analysed in this study are amongst the most voluminous compared with other natural-hazard- and disaster-media content analyses (see Appendix Tables 4.1 and 4.2). Some media content analyses refer to, or analyse only a few media articles in detail, others, tens, hundreds or even thousands. Most media content analyses reviewed relate to tens for qualitative to hundreds of articles for quantitative analyses.

In total 95 hours and 5 minutes of television broadcast coverage (TV1) was identified from the TVNZ website using a search with the keyword [earth]'quake' for the three years from April 2008 to December 2011. Removing the live stream rolling coverage that contained much repeating of segments, the coverage total was 83 hours. Note though that only 4.8% (4 hours 34 minutes) of the total content was from the 17 months prior to Canterbury earthquake. Comparison with past studies is not possible as they have not been explicit about the number of hours of content analysed. Over 80% of the total of 1407 television broadcast items were between one and five minutes in length (Figure 3.2).

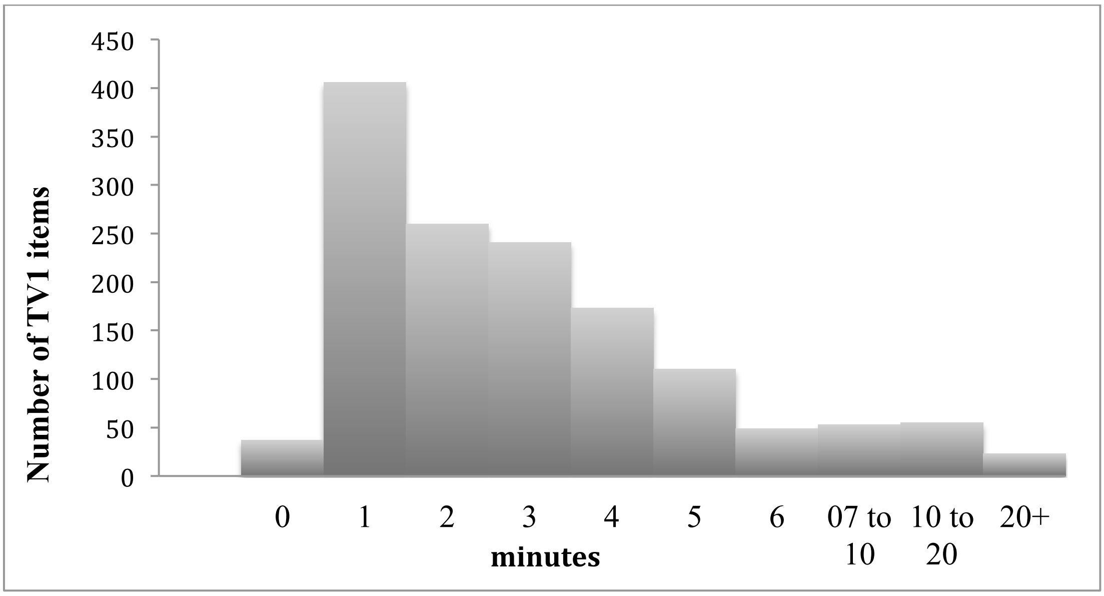



**Figure 3.2: Duration of earthquake-related television items – this reseach**
Duration of 1407 earthquake-related television items broadcast between April 2008 and December 2011.

There were approximately 50 items each 6 minutes, 7-10 minutes or 10-20 minutes in length. There were 23 television items greater than 20 minutes' duration. If items over five minutes in length are considered to be long enough to cover a topic in some depth and provide multiple-source comment there were potentially approximately 170 opportunities for this to occur.

#### 3.5.14 On-line comment was skimmed and qualitative reflections added to discussion in results chapters

On-line citizen comment below media articles is also a valuable resource for understanding citizen knowledge and their perspectives on how, scientists and policy-makers communicate and use science knowledge in DRR, and how they themselves can and are using it. For reasons of scope and time, citizen comment on the articles was not examined beyond an initial qualitative reading. Some reflections based on that initial analysis of citizen comment are however made in the results chapters.

-blank-

## 3.6 Frame development and coding – media analysis steps 4-10

### 3.6.1 Systematic ways of measuring earthquake-related content influenced coding

The aim in coding in this study was to find a systematic way of measuring earthquake-related science and earthquake-related DRR-communications in both academic research and the media.

Comparative and longitudinal studies are useful in any field of study, and are recommended for media and risk research by Bakir (2010). Literature review showed that there is no standard approach to content analyses of hazards, risks, or disasters or ways of reducing their effects.

Nisbet (2009, p. 14) noted that scholars of science communication exhibited a *"tendency to reinvent the wheel in identifying and labelling"* codes and frames. Similarly literature analysis has shown that previous natural-hazard- or earthquake-disaster-media content analyses have rarely applied or discussed frames that had an issue-specific theoretical basis. Previous media analyses could be described as either, qualitative or general and unsystematic in the application of frames or lines of argument. This meant that it was almost impossible to compare media studies of disaster or even particular disaster types across all four phases of the DRR cycle, let alone compare and contrast disaster studies relating to different risks or different hazards. While this is a matter that has not been widely discussed in the literature, some have made passing reference to the problem.

Lan (2009) referred to categorisation of what they termed 'focus points', which one might interpret as topic or issue frames, as not having been 'rigidly logical'. Houston, Pfefferbaum, and Rosenholtz (2012) who researched frames and frame changing in US disaster news called for utilization of their framing schemes. Houston, Pfefferbaum and Rosenholtz's frames might have been an easy option for coding. However it is not a theoretically robust option. For example their coding framework is focused on the response period and coding categories were combined simply for ease of coding, or unspecified, non-DRR-theory-based reasons, for example see note 39 in Houston et al. (2012). Houston, Pfefferbaum and Rosenholtz's recommendations for disaster news have been incorporated into the discussion in following chapters, for the above reason their coding has not.

In this study the core coding categories are theoretically based and are applicable to multi-hazard disaster topics (not only earthquakes). A constant comparative method within and between the data-sets generated cf. Boeije (2002) was applied to identification of important factors in DRR science communication. Code sets developed relate to conceptual communication issues, DRR issues, as well as a range of issue-specific DRR framings.

Code categories were constructed from scholarly and grey literature on the topics, and allowed to emerge from pilot study of the articles. The codes are the product of three separate iterations, 1) distilled from theoretical/research knowledge, 2) derived during initial coding of media content, and 3) derived on coding and analysis of survey results. Subtopic codes have been developed, where possible from other studies to enable discussion about issues of 'absence' or 'bias' that have been raised in previous studies.

The following sections of this chapter describe and background the frame types that are discussed throughout the three results Chapters 5, 6 and 7. For example the details of event frames are present in Chapter 5.

Frame (code) type descriptions are provided in the sections and Tables or Figures as identified in Table 3.12.

### 3.6.2 Frame types; news story, event, issue, procedural and substantive and interpretive frames

This research has analysed for story-, event-, issue-, procedural-, substantive- and interpretative-frames as are described below. This combines media and scientist approaches to analysis and understanding of what is communicated in the media about a particular issue.

There are many different types of frames that may be analysed. Media and communication researchers tend to consider what are variously referred to as 'news frames', 'media frames' or 'story frames' (Price et al., 1997; Valkenburg, Semetko, & Vreese, 1999). Science- or risk communication researchers may focus instead on 'issue frames' (Nelson & Willey, 2001). Issue frames are related to the representation of a particular topic, or subtopic. Examples might be DRR in general, maladaptive behaviour in disaster, or disaster recovery progress. When considering an issue researchers may analyse 'procedural frames', 'substantive frames' (Entman, 2004) or 'interpretive frames' (Porto, 2001). Procedural frames relate to evaluations of a character's legitimacy, for example the expert status of scientists. Substantive frames relate to problem definition, identify characteristics, consequences and cause, thereby often imply or describe blame, responsibility (moral judgment) or identify or endorse solutions - remedies or improvements. Interpretive frames link knowledge with suggested changes to perceptions or actions (Porto, 2007a). Another

**Table 3.12: Frame and code descriptions and basis – this research**

A range of theoretically robust frame types were considered in this research; once developed they became 'codes' for analysis (left hand column). Code descriptions, and where applicable examples, are provided as indicated (middle column). Key related results are provided in the right hand column.

| Coding/frames | Where coding description provided | Results tables and figures |
|---|---|---|
| **Survey/interview respondents** | | |
| Survey & interview respondent demographics | As per interview questions and table description Table 3.1 | Table 3.1 and 3.3 |
| Survey & interview respondent education, DRR and science background | Table description Table 3.2 | Table 3.2 |
| **Science and risk issues** | | |
| Stakeholder groups in science and risk issues and the media | Figure 2.2 in section 2.3.4, and more detail in section 3.5.8 including Table 3.9 | Table 5.40, 7.3 and 7.7 ( re DRR) |
| Environments in science and risk issues | Figure 3.5b and section 3.6.6, Appendix 9.2a | Figure 7.4, Table 7.13 |
| Problems in risk communication/citizen needs in DRR communication | Table 2.6 describes the five problems groups (Rowan's risk communication problems) so that these could be used to code reasons respondents gave for needing science communicated | Table 4.1 / Table 4.3 |
| Type of science mention (scientists, institution or other) | See table description Table 5.33 and see also science/scientists/experts section of Table 3.13 | Tables 5.30, 5.33-5.35 |
| Science institution mention | See table description Table 5.30 and see also science/scientists/experts section of Table 3.13 | Table 5.30-5.32 |
| Expertise | Table description Table 5.36 | Table 5.36 |
| Role of science | Keywords and groups as in Table 5.37 and Appendix Table 9.5 | Table 5.37 |
| Portrayal of science and scientists | Table 5.38 and examples in Table 5.39 | Table 5.38 |
| **DRR** | | |
| Phases of the DRR cycle (4Rs) | Figure 2.6, Appendix Table 9.1 | Table 2.5, section 7.3.1 (Tables 7.4), Tables 7.14 and 7.15 and Figure 7.1 |
| Disciplines involved in DRR or media research | Described in section 3.6.4 including through Table 3.13 | Table 3.9, Table 5.35, Figure 5.7, Figure 6.1-6.4, various tables in chapter 6 (Tables 6.1 and 6.3-6.30) |
| DRR communication topics (12) | As per Figure 3.4, detail in Appendix Tables 9.2a)-c) and 9.3 | sections 7.3.2-7.34 (Tables 7.5 and 7.6, Figures 7.2 and 7.3) and Appendices 16.1-16.7 |
| Whether scientists consider themselves DRR advocates | Table description Table 5.40 | Table 5.40 |
| Disaster cause hypotheses (groups and subgroups) | Table description and Table 7.8 itself - examples in Table 7.9 | Table 7.10 and 7.11 |
| Attribution of responsibility | Table description - Table 7.2 | Table 7.2 |
| **Media articles** | | |
| Media channels/medium | Table 3.9 itself and Figure 3.1 | Table 3.9 and Figure 3.1 |
| Media article or broadcast types | Tables 3.10, 5.22 and 5.23 - body and table description | Table 3.10 |
| Whether data is pre or post Darfield earthquake | Before, or on or after 04 September 2010 when the Darfield earthquake occurred | As noted in Tables and Figures |
| Whether academic or media articles contain only brief mentions of earthquake | section 3.5.6 | Table 5.19-5.21 and 5.23 and 5.24 |
| Media coverage - international and New Zealand earthquakes or both | Table 5.9 | Table 5.9 |
| Media articles relating to multiple events | Table 5.10 | Table 5.10 |
| DRR-related media story categories, groups and types | Tables 5.12-5.16, Appendix 9.3 and Appendix Tables 9.4a-j) | Figure 5.3, Tables 5.18, 5.22-5.26 and Appendix 12 |
| Story cycle types -DRR science | In Figure 5.7 - developed from disaster and science and risk story types as shown in Figures 5.5 and 5.6 and referenced in Table 5.29) | Figure 5.7 |
| **Media research** | | |
| Researcher or media location | Table description Appendix Tables 6.3 and 6.4 | Appendix Tables 6.3 and 6.4 |
| Study types for academic articles about eq-related media | Table description Appendix Table 6.2 | Appendix Tables 6.2, 6.5 and 6.6 |
| **Events** | | |
| Hazard types in disaster media studies | Figure descriptions (Appendix Figures 6.1 and 6.2) | Appendix Figures 6.1 and 6.2 |
| Earthquake events in research database | Table description - Table 3.7 and 3.8 | Appendix Tables 7.1-7.3, Table 5.11 and Figure 5.4 |
| Earthquake events in media - disaster, occurrence, historic or future | Table description - Table 5.2, Table 5.7a) - c) | Table 5.2, Table 5.9 |
| Earthquake events (names) in media articles - date/location | Table description - Table 5.3 | Table 5.3, Tables 5.7a)-c), Figure 5.1 and 5.2 |
| Multiple events (media or research) | | Table 5.10 and Appendix Table 7.3 |
| Disaster types that triggered earthquake articles | Table description - Table 5.4 | Table 5.4 |
| Event related harms, other issue, and issues with no event in the media | Table description Table 5.1, section 5.2.2 | Table 5.1 |
| Science events - earthquake related | Part of Figure 5.5 | Table 5.5 |
| DRR-science communication events | Table description Table 5.7 | Table 5.6 |

-blank-

set of frames that some researchers consider are ‘event frames’. These relate to the events that trigger stories.

Event frames have equivalence with ‘news pegs’ (Cooper & Yukimara, 2001). Event frames relate to the events that trigger stories. However, depending on researcher interest these may be one or a combination of different types of events. The events might be hazard occurrences (e.g. small earthquake events that cause little or no damage), disasters (large-earthquakes near population centres that cause a lot of damage), or a warning about a future event. Two more sets of events frames that have been identified in this research are ‘science-related event frames’, or ‘DRR-related event frames’. The tables in section 5.1 show the prevalence of event frames in the New Zealand mass media.

Literature review showed that there is no common or standard way in which story, event or issue frames have been coded in relation to science, risk, or disaster. This discussion continues in results section 5.2 where observations are made relating to New Zealand media coverage of earthquakes, science events and DRR events.

A significant part of this research project involved finding ways to find other common or standard frames relating to natural hazard, disaster, risk or DRR-related content as is discussed in the following sections. Frame sets (codes) were developed to hold regardless of the corpus analysed; for example whether the dataset was DRR-related academic journal article and conference presentation titles or the dataset was mass media research papers, or media headlines.

### 3.6.3 Character framing; who is the audience or communicating, who is blamed for disaster, who is responsible for DRR, and how the characters are portrayed

Character framing is an important part of understanding any issue and its resolution. Table 3.12 shows the key groups and subgroups of stakeholders in DRR as referred to throughout this thesis. Stakeholders are the ‘characters’ involved in communications as was introduced in the previous chapter.

Issues of public significance, and in particular risk issues are often discussed and analysed in terms of the perspectives of four key ‘stakeholder’ or ‘social actor’ groups as was introduced in section 2.2.17.

The groups are 1) scientists/experts 2) authorities 3) media and 4) other citizens as shown in Table 3.12. In this thesis as in other research authorities are also referred to as policy - and decision-makers (political or administrative, including planners. Citizens are alternatively referred to as 'residents', 'the public' or the 'lay public' (Hampton, 2009; Kornelis et al., 2007; Perez-Lugo, 2001). Advocates, and industry or business are other groups sometimes referred to. Meanwhile scientists, and policy-and decision-makers are sometimes collectively referred to as 'elites' (e.g Haynes et al., 2008). Scientists are considered in this research to be, as Besley and Nisbet described them;

> *individuals from across science-, medical- and engineering-related fields, working in research and non-research positions, holding varied levels of post-graduate degrees, and employed across the university, government, non-government or industry sectors*.
> (Besley & Nisbet, 2011, p. 2)

This is a broad definition of science and scientists. Rather than including only academics engaged in laboratory experiments this definition is one that acknowledges scientists as professionals and practitioners, applying evidence-based information at the science-society interface.

Character frame analysis is typically undertaken for one or more of four reasons. Those four reasons are to understand; 1a) *who* the communicator(s) are 1b) who is or is not portrayed in communications 2) *how* those characters are portrayed and 3) who is attributed with responsibility (blamed) for problems; 4) who is attributed with responsibility for solutions. 'Responsibility for solution' framing is a relatively recent type of frame analysis.

In this research attribution of responsibility has been split into three; i) characters charged with responsibility for disaster problems ii) characters charged with responsibility for DRR solution(s) and iii) characters charged with responsibility for science-, risk- and DRR-communication problems and solutions.

Silverstone (1991) reminded us that each of the character groups are heterogeneous. The individuals with them have just that, individual characteristics. Yet scholarly articles rarely identify how to code stakeholders with mixed roles when analyzing texts. Some scientists and professionals are involved in policy advice. Some might classify community leaders as policy- and decision-makers. However they could be classified as citizens, or as a fifth group, advocates (Perez-Lugo, 2001). Media sources may focus on their professional or disciplinary considerations, emphasise DRR advocacy, or both. Health, engineering and architecture professionals may or may not be involved in advocating for DRR.

The approach taken in this research was to code, or make qualitative comment as per the primary role as reported in the media. Within the four social actor groups there are many different ways of further categorizing the individuals, organization or institutions. For example media personnel may be separated into journalists and editors or television anchors and reporters. Other examples as used in this research are the sup-groups presented in the right-hand column of Table 3.13.

**Table 3.13: Stakeholder/actor subgroups in DRR.**
This table extends the groups shown in Figure 2.2. Scientist groups are extended from those in (Cottle, 2000). Yang's (2010) grouping of domestic government, domestic non-government, and international government were considered but not applied in this research. Development of source codes was also influenced by others' work on media and disaster. For example Hornig et al. (1991), Masel-Walters and Hornig (1993), and Ashwell (2011)'s discussion of stakeholders in relation to portrayal of GM-related science in New Zealand.

| GROUPS | SUBGROUPS |
|---|---|
| SCIENCE/SCIENTISTS/EXPERTS | (*NZ/International*)<br>Academic<br>Professional - consultants/small private business/ including small health providers)<br>Professional - large business (incl. bank or district health board)<br>Professional - group<br>Government – (Crown) research institute (CRI)<br>Government – regulatory (officials) with primarily technical role<br>NGO |
| AUTHORITIES (POLICY and DECISION-MAKERS) | (*Central, regional or local Government*)<br>Elected representatives<br>Public servants (primary role is not technical even if qualifications in science)<br>Other authorities including emergency management professionals) |
| MEDIA (journalists, editors, producers) | Broadcast – online - television<br>Print – online daily<br>Women's magazines |
| CITIZENS (Individuals or groups) | NGOs (non-scientists, not for profit, or associated with government function e.g. lifelines or schools<br>Business owners/groups (incl. lifelines or school)<br>community) organisations – as aid or recovery advocates<br>Business owners/groups (incl. lifelines or school)<br>Community (generic not named group)<br>Individuals-residents<br>Individuals-unaffected citizens<br>Individuals-foreigners |
| UNSPECIFIED | |

It was typically unclear whether CEOs and other 'Managers' (e.g. from local or central government) who often front media questions have a science background or not. For consistency individuals whose primary role was not research were not coded as scientists.

Science or scientists may also be defined in terms of the disciplines they work in so an alternative subgrouping is of scientific disciplines. The detail of how the disciplines relating to DRR have been classified is presented in the following section 3.6.4. For a list of scientists and experts who commented about science or were mentioned in earthquake-related science articles in the 1000-Stuff and TV1 databases see Appendix11.

The science-related ‘characters’ in earthquake-related-science stories in the New Zealand media were identified from the 1000-Stuff print media dataset, and a subset of the TV1 dataset (section 5.5 and chapter 6). However only a brief discussion of results relating to all the characters that have discussed earthquake-related science is presented (in section 5.7).

No previous research has developed a code framing for all DRR characters identified as responsible for DRR actions or for identified disaster causes. The development of the coding framework and frames are presented in section 7.4 (cause/blame). DRR characters identified as responsible for DRR are presented in section 7.2.

### 3.6.4 The ‘sciences of DRR’ (discipline codes) have been identified for the first time

Table 3.14 summarises the disciplinary groups and sub-disciplines involved in DRR research as developed in this research.

Sciences across a wide disciplinary spectrum contribute to DRR solutions, and it is widely recognized that integration of the knowledge generated by all of these disciplines is required for successful DRR (section 2.5.8). However, generic mentions and generalized lists aside, literature review has shown that there has never been a detailed review of the disciplines involved either in DRR research itself, or for DRR media analysis; there has never been a systematic review of what the ‘sciences of DRR’ are.

The disciplinary groupings shown in Table 3.14 were derived from initial immersion in earthquake-event-based datasets to mirror the media’s event-based approach; the earthquake-research and media datasets (Tables 3.5 and 3.6 respectively). Web of Science or Scopus disciplinary categories were initially considered as disciplinary frame categories. However those bibliometric units are not only numerous and therefore unwieldy in terms of coding, but are based on the journal in which the article was placed rather than the scholars’ background or the topic of the article. For example the journal Acta Seismologica Sinica rather than relating purely to seismology contained earthquake-related articles on engineering and geotechnical topics, atmospheric precursors and earthquake-related casualty figures.

The groups in Table 3.14 enabled and served as the basis for quantifying or coding and qualitative discussion of the disciplinary framing. These code groups may be used whether

**Table 3.14: The sciences of DRR**

Disciplines in italics are illustrative detail, part of the group named in the line above/before. Note that psychology does not appear as a single discipline. For more detail see Appendix 8.1.

| Disciplinary Grouping | Sub-Disciplines/Subtopics |
|---|---|
| BUILDING | Architecture (structural design)<br>Sustainability science<br>*Construction,* Materials science<br>Structural engineering – Design/construction for buildings and infrastructure<br>Technology (not IT, GIS or remote sensing (RS)) |
| COGNITIVE & BEHAVIOURAL | Social psychology<br>Sociology/Social anthropology (*Cultural studies*)<br>Crime science |
| EARTH & PLANETARY | Atmospheric science (hazard-related)<br>Geology/Physical geography/Hydrology<br>Oceanography<br>Seismology (*Geophysics*) |
| ECONOMICS | Financial/Markets, Insurance, Property, Tourism, (Other) Business & Industry, Employment |
| ENVIRONMENTAL (see also below MULTI-/INTER) | Botany, Ecology, Hydrogeology, Zoology, Biological science, Coastal science, Sustainability science, Environmental engineering |
| GEOTECHNICAL | Geoscience + Engineering<br>Earth observation technology<br>Geospatial information technology |
| HEALTH | Emergency medicine (including *Pharmacology*)<br>Forensic sciences (Dentistry, Epidemiology, Forensic Anthropology, Pathology)<br>Clinical psychology/Psychiatry<br>(Other) Public health<br>(Health) Technology/IT non-disaster specific |
| INFORMATION, DECISION & MANAGEMENT | Information science<br>Management science<br>*Other* Communication science |
| PUBLIC ADMINISTRATION & POLITICAL | (Leadership/Management-governance, Economic policy, Legal/Social-other legislation & compliance), Communication in crisis/Public policy & relations) |
| URBAN DESIGN & PLANNING | Planning<br>Landscape design<br>Urban design |
| INTER-/MULTI-DISCIPLINARY | Risk research or Disaster research (focus on effects, or 4Rs |
| OTHER | Archaeology/Heritage/Historical restoration<br>Mathematics/Statistics<br>Resource sciences-*Agriculture, Forestry, Energy*, Veterinary science<br>Science & Technology studies /Sociology of Science/Applied science |

the body corpus (dataset) analysed is DRR research, media content and survey and interview responses.

The wide range of disciplinary approaches to DRR-related research was quantified by recording the disciplinary groups and sub-disciplines of the earthquake-research dataset is discussed in more detail in Chapter 6. Also reported in Chapter 6 are the results of quantitative content analysis of both the scientist sources present in media broadcasts or the body text of media articles, and of the science discipline headline topic focus.

Psychology is primarily split between a) health science where it relates to the psychosocial effects of disaster; and b) in relation to cognitive science and behavioural/social psychology in DRR. Psychology research may also be part of crime science. Africology has been coded as cognitive and behavioural-anthropology. Communication includes media studies, risk-, science communication, public understanding of science. International studies were coded as ‘public administration and political science’.

The term ‘disaster researcher’ has been used with some reticence in this thesis to describe those researchers who both understand DRR and bring another quite different disciplinary background to study DRR. This reticence is because of the emphasis on disaster, the problem. However these researchers often approach DRR from a multi-disciplinary perspective or lead research teams that draw experts from a variety of disciplines.

### 3.6.5 There are twelve topics to be communicated in DRR (see the ‘DRR wheel’)

An aspect of risk communication that has been rarely canvassed or discussed is just what DRR topics are, or should be communicated. Categorising DRR knowledge seems particularly important where *complete* or *comprehensive* communication is considered an ideal (cf. section 3.1.1). Earlier discussion has shown that DRR covers a diverse range of topics. Therefore a significant challenge in this research was the need to distil a complex issue, DRR, into a representative set of key topics.

A rather extreme example of why this is important, is that the measure of whether citizens had appropriate ‘earthquake knowledge’ used by Tekeli-Yeşil, Dedoğlu, Braun-Fahrlaender, and Tanner (2010) was that they: *“gave a scientific explanation as the cause of an earthquake, and being able to give at least 2 measures of ‘how to behave in an earthquake’”*. This cannot be said to have tested a wide range of earthquake-related DRR knowledge.

There have been very few typologies of mitigation possibilities created by academic researchers. Although a wide range of ‘interventions’, or possibilities in DRR are recognised (Chapters 2 and 3) compilation of these does not really exist. Mileti, Fitzpatrick, and Farhar (1992a) acknowledged the wide range of disaster reducing interventions possible but did not group them. Some media research studies appear to have haphazardly chosen a small range of frame types to discuss (e.g. Borah, 2009; Choi & Lin, 2008; S. Robinson, 2009b). Some researchers mentioned a fairly comprehensive list of topics (e.g. Hiroi et al., 1985; B. F. Liu, 2009; Needham, 1986). However, in each case missing topics can be identified. Understanding the basis for the frame categories is also difficult. Other studies refer to having analysed for main ‘themes’ or ‘frames’ however these are better described as story frames rather than topic frames (e.g. Caldwell, Clark, Clayton, Malhotra, & Reiner, 1979; Fu et al., 2012; Kodrich & Laituri, 2005; McKay, 1983; Needham & Nelson, 1977; Souza & Martínez, 2011; Wilkins, 1985). The first of the small body of researchers who summarized disaster topics or media disaster frames was Kreps (1989). Kreps’ list is presented in Table 3.15 along with review notes from this study that illustrate the development of the coding used in this research.

Any of the lists or frames by the authors mentioned in this section might have been useful as a basis for a purely theoretical, or academic discussion. However, none of the lists had a clear intersection with disaster research theory, let alone risk management practice. In an attempt to remedy this various aspects of theoretical ‘comprehensiveness’ introduced in the definitions in the previous chapter were integrated. These include the ten frame-types shown in Table 2.1. A holistic and integrated approach requires communication of different stages of risk analysis, from risk identification, perception, assessment, evaluation and action (section 2.4.4), in all four phases of the DRR cycle (section 2.5.2) and in relation to various risk reduction actions (section 2.2.14). Each of these has been considered and integrated and then reduced to as few topics as possible. Immersion in the four main datasets (1-4) described in section 3.5.2, and a constant comparative method (cf. Boeije, 2002) resulted in a progressive distillation to twelve key DRR topic areas.

Development of the ‘DRR topics wheel’ comprising these twelve key DRR topics occurred through literature review of DRR, media content analysis and coding of the earthquake-related-research dataset.

The wheel might appear to have similarities to Alexander (2007). However the wheel was in fact most influenced by the wheel concept attributed to a personal communication in

**Table 3.15: Example of a historic compilation of DRR topics**

Adapted from Kreps, 1989 Table 3 p227 'domains' of disaster research. The column headed 'Notes – this study' are notes made on reviewing Kreps' compilation including aspects of DRR identified as missing from Kreps' compilation. This table was used to develop DRR-topics-code for this study (right hand column). Krep's domains show the clear emphasis on authorities' planning and preparation and 'command post' in response phase of DRR as fitted the dominant paradigm in DRR at the time of publication (1989).

| | Topics identified in Kreps (1989) | Notes – this study | DRR Code |
|---|---|---|---|
| 1 | Hazard-vulnerability analysis | | 1, 2 |
| 2 | Maintenance of stand-by human materials and resources | Household and community as well as authorities | 6 |
| 3 | Disaster preparedness, planning and training | Individual, household, community, business, organizational, governance, emergency management | 6 |
| 4 | Public education | Communication re evidence basis for DRR options | 6 |
| 5 | Hazard mitigation-structural | | 3 |
| 6 | Hazard mitigation-non-structural | Contents (3) land use (6) legislation (6) | 3, 6 |
| 7 | Insurance | Risk transfer | 6 |
| 8 | Issuance of predictions and warnings | Scientific forecasts and advice | 2 |
| 9 | Dissemination of predictions and warnings | Communication | 6 |
| 10 | Evacuation | Reaction to risk | 6 |
| 11 | Protective action | Drills-readiness/actions for response | 6, 9 |
| 12 | Mobilization of emergency personnel and resources | Aid not separately mentioned | 9 |
| 13 | Search and rescue | Part of Kreps 12 | 9 |
| 14 | Medical care | | 9 |
| 15 | Care of fatalities | Also victim identification? | 9 |
| 16 | Providing victim basic needs | Shelter/housing, food, water | 9 |
| 17 | Damage needs and assessment | | 8 |
| 18 | Damage control | Safety assessments and restricted access | 8, 9 |
| 19 | Restoration of essential services | Infrastructure repair/restoration | 9, 11 |
| 20 | Public information | Crisis information | 7,8,9 |
| 21 | Traffic control | Part of co-ordination and control | 9 |
| 22 | Law enforcement | Part of co-ordination and control | 9 |
| 23 | Local governance | Legislation, policy and involvement in all levels of governance (including assessment): codes (6) plus 8, 9, 11, 12 | Mult. |
| 24 | Co-ordination and control | Emergency management | 9 |
| 25 | Reconstruction planning | | 11 |
| 26 | Reestablishment of physical structures | | 10-12 |
| 27 | Reestablishment of economic functioning | | 10-12 |
| 28 | Resumption of other social institutions | | 10-12 |
| 29 | Determining liability for the event | Cause of disaster (4), responsibility, inquiries, inquests (5) | 4, 5 |
| 30 | | Review of DRR options (5) and application of lessons learnt (1-12) | 5 |

Southern (2009). The latter wheel and Kreps' list above are both based on key concepts in DRR from the 1970s and 1980s when an authorities-focussed 'command post' response to disaster was favoured (Quarantelli, 1975, 1981).

This is just one of the significant differences in the wheel as constructed here. The main difference is that the structure of the wheel itself is based on current concepts and definitions from risk, disaster and of DRR research were introduced in the previous chapter. Disaster risk reduction can be conceived as involving:

a) activities in all four phases of a conceptual DRR cycle; and

b) a three-stage process of risk identification, risk analysis/evaluation and risk management in each of those four phases (as shown in Figure 3.3).

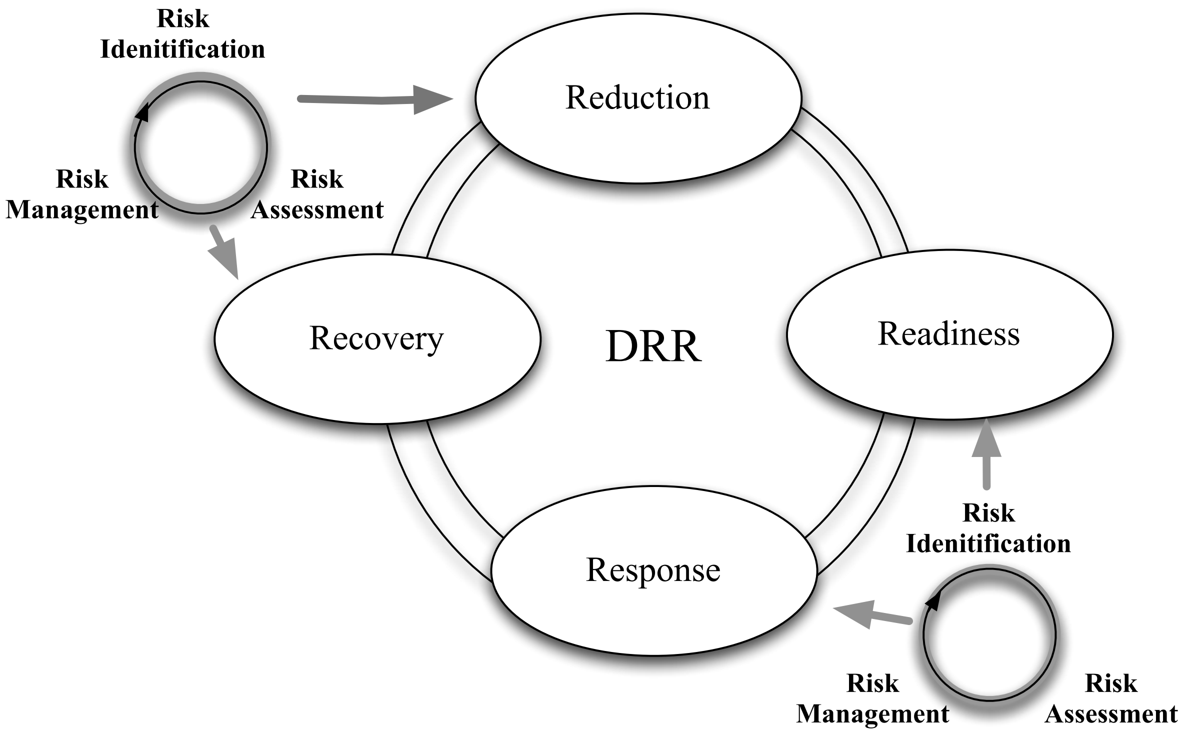



**Figure 3.3: Development concept for the DRR-communication topics wheel**
The three-stage risk identification-assessment-management cycle applied to each phase of the DRR cycle yielded twelve key DRR-communication topics shown in Figure 3.4

Applying the three stages to each of the four phases of the DRR cycle has generated a twelve-topic framework (3x4=12). This framework was developed to accommodate each of the DRR topics or and activities that were identified, even causal attributions, and attributions of responsibility for DRR.

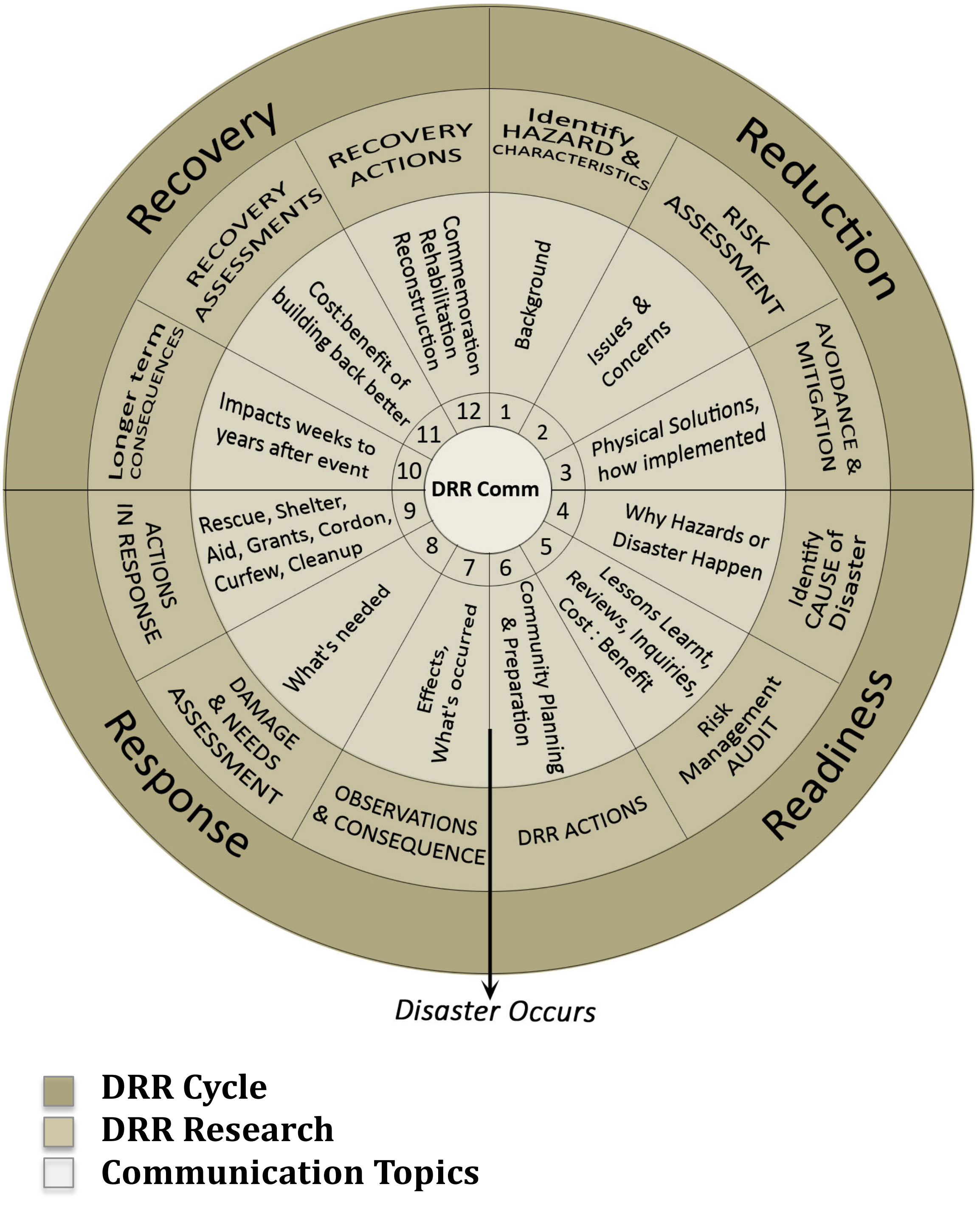



**Figure 3.4: The DRR-communication topics wheel**

This figure shows issue-based framing of the topic of DRR. DRR-communication lies at the centre of the wheel while the outside ring shows the 4Rs. The middle and central rings identify the 12 topic labels (e.g. 'Risk Management Audit') and corresponding topic numbers (e.g. topic 5). The 12 large segments briefly describe the communication topics (e.g. Lessons Learnt, Reviews, Inquiries, Cost:Benefit). The wheel might appear to have similarities to Alexander (2007). However the wheel was in fact most influenced by the "Disaster management cycle" attributed to a personal communication by a Fred Cole of the OFDA in Figure 3 of chapter 7 of Southern (2009).

As a result the twelve key topic sectors of the DRR-topics-wheel (see Figure 3.4) are a combination of a real-world risk identification-analysis-management cycle and key DRR concepts as per the hazard, risk and equations and the four phases (4Rs) of DRR presented in Chapter 2. The wheel therefore represents the full range of evidence-based information available and necessary to understand DRR before, during and after disaster events. This time-related factor would not have been achieved by using the eleven DRR solutions areas described in Equation 6 (section 2.5.1).

To summarise; information is used to achieve:

- awareness of the nature of hazards and their consequences
- understanding and assessment of the degree of risk
- awareness of the possibilities available avoid and mitigate risk
- understanding of the cause of disasters
- learning from disasters through audit and review of what has occurred
- planning for disasters
- sense-making when disasters occur
- understanding of disaster needs
- disaster relief from governments and individual efficacy in response
- understanding of the long-term consequences disasters
- weighing of opportunities in disaster *recovery*; and
- further improvements in risk *reduction* through rehabilitation and reconstruction.

For examples of media headline coding according to the twelve topics see Appendix Table 9.1, and for a more detailed description of the subtopics within each of the twelve key DRR topics generated from pilot analysis of the 20 earthquake academic research dataset see Appendix 9.2.

### 3.6.6 Considering and coding natural, social, built and economic 'capitals' is valuable

The importance of seismic risks and DRR solutions being considered in terms of natural (ecological), social, built and economic elements was alluded to in Chapters 1 and 2. Communicated content might be expected to cover the range of environments if that communication is to be considered in that it touches on all aspects of expert knowledge of DRR. The background to, and rationale for analysing for these four elements in this study is discussed below.

Sustainability and holistic DRR approaches increasingly refer to 'environments' or 'capitals'. These are concepts from environmental studies and economics that reflect community assets or capabilities, including the physical or built, economic or financial, human (e.g. demography, education, health), social (including political and cultural), and the variously termed natural, environmental or biospheric resources (Bebbington, 1999; Putnam, 2000; Samuelson & Nordhaus, 2004; Weichselgartner & Kasperson, 2010).

Jeanneret (2008) included a diagram from Wikipedia to show sustainability at the intersection of three 'preoccupations', social, economic and environmental (natural), as per the diagram below (Figure 3.5a). Quite recently an international tsunami survey team reported having explored for the *"first time ever the nature and linkages between physical, social, economic and environmental systems in order to provide a more sophisticated understanding of tsunami and its impacts"* (UNESCO-IOC, 2009, p. 30). In New Zealand the Ministry for Civil Defence and Emergency Management (MCDEM) embraced a similar, holistic approach as part of its recovery planning framework prior to the Canterbury earthquakes, and a similar diagram may be seen on p. 4 of MCDEM (2005b). That diagram shows community at the intersection of four environments, social, economic, natural and built. In recent years a few media content analyses of disaster have begun to mention and consider 'environments' and capitals. A discussion of the findings of previous research combined with results from this research may be found in section 6.3.4. In this study these four environments (Figure 3.5b) were used as the basis for coding and recording 'capitals'.

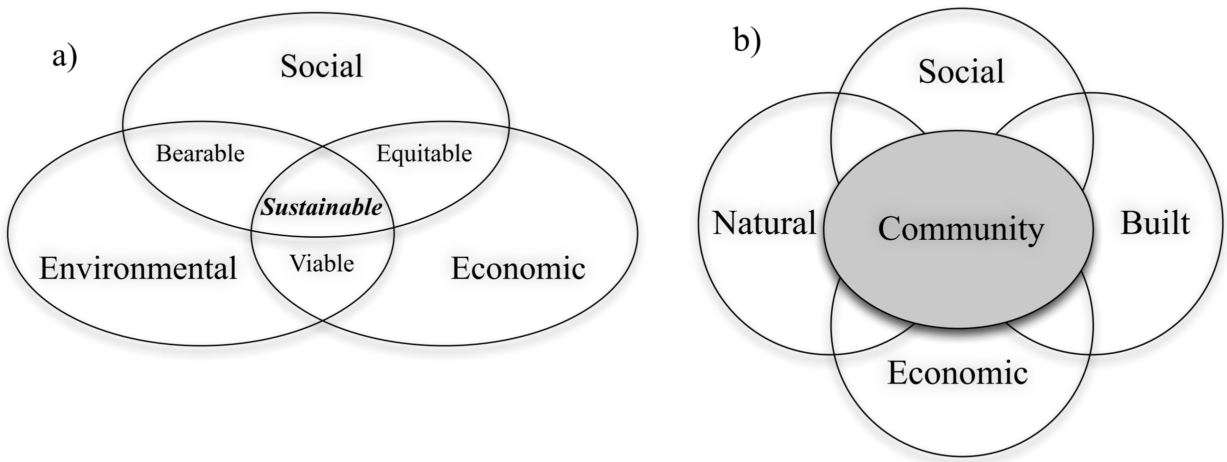



**Figure 3.5: 'Environments' or 'capitals'**
Sustainability and community are central to four 'environments' or 'capitals' as adapted from a) Wikipedia's canonical model of sustainable development (Jeanneret, 2008, p. 248);and b) p. 6 of (MCDEM, 2005b, pp. author-year), and R. Smith (2009).

Up to three 'capital' frames were assigned to each article headline (for mass media articles) or article titles (for the DRR research dataset) reflecting the degree of attention placed on one or more of these capitals. Where it was considered that there were two frames the dominant frame was assigned a score of 2 and the other 1. Where there were three or more frames each was assigned a value of '1'. For example an article or item about future insurance or reinsurance while primarily an economic topic (therefore weighted 2) is typically also about insuring the built environment (weighted 1). Where all frames were present, 'all' was entered as the first frame code and each was assigned a value of '1'. The weighted values were summed. The results are presented in section 7.3.5. As with other coding, inter-coder reliability for this research is shown in Table 3.16.

### 3.6.7 Media story types, groups and categories were identified

Media story types give a good impression of what the reader of viewer might have read or watched in the news. Note that media story types are quite distinct from the science-related story types that are often considered in science-related media research.

Identifying earthquake-related media story types was a key part of this research; this meant identification of story types that align with media content, story types that all stakeholders could readily recognize. DRR, and science-disciplinary groupings (codes) presented in previous sections of this chapter were then broadly used to group and categorise the story types.

In the past disaster media researchers have identified different story types relating to specific disasters, or to specific topics of interest, but there has never been a consistent grouping. Also, there is no known research where different story types across the whole DRR cycle have been identified.

It appears researchers have in the past identified story types and groups that are meaningful to their research concerns as scientists or science, risk or media communicators. However these story types rarely fit any holistic understanding of DRR. Nor do the story types reflect what any other citizen might consider the story type to be, and are therefore not easily replicable by another coder.

The media-story types developed in this research were then grouped according to other frameworks, such as DRR theory (e.g. the 4Rs) or an understanding of how scientific disciplines are framed (or grouped). This allowed an understanding and easier discussion of the emphasis of media articles in terms of DRR and science. For example five story categories are an artificial construct in this research (aligned with but not identical to the 4Rs) used to understand the emphasis of media on particular aspects of DRR.  Subgroups align broadly with the four environments.

### 3.6.8 Article titles and media headlines were used to code story types

In this research story types were identified from academic article titles or media article and television headlines rather than body text.

Particular words used in the headlines build a societal image of science's relationship to any issue. Headlines and lead sentences are recalled more than detail in body text (Reder, 1982). Previous research has been done into the way science-issues are framed in the media. Similarly a few disaster researchers have tracked media story types or frames from warning through to the early stages of disaster recovery. Piecing these together one may compile a set of DRR-related media story frame types or stories. Examination of the headlines of NZ media stories allowed further DRR-related media story frames and science-issue-story-frames to be identified and discussed, as is done in section 5.2.

The body text of the stories may traverse a range of media headline story types. (For example a discussion of the tertiary effects of the Tohoku earthquake may range from *Background/Expectations* to *Research Findings* to *Other Health Warnings* and may include a paragraph that is in itself a *Survivor/Victim Story*.) The headline will however be framed as only one of these. In television broadcasts the headline is used to select an item to view, audio typical picks up on the headline, and parts of the headline are also often written as text on the 'screen'.

A significant challenge in this research was deciding how to categorise media stories relating to scientific research and research knowledge. This was because research and associated knowledge is an activity that occurs and is reported on in all four phases of the DRR cycle, yet reported in similar story types regardless of the particular DRR phase a community is in when the article is published (see Appendix 9.3a for details of scientific research-related media stories). Examples of how media story types were coded are given in Appendix Tables 9.1 and 9.2. It is acknowledged that some articles contain material that relates to issues and topics not represented in the headline. However immersion in the articles showed that overall the headline was a good indicator of the early paragraphs of the article. The first paragraphs of most media articles, or minutes of television items are read/watched; but audience interest decreases with time.

### 3.6.9 Media story types are distinct from risk-issue, science- or DRR-science issue types discussed by media researchers

When choosing how to code stories it was considered that doing so in terms of a science- or DRR-focus would be artificial as this would not have been the media's intention. For example, education is an issue topic (like military or police involvement in response) that academics have particular interest in. As the media also have journalists focusing on these 'beats' it was tempting to use these code groups. However pilot analyses identified that the media used a variety of different story types to report on education topics.

To understand the ebb and flow of earthquake-related DRR-science issues in the media DRR-science-issue codes were developed from media article headlines as described in section 5.4.

### 3.6.10 Keywords were identified and used to generate headline codes

To enhance future coding reliability sets of keywords were collected to represent the DRR- and science-frames (see Appendix 7 and section 5.7.3). These might, with further development allow future automation of coding (cf. Cai, Liu, & Wang, 2011 who undertook digital automated analysis and classification of disaster news). Analysis would be less time consuming than the process undertaken in this study. However the analyst would not gain the issue-related learning that is achieved from reading abstracts and articles. These keyword sets are far more extensive than the keywords used in the very few other DRR-related studies that have used keywords. For example Pasquarè and Pozzetti (2007) searched for just five keyword sets vulnerability, land-use planning, risk prevention, safety, protection.

### 3.6.11 Inter-coder reliability achieved in this study was within acceptable limits

Kolbe and Burnett (1991) write that inter-coder reliability is often perceived as the standard measure of research quality. Neuendorf (2002, p. 141) wrote, *"without the establishment of reliability, content analysis measures are useless"*. Descriptions of the various types of inter-coder reliability testing for content analysis are presented in Riffe, Lacy, and Fico (1998).

The PhD researcher undertook most of the coding. A second coder repeated the coding for selected parts of the work. Four other coders performed checks for inter-coder reliability. One of these coders had a background in geographical research but the others had no science- or media-research background. The other coders coded over 50% of each dataset in exactly the same way as the PhD researcher. This is a large proportion compared with most media analyses. In other studies 'inter-rater reliability' (another name for inter-coder agreement) was achieved by coding 50 articles (Barnes et al., 2008) or 10% of all articles (Cox et al., 2008) were coded the same by different researchers.

The two results were compared for each of the datasets. Levels of agreement for each of the code groups were recorded and are shown in Table 3.16. What is shown is worst-case inter-coder agreement as a percentage proportion of the total items duplicate coded.

Inter-coder disagreement was used to refine the coding protocol (definitions of codes) in an iterative process. Therefore these levels of disagreement represent worst-case scenarios. While inter-coder reliability was established throughout this research, sophisticated statistical methods of reliability (e.g. Hayes & Krippendorff, 2007; Lombard, Synder-Duch, & Bracken, 2006; Matthes & Kohring, 2008) have not been applied. No statistical tests are presented because the data is, in the main, a census rather than a sample (cf. Hornig Priest et al., 2006).

Typically agreement above 80% is considered acceptable in media analyses. This was achieved for all codes in this study.

**Table 3.16: Inter-coder reliability – this research**

Worst-case (%) inter-coder reliability for datasets as listed at the top of each column. The details of these datasets is shown in Tables 3.5 and 3.6. Inter-coder reliability is expressed as worst-case percentages for the various code types as shown in the left-hand column. In most cases the results presented in tables in this thesis show refined coding as a result of inter-coder reliability checking. Where there is no number shown the particular code type is not reported for that dataset in this thesis.

| | 1000-STUFF | TV1 ALL | ODT ALL | Earthquake-research | Women's magazines |
|---|---|---|---|---|---|
| Full or brief mention | - | 99.3 | 97 | - | - |
| 12-DRR-topics | 91.1 | 94.2 | 94 | 97.8 | 91 |
| Environments | 92.5 | 90.6 | 97 | 93.1 | 92 |
| Event | 96 | - | 96 | - | 100 |
| Science-issue type | 84.6 | - | - | - | - |
| Media-headline-story type | 86.7 | 89.5 | 88 | - | 96 |
| DRR-headline topic | 91.1 | - | - | - | - |
| Science-story type | 86.8 | - | - | - | |
| Science keyword | 99.3 | - | - | - | - |
| Research or science word type | 96 | - | - | - | - |
| Science sources | 91 | 92.7 | - | - | 100 |
| Science implied by headline/title | 99.6 | 99.7 | 91 | 92.5 | 100 |
| Role of science | 89.9 | - | - | - | - |

## 3.7 Summary of methodology and previous content analyses

DRR science communication in this research was underpinned by twin goals: communication and DRR goals. It was identified that scholars have examined a range of different communicative and DRR-related goals when studying the media communication of natural hazards, risks and disasters. Each different goal has resulted in a different content-related focus. In this study the goal was *considerate* and *comprehensive* media coverage of earthquakes, related disasters and DRR.

In this research analysis was of how *considerate* and *comprehensive* media coverage was. Quantitative comparisons were to be made of the relative proportions of some key issue-centric indicators. Science knowledge was compared and contrasted with what was communicated in the mass media.

In evaluating or developing a study of media representations one must consider the most appropriate focus. This may relate to general issue-based representations or an event-based focus. This study examined a range of aspects of the representation of earthquake-related DRR (the issue) before and during the Canterbury earthquake sequence of 2010-2011 (the 'event').

The choice of media outlets and format to be studied is a consideration, as are time spans and how findings may be interpreted. Literature review had identified that few studies of media disaster content cover all of the four phases of the DRR cycle (4Rs) for one event. Therefore a decision was made to consider each media channel over a period of at least two years prior to the event and two years afterward. In this study all earthquake-related stories within a given time period (2008-2012) were analysed to allow analysis of how earthquake-related science is situated within that body of earthquake-related articles and items in the mass media.

This research considered digital, on-line representations of television broadcasts and print media, as well as women's magazines about print media articles. However, for reasons of scope, only a few reflections relating to on-line comment have been included in the results chapters.

Review of over 300 academic articles showed that there have been few studies of natural-hazard- and disaster–related content where the content is not media news content. While media news content analysis was a large part of this research, other content was also examined. The three other sets of research content analysed were DRR-related research publications relating to twenty earthquakes, academic natural hazard disaster media content research and pre-earthquake publications created by New Zealand authorities. A series of analytical groupings or codes were developed, so that they could be applied not only to analysis of DRR-related media content, but research publications, policy documents and citizen comment about DRR-communication, as gleaned from surveys, interviews, workshops etc. This was a deliberate attempt to find measures (codes) relevant to the issue and appropriate to any stakeholder/audience.

The notion of *comprehensive* or *complete* DRR-communication may be, and has been explored in a variety of ways. *Comprehensive* or *complete* communication requires communication of all of the problems and possible solutions. Acknowledging the disciplinary diversity in DRR gave rise to analysis of the 'sciences' of DRR. This is both the disciplines represented, and the scientist sources used to do so. *Comprehensiveness* of topic was also examined in terms of a set of 12 DRR-topics the distillation of which was a key part of this research (section 3.7.5). Another measure of how *comprehensive* considered in this thesis was the balance of attention to the natural, social, economic or built environment.

Analysis of the responses of citizen survey and interview provided insights into citizen knowledge of DRR, how citizens frame the problem of seismic risk, and possible solutions (disaster risk reduction). More importantly, it offered insights into what citizens want communicated. When contrasted with what was communicated in the New Zealand mass media, the results of survey and interview have offered insights into the information citizens want and therefore how to align DRR-communication with citizen needs.

A fully empirical-graphical approach to presentation of results of the content (framing) analysis would be possible, but without qualitative detail, there would be little gained in terms of content-based changes. Development of content-based recommendations was therefore the favoured, more practical approach. Comparisons between the results of quantitative and qualitative analyses and where possible to previous studies[11], and a discussion of what they illuminate about potential improvements to mass media communication of earthquake-related DRR are presented in Chapters 5, 6 and 7.

[11] Quantitative and qualitative analyses of previous natural-hazard or disaster-media related research (section 3.6.2 and Appendix 6.6) identified only isolated studies that might be compared with aspects of this study. Even then results of previous studies were not easily compared with this one. For example, media content studies that analysed for content related to risk reduction as this study did were rare. Two exceptions were Pasquarè and Pozzetti (2007) and Fu et al. (2012). Fu et al. (2012, p. 75) defined mitigation as activities to "*reduce the long-term risk to human life and property*" but combined the results for *response* and mitigation. This ambiguity may be the reason that their inter-coder reliability was poor for that code. It also made it very difficult to make comparisons between their studies and the present one.

# 4 DRR science communication: from problems to solutions

## 4.1 Scoping the solutions from previous science, risk and media communication literature

### 4.1.1 This chapter identifies a range of practical ways to improve communication

This chapter presents a combination of reflections from literature review and citizen satisfaction research.

Scholarly recommendations from science-, risk- and disaster communication are synthesized, discussed, and extended to consider a wider range of stakeholder needs for communication in this chapter. The objective was to identify practical ways in which media, scientists and policy- and decision-makers could individually and collaboratively improve the content of mass media.

The perspectives of scientists, media practitioners and researchers, some policy- and decision-makers and many lay citizens were sought through survey and interview as described in Chapter 3. Recommendations from researchers were supplemented by and integrated with the observations other stakeholders or ‘characters’. Consequently the collective wisdom of scholars from a variety of disciplines, and the views of 400 New Zealanders from a range of walks of life have both informed, and are woven into the discussion. Sixteen content-related features of ‘good’ science- and risk- communication were identified as discussed section 4.2. The chapter also includes a strategy for communicative content referred to as the 7Ts strategy (section 4.3).

### 4.1.2 The most common of four genres of communication research identified failings

Science-, risk-, media- and DRR-communication research reviewed in this thesis relate to four genres. The most common genre defined failures or problems. In the second genre researchers made one, or a few, recommendations to improve communication with regards a particular subtopic. In a third, far less common genre, recommendations were combined into a strategy (discussed in section 1.1.) A fourth, rare genre provided useable examples for those engaging in the communication (e.g. Radford & Wisner, 2012; UNISDR, 2011a).

There is a significant volume of science- and risk communication research that referred in some way, in summaries and conclusions to the need for ‘improvements’ to risk–related communication. Failures or flaws in the communication of risk were widely accepted and, on examination, wide-ranging, but many references simply stated that 'better' or 'more effective' communication was needed, without any discussion of what this entails.

As was introduced in section 2.6.6 and section 2.7 there are many who consider that the media is of little or no value to DRR, or even a hindrance to it. Key stakeholder group failings are summarised in Table 4.1 in relation to citizen needs and in terms of communication of each of the twelve DRR topics (to recall the latter see Figure 3.5).

### 4.1.3 This research yielded unsolicited comment about media failings

Survey and interview in this research yielded a range of unsolicited comments about media failings some of which are presented below (see also summary interviews in Appendix 10). The comments reflected many of the problems with science- and risk- and media communication discussed in chapter 2 (and summarised in Table 2.6 and 4.1).

There were comments that presumed the media was sensationalist and that citizens were considered by media to be shallow; for example:

> *I really don't know why the media believe that people in the city are so shallow, that they want sensational stories … because I genuinely believe that people in this city are hungry for good information*
>
> Interviewee I020

As one interviewee with significant media experience stated:

> *I don't think there's any doubt that mass media provides the 'knowledge soup' but it's not entirely reliable, and it's easily miscued and it can get distorted in ways that aren't necessarily helpful*
>
> Interviewee, I018

Another interviewee recalled that concerns about liability had been a reason given by engineers to decline commenting in the media.

> *Engineers, or geoscientists, experts [are] often compromised by their own position, company, personal liability, their relationships with the people who are contracting them to provide risk assessment. There are a whole lot of things which work against good information flows*
>
> Interviewee I019

Burkhart (1987) and references therein referred to a 'culture gap' between scientists and journalists, with scientists being wary of the press. Echoing this one of the scientist interviewees in this research stated (but remains anonymous with respect to this comment) *"We're avoiding the mass media – there's better communication methods than the mass media, and community meetings are really good".*

Others recognised that there were missed opportunities through the assumption that there is little value or point in investing in better media communication.

> *There are far too many people in New Zealand involved in emergency management ... who have been indoctrinated, although it is changing, to take a cynical view towards the media, and so that influences their approach to working with the media … they see the media as a threat rather than as part of the solution.*
>
> Interviewee I027

Interviewee I029 called for the media to be part of recovery by building confidence rather than *"generating a feeling of unease, mak[ing] you feel like you're being ripped off ... always looking for the negative story"*.

### 4.1.4 This research shifted attention from problems to recommendations

As recommended by Rowan (1994b) the approach in this research was to ensure a focus on solutions. The need to *"shift from the stage of phenomenon identification and analysis to that of problem solving"* has also been discussed in DRR (K. Takeuchi, 2011, p. 117) and risk assessment (Finkel, 2011). The recommendations should be practical - able to be used by any characters communicating even if they have little scientific or other academic background.

### 4.1.5 The need to collate the existing conclusions and recommendations for science- and risk communication was identified

It became obvious during this study that there was also a need for the existing conclusions and recommendations for science-, risk- and disaster-related communication to be collated, so that they could be put into practice.

There are few publications containing content-related recommendations in relation to DRR-communication. Some examples are Radford and Wisner (2012), UNISDR (2011a) and the World Health Organization's guidelines for 'effective media communication' (WHO, 2005).

Review also showed that the variety of recommendations addressing deficits by improving communicated content has not been collated. In particular there have been few content-specific guidelines or strategies relating to science- or risk communication, let alone DRR-communication.

There are few collections of recommendations from the general science- and risk communication literature. Most recommendations are practice-, rather than content-related. Advice from scientists to disaster journalists for example Burkhart (1987), includes the need to attribute knowledge to named sources, to run drafts of copy past sources, and for

**Table 4.1: DRR communication topics, rationale for, and problems in communicating DRR**

This table brings together and shows the alignment of various theories and models relating to the communication of science, disaster and risk, including framing research by Paton (2009 – right hand-most column and a study of citizen information needs by Becker et al (2012).

Key stakeholder group failings are summarized (columns 5-9 from left) in relation to citizen needs (fourth column from left) in terms of communication of information relating to each of the 12 DRR topics (Figure 3.5 – topic and topic codes in two left hand columns). The third column from the left indicates the rationale for providing science (that aligns with deliberative inclusive process model).

Problems in communicating science and risk in terms of all four stakeholder groups (Figure 2.2) are after Anzur (2000), Balaji (2011), Besley and Nisbet (2011), Borah (2009), Carvalho (2007), Cuzens et al. (2007), de Marchi (1991), William R. Freudenburg et al. (1996), Keen and Ryle (1996), Levy-Leblond (1992), Mason (2011), Nelkin (1995), Nisbet and Mooney (2007), Nisbet (2009), Ohta and Kitao (1977), Parker (1980), Rojecki (2009), Rovai and Rodrigue (1998), Seo et al. (2011), Van Dijk (2000), Vasterman et al. (2005), Voorhees et al. (2007), Waxman (1973), and Wenger and Friedman (1986).

See also section 6.5.3 for types of sensationalism attributed to the media. Note that some problems that are not specific to a particular topic(s) are not shown here; for example the problem of highly technical language that highlights the stature of experts (Rojecki, 2009) or academics having generally negative attitudes to media (Poliakoff & Webb, 2007).

There are two aspects of outcome expectancy. 1) The most commonly referred to outcome expectancy relates to likely negative consequences. 2) The other aspect of outcome expectancy is the potential for risk reduction (a successful outcome from risk management). Note however that CARMA (2006) concluded that Western self-interest is the overwhelming pre-condition for the coverage of humanitarian crises (which some might refer to as a successful risk management outcome).

| DRR Communication Topic | Topic Code | Rationale under DIP (Science communicated to provide) | Citizen information needs (influenced by Becker et al 2012) | Science in Media Tension | Problems attributed to media | Problems attributed to scientists | Problems attributed to authorities | Problems attributed to human nature | Theory/ Model | Perceptions | After Paton (2009) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Characteristics | 1 | Background - core scientific principles to support disaster decision making - all disciplines | What is known about this? | Accuracy - myths versus facts in this and all other communication topics | Perpetuate biases and myths, shallow/ignorant | Credibility, awareness, understanding | Reliance on media as source of information | Disinterest or ignorance | Knowledge gap theory | n/a | n/a |
| Consequence | 7,10 | Information | What has occurred/can occur? | Sensationalism versus 'critical awareness' | Dramatic damage / unusual - causing distress/cause psychological distress/ portrayal of minorities, violate rights and dignity | n/a | Not using opportunity for fear of 'panic' | Denial in face of excessive fear, discount risk as 'extreme' | Outcome expectancy (1) | Disaster perception | |
| Cause | 4 | Sense-making in disaster and directs attention to solutions | Why has this occurred? | Natural/human blame/ responsibility | Emphasising natural causes, not social | Physical scientists emphasise natural as uncomfortable with political conflict | Shift responsibility | Fatalism, optimistic bias | Causal attribution | | |
| Audit/Lessons | 5 | Attribution of responsibility | How could we stop this from happening again? | Responsibility/ lessons learned | Addressing political and ideological conflict | | | Busy, lazy | Attribution of responsibility | | |
| Risk Assessments - Pre-event | 2 | Provides risk scenarios | What will happen next? | Whose views most important? | Predictions, pseudoscience, precursors and premonitions | Mainstream science only | Concerned about public reaction, panic, self-evacuation, economic loss, and liability. Risk-averse. | Panic, are gullable, optimistic bias, denial | | Risk perception | Risky choice framing |
| Risk Assessments - Pre-event, Needs in Response, Recovery assessments. | 2,8,11 | Trust/tell it like it is 1) Uncertainty | How risky is this? Does this require attention/action? | Sensationalism (alarm/ reassurance) | Use to gain attention to sell | Alarm/reassurance (self-interest, future research and funding) | | Errors in judgment, optimistic bias | Discounting or acknowledging risk | | |
| | All | Trust/tell it like it is 2) Uncertainty - unknowns | What is known/unknown? | Uncertainty | Struggle with communicating uncertainty | Not admitting uncertainty to avoid undermining expertise | Precautionary approach | Discomfort with uncertainty | | | |
| | | Trust/tell it like it is 3) Transparency | Who pays, who benefits? Whose and what goals are being achieved? | Influence of authorities and elites | Providing only one or bizarre perspectives, local media gate-keeping, corporate interests not disclosed | Agenda-setting, providing only scientific perspective | Power, control and economic gain | Cynicism re political process and influence | | Coping perception | Goal framing |
| Risk reduction | 3,6,9,12 | Achievement potential | Can something be done? | | Rarely mention, don't use lives-saved frame | Reticent to provide advice | Emphasise survival only | Denial, western self-interest in humanitarian crises | Outcome expectancy (2) | | |
| | | Possibilities/options | What can/is being be done? | Suggesting solutions (versus focusing on problems) | | Emphasis on technological solutions | That show command post | | Action coping, response efficacy | | |
| | | | Who/Can I make a difference? | | | Not involved in community/advocacy | That show command post | | Self-efficacy | | |
| | | | How can I make a difference? | | | | Power, control and economic gain | | Citizen participation | | |
| | All | | Who can I trust? | Trust | | Not involved in policy | | | Leadership | | |

**Table 4.2: Indicators of resilience and suggested risk communication frames.**

This table combines Rowan (1994b)'s communicative aims (column 1) with Paton's (2005;2007a) indicators of resilience (column 3) and Pomeroy (2010)'s suggested recommendations for risk communication (column 5). An explanation of Paton's resilience indicators is provided in column 4. The nature of the information (or communication) shown in column 2 is a concept developed in this research that articulates the link between Rowan's communicative aims and Paton's indicators of resilience. Trust has been extended to cover media and community. (Note: Empowerment is described in Paton (2007b;p374) as "[Citizens'] capacity to gain mastery over their affairs and to deal with issues and opportunities using intrinsic resources". Consideration for and respect of autonomy is also a mark of ethical communication (Cronin, 2003). Success of risk communication is closely tied to trust (Keey, 2000).

| **Rowan's communicative aims** | **Information** | **Indicators of Resilience (after Paton 2005; 2007a and Seville, 2009)** | **Explanation of Resilience Indicators** | **Suggested risk communication frames (recommendations)**<br>**(heavily adapted from Pomeroy (2010) using literature referenced throughout this chapter (4))** |
|---|---|---|---|---|
| Build Credibility | Access to creates | Trust | In institutions – all levels government, community leaders, legislation, media<br>In science and scientists<br>In individual and community ability & participation | Communication should be open, honest and transparent<br>Community involvement in the decision-making process should be visible<br>Not only to increase knowledge but identify, distil and communicate key lessons<br>Integrate 4th order, bottom-up communication practices, including ability of 'public' |
| Create Awareness | Availability results in | Critical awareness | Risk identification – being aware of hazard, Risk analysis – being aware of the outcomes of technical risk analysis, exposure, probability and vulnerability | To achieve critical awareness (after Paton 2005; 2007b). While Pomeroy (2010) suggests only 'sharing of scientist and emergency manager knowledge and experience of hazard and citizen stories of experiences'. Acknowledgement of the complex nature of natural hazards was suggested as a way of enhancing positive outcome expectancy by Pomeroy, but is considered more appropriate in terms of critical awareness. For reasons of comprehensiveness (discussed in section 2.8.3 and 4.2.2) reference to awareness of aspects of risk analysis and risk management (risk reduction) have been added |
| Build Understanding | Appropriate-ness to Achieve DRR | Action coping | Understanding to inform risk and coping appraisal, thinking about and taking | Shift focus of understanding to risk reduction solutions- provide examples (case histories/stories) of individuals and communities involvement in 4Rs |
| agreement about Solutions | re what is Achievable | Outcome expectancy | Knowing what is possible in risk reduction (management) | Developing positive outcome expectancy<br>Show how people can practically avoid losses - Information that is practical and easy to put in place is more likely to be adopted (Lindell and Whitney, 2000)<br>Demonstrate that mitigation actions are effective (McClure et al, 1999; Paton et al. , 2006)<br>Demonstrate that losses are avoidable<br>Emphasise an immediate benefit from the protective action - for example cost-saving<br>Reducing negative expectancy<br>Do not over-dramatise consequences or emphasise widespread damage or destruction – but be aware of alarm/reassurance<br>Show that consequences (losses) tend to be more serious where community exposure to hazard, or community vulnerability is greater.<br>Show how risk reduction choices (mitigation and preparedness) influence the extent of loss |
| Enactment of Effective response | re Ability | Empowerment (locus of control) | Citizen belief that they have influence (cf. reliance on technocratic approaches, legislation, experts, elites.) | Communicate examples of community- as well as expert- or institutionally-led risk reduction |
| see above | as above | Self-efficacy | Knowing and having the skills and tools to make a difference | Encourage personal responsibility for risk identification and risk reduction<br>Encourage community participation |
| see above | re Actions | Individual and community participation and teamwork | 'Democratic' approach – active community involvement, including belief of ability to make a difference and the need to work together | Encourage community participation – through communication type, and provide examples of how having skillsets that support community participation result in positive DRR outcomes |
| as above | shows Active | Leadership | Skills that support community participation | Provide examples of how ability to articulate problems, solutions and how to achieve these result in positive DRR outcomes |

researchers to communicate several times via multiple channels (Mileti & Darlington, 1997; Mileti, Fitzpatrick, & Farhar, 1992).

Rowan related five key problem areas (credibility, awareness, understanding, agreement about solutions and enactment of effective response) in risk communication to a sequence of solutions. These could have been used as the sole basis for discussion in this research. However Rowan's focus was on issues and recommended solutions for scientists. Furthermore Rowan's solutions aligned *what* needed to be done, not *how* these could be achieved.

With greater acceptance of third-order communication models since 1994, there has been much written of how these aspects may be achieved. There are many, often repeated, observations and recommendations, but were rarely synthesized.

What is presented in and through the mass media is said to reflect a combination of journalistic endeavour, media resources, and the efforts and resources of experts and elites (Gamson and Modigliani, 1989; Carragee & Roefs, 2004). Media content may thus be considered a combination of citizen narratives, journalist narratives, expert or science-related narratives, and authorities' narratives. Given this is the case then, it is not only journalists who are responsible for media content. For this reason the emphasis in this and later results chapters is on finding recommendations for all communicators collectively. Rowan similarly recognised that *"risk communication, like risk management, will be most effective if it is viewed as every affected party's responsibility"* (Rowan, 1994b, p. 373).

### 4.1.6 Recommendations should be goal appropriate

Risk communication recommendations and strategies should have a vision of a desirable future that achieves the desired outcome or goal (Cuzens et al., 2007), that is, they should be 'goal appropriate' (Bier, 2000). A common thread through Chapters 1, 2, and 3 was the importance of understanding the communicative and issue-related goals. It was established that definitions imply goals where these are not explicitly stated. In DRR-communication there are twin goals; achieving both communication and DRR that are well-regarded or considered 'effective' by a range of stakeholders.

Achieving both of these goals would require *considerate* communication (section 2.7.3 and 4.2.2), communication that is sufficiently *complete* and *comprehensive* as to achieve DRR goals (e.g. resilience). This chapter discusses features of communication and elements of a communication that are goal-appropriate to contemporary communication and DRR.

### 4.1.7 Research into resilience indicators and Rowan's communication issues align

The assumed communicative goal in this study is well-regarded DRR-communication; communication that includes examples of 'best-practice', and communication that is *considerate* (sections 2.8 and 4.2.2).

Improvements in DRR-communication should not focus only on scientific credibility, hazard awareness or citizen understanding. Critical awareness of solutions, agreement about solutions and the enactment of effective actions through communication are as great, if not a greater imperative.

Risk communication literature and scholarship in risk perception has not fully kept pace with communicative and DRR models (Chapter 2). With resilience a key goal in DRR, it is reasonable to suggest that aspects of resilience be communicated. As shown in Table 4.2, communication issues identified by Rowan fit relatively easily next to the indicators of resilience. For example credibility is a by-product of trust. Access to information assists in building trust and is the first of 7As summarising how information relates to resilience indicators. Other links are that availability of information creates critical awareness, but that this needs to relate to more than threat, namely to solutions.

The last column in Table 4.2 contains a set of resilience-focussed risk communication frames or recommendations, aligned with both Rowan's (1994) recommendations and Paton's resilience indicators (Paton, 2005, 2007). The suggested recommendations are drawn from an unpublished report commissioned by MCDEM that utilised those eight indicators to develop risk communication and 'engagement' strategies (Pomeroy, 2010). These are well-supported by (and also extend) historical risk communication research.

### 4.1.8 Interview themes were of citizen desire for understanding and informed choice

Both interviewee and survey respondents made general suggestions about communication that fit with and are woven into the discussion in section 4.2 below. In particular strong themes from interview were the desire of citizens to understand, for informed choice; for empowerment. There was also an emphasis on the need for all in a community to better understand risk, sharing the risk and owning the solutions.

Some interviewees portrayed citizens as being unable to cope with alarming messages or with probabilistic risk messaging; many citizens requested to be 'told like it is'. Some suggested less detail was required about scientific topics, others that more should have been heard from certain scientific disciplines, or about specific DRR topics. The suggestion was made that links to the detail could be provided in media articles.

Interview respondent views on DRR-specific information in the New Zealand media are summarised in section 7.3.2. There is more detail of aspects of DRR-communication that each interviewee thought could be improved in Appendix 8. Discussion about respondents' science specific and issue-specific (DRR-specific) suggestions are discussed in Chapters 6 and 7 respectively.

### 4.1.9 Survey and interview respondents were generally satisfied with DRR information in the media

One previous study Guobin (2008) found that 93% of citizens were either satisfied (43%) or very satisfied (50%) with media content after the Sichuan earthquake. In contrast Voorhees et al. (2007) in the US found that only 13% of interviewees trusted television coverage of Hurricane Katrina. Over half (57%) of Vorhees et al's respondents considered that the media coverage was not congruent with their experience of the Katrina event.

Figure 4.1 shows respondents' Likert-scale ratings of how well they consider communication since the first Canterbury earthquake has improved their understanding of earthquake-related science, risk and DRR. Overall it appears that most respondents indicated that what was communicated in the mass media improved their understanding of earthquake science and risk. Comparatively few considered that mass media communication had vastly increased their understanding of any of the topics. Few suggested that the media had contributed to their knowledge and understanding of risk reduction. Of the three topics, earthquake science, risk, and DRR, respondents appear to consider that the mass media coverage has added least to their understanding of DRR. These results could be taken to indicate an overall general satisfaction with the provision of information by New Zealand mass media. Beyond suggesting that communication of DRR could do with improvement, the results of this question alone do not offer anything in terms of what to improve.

Content-related comment by respondents is presented in section 7.3.2 and generally throughout Chapter 7.

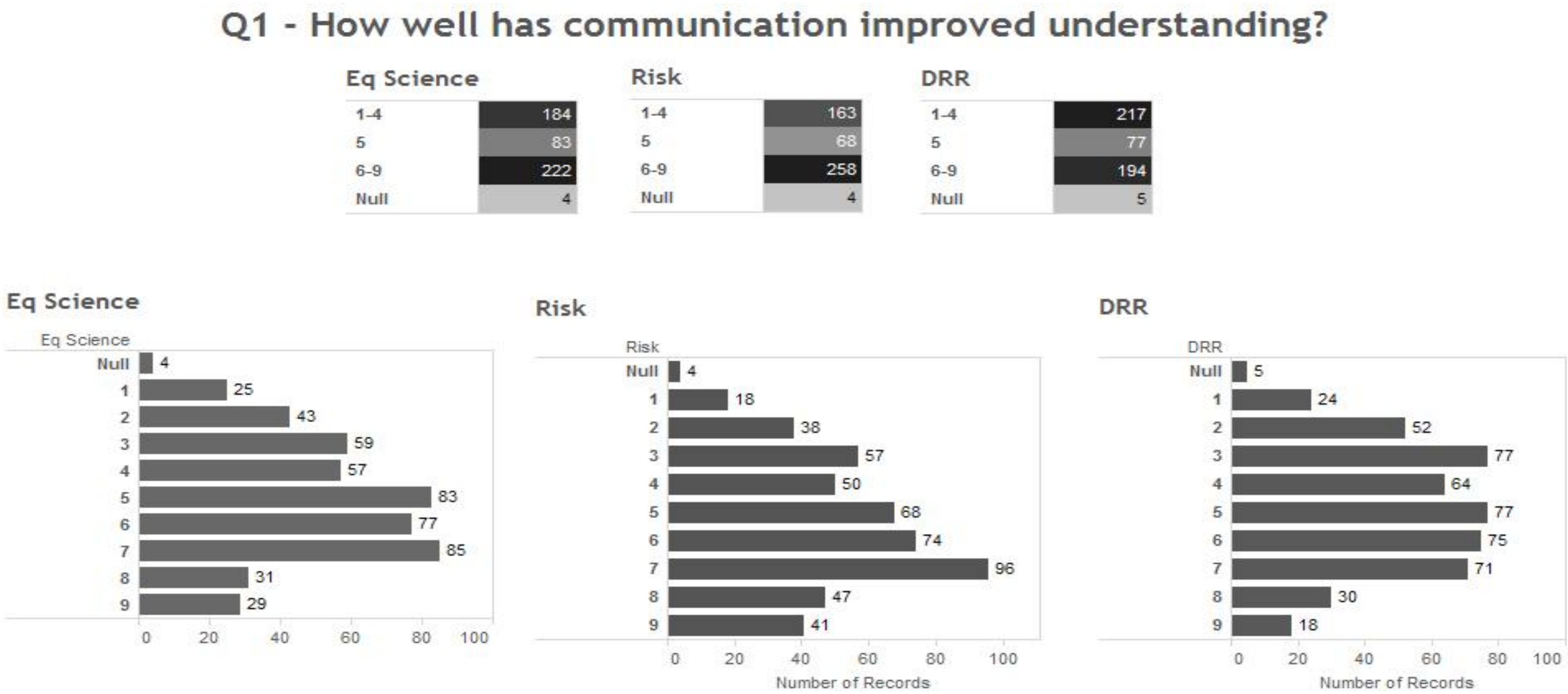



**Figure 4.1: How well media communication improved respondents' understanding – this study**

Responses to Question 1 of the survey, ranking earthquake-science-, risk- and DRR-communication provided in New Zealand in 2010. Respondents ranked 1 for communication that had not improved their understanding much and 9 where they felt communication had improved their understanding a great deal.

### 4.1.10 New Zealanders want DRR-communication to positively influence outcomes – consequences and preparedness

Responses from the New Zealand survey respondents in this study mirrored the range of communication-specific and DRR-specific goals identified in Chapters 2 and 3.

Analysis of open-ended responses to the 'why' parts of Questions 2 and 3 of the survey is summarised in Table 4.3. Perhaps the most surprising result is that no one, in answering the 'why' questions, suggested that communication was important to build trust or credibility. Respondents who referred to issues such as communication of pseudo-science presumably had other goals in mind also, but did not articulate these in the 'why' response. The responses showed clearly that survey respondents preferred DRR science communication to positively affect DRR-related outcomes. Detail of specific desired DRR-related outcomes are discussed in Chapter 7.

Citizen awareness and self-efficacy were each mentioned by just over 10% of respondents. As respondent W217 (an Aucklander) said *"I think it's important to help people feel like they're doing what they can, not helpless"*. Answering open survey/interview questions as to what needed to be communicated and what could have been communicated 7.8% of citizens specifically referred in some way to wanting to be able to make informed decisions using the best, evidence-based information possible. A tertiary-educated non-scientist from Canterbury responded;

> *People need to be presented with the data that the geologists and engineers have. ... then the people should be free to do what they want with that data. For private land use it is not the role of government to dictate where and what to build. It is definitely not the role of government to kick people off their private land because the government deems it unsafe. If we really are free, we have to live with the consequences of our own actions.*
>
> (On-line survey respondent W089 – home destroyed, business affected in Canterbury earthquakes)

Further details of what is important to citizens were gleaned from analysis of frames in respondent responses to how they have been affected by the Canterbury earthquakes (Question 7). Respondents identified avoidance of anguish, having a liveable home post-quake, enhanced survival, limiting economic or environmental harm; these are all factors in risk assessment. The primary concern though, would appear to be for the communication to achieve a positive outcome regardless of who is responsible or how this is achieved. This gave more weight to the importance of emphasising a multi-stakeholder approach to improving both DRR and DRR-communication in the discussion in the following chapters.

One of the key learnings from survey and interview was the breadth of suggestions as to what needed to be communicated, and what needed to be *better* communicated. This was particularly the case from Cantabrians who had experienced the Canterbury earthquake disasters. Aucklanders in contrast mainly focused on household preparedness and survival as has been the focus of the New Zealand Ministry of Civil Defence and Emergency Management (MCDEM) messaging in the media, and earthquake risk as communicated by crown research institute GNS. The fact that the topic groupings in DRR could not easily be reduced to fewer than 12 subtopics (section 3.7.5) is further evidence of the breadth of necessary communication topics.

**Table 4.3: Citizen needs for DRR-related science communication**
Reasons given by survey respondents (all New Zealand citizens) for needing the sciences of DRR communicated in the media. These were open responses, with no prompting of possibilities. Some respondents gave multiple reasons, although many web-based respondents did not give any at all. Auckland face-to-face survey respondents were prompted to give a 'why' answer (but not of possible answers).

| **Reason (grouped to align with Rowan's CAUSE mnemonic (1994)** | **# of times a need was mentioned** |
|---|---|
| build trust/Credibility | **0** |
| create Awareness /build Understanding (mostly of hazard/threat) | 51 |
| effective Solutions a) to positively affect outcomes – consequences | 217 |
| effective Solutions b) to positively affect outcomes – preparedness | 150 |
| Enactment of effective response- self-efficacy, informed decision making or resilience | 62 |
| No 'why' answer given | 99 |
| Total | 579 |

## 4.2 Sixteen features of best-practice science- and risk communication

### 4.2.1 Introducing the 16Cs (sixteen features of good-practice communication)

Rowan's (1994b) problem-solving approach to risk communication related 5 key identified problems (section 4.1.1) to a sequence of solutions. These were to build trust, create awareness, deepen understanding, gain agreement on solutions and motivate action. These could have been used as the basis for a discussion of what is important in science-, risk- and by extrapolation DRR-communication. However there has been a lot more written since 1994, not only of how these aspects may be achieved, but also of other factors that are considered important in risk communication. A synthesis and discussion of those general recommendations from risk perception and science- and risk communication research resulted in sixteen key features being identified (Table 4.4).

Some of the issues noted in past risk communication research are of little concern under third- or fourth-order communication models. 'Good, 'effective' or best-practice communication is measured differently if complex patterns of individual and societal perception, values, attitudes, decision-making and behaviours are accepted. When a multiplicity of perspectives is expected and accepted 'differences in risk perception' are of less concern than where specific judgments and behaviours are desired.

The synthesis provided here has some similarities to, but extends far beyond the recently-published summary of the common characteristics of effective communication in risk, crisis and wildfire literature in Table 1 of Steelman and McCaffrey (2013) in terms of being rooted in dialogical models of communication, providing contextual information, consideration and credibility. In particular it is less about educating or motivating action, and more about discussing, after having understood stakeholder value and concerns.

Despite having been rooted in historical communication models, the findings of past science- and risk communication research are of both interest and use when considering 'bottom-up' DRR-communication. In the following synthesis as many historical recommendations as possible have been incorporated – unless they are considered to be at odds with the ethical considerations and goals of third- and fourth-order communication.

The sixteen key features of 'well-regarded' or 'effective' science communication practice are presented in Table 4.4. These features and associated recommendations derive in the main from research designed to improve scientist and expert communication of science and risk for citizens. However they are equally applicable and valuable for media, or for policy-or decisions-makers to consider and apply. For example Weichselgartner and Kasperson (2010) have identified that policy- and decision-makers require scientific information to be relevant, true, unbiased and applicable, all of which are covered in the 16 features of best-practice science communication.

**Table 4.4: Features (16Cs) and a strategy (7Ts) for science- and risk communication**
Sixteen key features of 'effective' science- and risk communication beginning with the letter 'C' (16Cs) are shown in the first to third and fifth columns. Seven elements beginning with the letter 'T' that together exemplify 'best-practice' to define a strategy (7Ts) for DRR-communication influenced by the 16Cs, Weingart et al. (2000) and Miller (2008). The 7Ts also included other recommendations for communicating risk from Amberg and Hall (2010), Fisher (1999) and Weber & Word (2008). These key features are applicable to a story of only a few sentences in length, such as a short television interview, a print news story, a book, or an evening of public consultation.

<table>
<tr><th colspan="5">16Cs – features of well-regarded science- and risk communication</th><th>7Ts Strategy</th></tr>
<tr><td rowspan="13">A CONSDIERATE communication that is…</td><td rowspan="3"></td><td>Clear</td><td>simple, clear core message</td><td rowspan="13">… and exhibits the COMPLETE range of strategy elements</td><td>begin, conclude or include options for Tangible action</td></tr>
<tr><td>Captivating</td><td>entertaining, engaging, salient, storied</td><td>Tell the story</td></tr>
<tr><td>COMPREHENSIVE</td><td>evidence-based, holistic, integrated and remember audiences don't know what they don't know</td><td rowspan="2">make sure it's Theoretically robust and The whole story</td></tr>
<tr><td rowspan="4">Contextualised</td><td>communicates Complexity</td><td>multiple perspectives, facts separated from frames, starting with clear definition of goals</td></tr>
<tr><td>Comparable</td><td>provides a standard of comparison</td><td rowspan="2">Touch base with the audience</td></tr>
<tr><td>addresses Concerns</td><td>provides local context and considers audience criticisms, values and information needs</td></tr>
<tr><td>acknowledges unCertainties</td><td>is clear about what is certain and what is not; science is provisional knowledge, models have limitations, clarify uncertainty terminology</td><td rowspan="3">Tell it like it is</td></tr>
<tr><td rowspan="6"></td><td>Credible</td><td>transparent, believable</td></tr>
<tr><td>Counteracts myths</td><td>addresses topics and concerns that, having little evidence-basis don't serve society well</td></tr>
<tr><td>Comprehensible</td><td>does not use jargon</td><td rowspan="3">Tell them what they want to know</td></tr>
<tr><td>Concise</td><td>avoids superfluous information</td></tr>
<tr><td>Confirmable</td><td>checkable – links to other information</td></tr>
<tr><td>Concrete</td><td>advice linked to evidence-based information about solutions, actions and responsibilities</td><td>Tangible action</td></tr>
</table>

### 4.2.2 Considerate; be clear about what citizens want to know

*Considerate* communication is viewed as an over-arching notion of importance in third- or fourth-order science- and risk communication and therefore in DRR-communication (see Table 4.4)

First, this section develops the notion of considerateness in terms of communicated content. As discussed in the previous chapters consideration is linked with the concepts of democratisation of risk, 'ethical' risk communication, and 'science in society' goals.

The notions of an ignorant public that needs to be 'educated' to achieve 'accurate' risk perception, are considered to be 'inconsiderate'. Instead the information provided should be a balanced explanation of controversial issues S. Miller (1997) that engages by inviting the audience to form individual judgments rather than prescribing a response. The information should support, rather than direct audience decision-making (Bostrom, Atman, et al., 1994; de Marchi & Ravetz, 1999).

Even where scientific expertise is being used to inform DRR-decision-making 'in the public good' it should be explained. B. B. Johnson (1999) suggested that it is preferable to reveal the goals of several options. In particular *considerate* communication requires a clear distinction between objective and subjective information, between facts and frames (Cerroni, 2007; Leach et al., 2010; A. Stirling, 2007). Facts may be considered verifiable evidence-based information, and frames as value judgments (Druckman & Bolsen, 2011). Explicit communication of value judgments is a part of Funtowicz's (1993) 'post-normal science'. This requires clear separation between the data, information, knowledge and wisdom being communicated as was illustrated in Figure 1.1. Communications about risk issues typically involve a *"normative leap" from data to recommendations, from facts to values, from what "is" to what "ought" [to be]"* (Schön & Rein, 1994, p. 26). Issues in the public sphere in general, and particularly in the media are a mixture of empirical, evidence-based information (science) and subjective value judgments, including 'emotive appeals' (Baumgartner and Jones, 1993). The communications thus become *"ionized in value fields"* (J. Weber, R. & Word, 2001, p. 493).

A significant portion of *considerate* communication is whether contextual information is provided; whether the different perspectives of various stakeholders are identified and recognized - in terms of culture, point of view, needs and constraints (see sections 4.2.8-4.2.12). Where communications are about decisions made by policy- and decision-makers on behalf of citizens those communications should include a discussion of how those decisions were made on the public's behalf (Keselman, Slaughter, & Patel, 2005). There should also be a clear distinction between the knowledge base (including scientific uncertainties) and the decisions (that will incorporate social, economic and political values). Openly communicating subjective contexts, alongside objective information increases public trust and enhances civic engagement (Bickerstaff, Lorenzoni, & Pidgeon, 2010; Jasanoff, 1993; Wynne, 1992). Further discussion of the building of trust continues, most particularly in six sections relating to Contextualised communication (sections 4.2.6-4.2.12).

### 4.2.3 Complete; include all aspects of the '7T's strategy

Collectively, communications should be *complete* in that they include examples of best-practice; examples of all elements of the practical 7Ts strategy (see Table 4.4). As a consequence the communications will be *complete* in that they include all features of *considerate* communication. (An explanation of the 7Ts strategy is provided in section 4.3.2).

### 4.2.4 Comprehensive; include all topics and subtopics of the issue

Risk (and science) communications should be *comprehensive* (Friedman, 1994; Mileti et al., 1992a; Wilkins & Patterson, 1987). However, as was introduced in section 1.3.12 comprehensiveness has not been the subject of much previous science- or risk communication research.

Comprehensiveness as considered in this research relates to communications, whether they are considered at sub-topic level, or collectively about the full issue the communication should be theoretically robust and tell the whole story (see Table 4.4). Communications should be relevant. However people do not know what they do not know and so rely on science- and risk communicators to identify what is relevant; using a DRR-related example, not communicating about the economic aspects of a disaster but focussing on damage to the built environment. A variety of ways of assessing whether DRR-communication is *comprehensive* were discussed in chapter 3 and the discussion is taken up in section 6.1.

### 4.2.5 Clear; avoid ambiguity or absence of a core message

There should be a clear, core message (Quarantelli, 1980; Tinker et al., 2001) to avoid ambivalence resulting from ambiguity (Fischhoff, 2006; X. Wang, 2008). Also identify up-front what the point of the knowledge being imparted is. Consider: what will the audience be able to take from the discussion, what should they do, should they be alarmed or reassured, will they be left clear about possible solutions and about responsibilities?

### 4.2.6 Captivating; storied or visual approaches are most engaging

Risk information should be made as visual as possible (Greenberg, Sachsman, Sandman, & Salmone, 1989a). This can be achieved by using stories in whatever form, or visuals, graphics or diagrams or info-graphics should be used to enhance understanding of issues and retention of related knowledge (Ibrahim, Salman, Kee, Mustaffa, & Ahmad, 2012; Rowan, 1994b). Within text, structure is increasingly used to tell better stories. For example business writing courses (e.g. write.co.nz) suggest the use of headings, bold text and underlined text to summarise key ideas.

As early as the 1960s it was said that the communication of science should be entertaining and educational, as well as interesting and informative (Krieghbaum, 1967). Many scholars (e.g. Klassen, 2010; Sandman, Sachsman, Greenberg, & Gochfeld, 1987) recognise the need for the material to be engaging. This is to gain citizen attention, and to satisfy news media needs (de Marchi, 1991). The media need also to entertain (Arifon, 2009) since to make events entertaining is to make them newsworthy (Molotch & Lester, 1974). Entertainment need not be equated with frivolity; the seriousness of risk and opportunities in disaster risk reduction can often be captured through a human-interest story.

Storied, or narrative approaches, rather than technical language in a passive voice, are recommended by a number of researchers (Ball-Rokeach & Loges, 2000; Golding, Krimsky, & Plough, 1992; Lanza & Negrete, 2007). Connection of multiple different frames into a jointly meaningful story can generate motivation and commitment for collective action and provide the potential for crafting innovative solutions to risk issues (Bosomworth, Handmer, & Dovers; Brugnach et al., 2011). Participatory storylines or narratives influence whether the public participate in policy processes (Hendriks, 2005). Ricketts, Shanteau, McSpadden, and Fernandez-Medina (2010) showed that story-based messages resulted in a 19 per cent improvement in safety behaviour, compared with non-narrative communications.

Stories can bridge the gap between what is referred to by many as the impersonal nature of science, and the need for emotion in communication (e.g. Denis, 1995). Part of the rationale for this recommendation is rooted in the fact that technical information has been found to have little or no effect on risk perception whereas emotive and or humorous language does (Golding et al., 1992; B. B. Johnson, Sandman, & Miller, 1992; Sandman et al., 1993).

Research by Marx et al. (2007) in risk communication and subsequent decision-making, also suggests that personal or vicarious experience, vivid descriptions in the form of scenarios, narratives and analogies, appear to elicit responses that are often favoured over statistical (analytical) information. Analogies and metaphors are powerful (Rowan, 1994b). Salience can be shown through analogy, or historical precedent (Plough & Krimsky, 1987). In the absence of sufficient information about DRR, citizens set their achievement levels in relation to their peers (Nara, 2010). In contrast, stories can provide examples that are more pertinent and personal.

It has been suggested that "story form corresponds to an underlying cognitive structure that may, possibly, be genetically programmed, and if they are right, the story must, indeed, be viewed as essential" (Klassen, 2010, p. 306). W. R. Fisher (1985a, 1985b, 1988) in his Narrative Paradigm theory proposed that all meaningful communication is a form of storytelling. In pedagogy, narrative and stories contextualise learning, result in greater understanding of factual content, allow perspective shifting (cause new frames of reference to be entered into), create an environment where there is unconscious learning, foster critical thinking and co-operative enquiry, allow multiple knowledge systems to be accessed, foster co-operative inquiry, have a motivational function and lead to retention of information, since story detail is integrated with memory (Abrahamson, 1998; Jane Gilbert, Hipkins, & Cooper, 2005; Klassen, 2010; McQuiggan, Rowe, Lee, & Lester, 2008). Stories are said to engender trust and bonding, help people understand and remember, alter perception, encourage action, cause people to act, and allow integration of diverse pieces of information (Gargiulo, 2005; C. Heath & Heath, 2007; Stiff & Mongeau, 2003). Research by Marx et al. (2007) in risk communication and subsequent decision-making suggests that personal or vicarious experience, vivid descriptions in the form of scenarios, narratives and analogies, appear to elicit responses that are often favoured over statistical (analytical) information.

Stories are thus a form of collective memory of DRR lessons that communities can utilise before a disaster, rather than learning those lessons through a disaster event (G. Su et al., 2008). However, disasters increase concern and focus attention on the value of DRR (Birkland, 1997; Lindell & Prater, 2002). The caveat is that concern has been shown to peak immediately after events and then die off (Burger & Palmer, 1992; G. Gregory et al., 1997; Helweg-Larsen, 1999). In New Zealand focus group participants with experience of various hazards showed no greater preparedness over the long term, than others in the focus groups studied (G. Gregory et al., 1997). However, Hanson, Vitek, and Hanson (1979) found that awareness of the possibility of natural disaster does not decrease with time, provided there is reinforcement at school and by media. Therefore risk communications that tell stories of others' experiences of loss in disasters may counter optimistic bias, deriving from concepts of impersonal impact (McClure, 2006). However, stories that are captivating only in terms of the degree of damage or potential damage are not recommended (as is discussed in Chapter 6). A few survey and interview respondents also mentioned the value of storied approaches.

### 4.2.7 Contextualised; there are four aspects to context

Increasingly, *contextual'* information is recommended in good risk communication (e.g. Golding et al., 1992; Jönsson, 2011; Kasperson, 1986; Lowrey et al., 2007; A. Stirling, 2008b; Wynne, 1991). Context is very important for understanding the complexities in risk-management decision-making processes (Bier, 2000; Lowrey et al., 2007; Seville, Vargo, Stevenson, & Stephenson, 2011).

Note that in spite of all the recommendations relating to contextual information, there is still very little research that offers practical guidance (Johnson, 1999), such as provision of multiple frames, or the impact of multiple frames on audiences, while at the same time remaining *concise*. Nor is there, for all the criticism relating to media bias, much guidance about just what constitutes appropriate or 'balanced coverage' (Kodrich & Laituri, 2005; Wilkins & Patterson, 1987). The research in this thesis has considered different types of contextual information that citizens might most benefit from. In Chapters 6 and 7 at least one example and recommendation has been provided that is applicable for each New Zealand earthquake-related DRR story type.

Scholars making these recommendations discuss provision of context in one or more of four ways, 1) contextual precision, 2) presentation of multiple contexts (alternative interpretational perspectives), 3) addressing concerns (including providing local context), and 4) contextualising uncertainty. These aspects of context are discussed in sections 4.2.8-4.2.12.

### 4.2.8 Contextualised 1 - Comparable; use numbers carefully and with supporting narrative evidence so that information is comparable

'Contextual precision' is needed because while citizens are said to like numbers as well as qualitative information citizens require more than numbers (Amberg & Hall, 2010; Hornig, 1993). All important factors, even those that are not quantifiable should be included (Gallopin, 2001). Rather than presenting numerical risk information in an absolute numeric format, it should be presented with 'contextual precision', that is with 'narrative evidence' (Dieckmann, Slovic, & Peters, 2009) as a 'standard of comparison'. This may be referred to as comparable or confirmable information (Amberg & Hall, 2010). It is important to avoid using numbers in a way that recipients confuse precision with accuracy (Cuzens et al., 2007). Cuzens et al. (2007) have collated some ways of avoiding miscommunication in relation to numbers, such as:

1) using frequency statements whenever possible
2) being careful not to reverse the order of conditional probabilities
3) not confusing relative percentages
4) not using single number probabilities without reference information
5) not drawing risk inferences from numbers; and
6) not using precise numbers to imply a level of accuracy that does not exist.

This is an example of separating facts from frames.

### 4.2.9 Contextualised - 2) Complexity; the provision of multiple perspectives is very important

A second aspect of contextualised communication is that complexity should be communicated. Assumptions, conventions and protocols relating to risk assessments need to be explicitly stated (Stirling 2009). Contextual details might include the boundaries drawn, the baselines set, methods chosen, expertise used and who commissioned the research, the range of disciplines involved and how sensitivities were explored (even if these details are provided as links only).

A key feature of deliberative inclusive processes, as introduced in section 1.2.6, is that different discourses on the same issue need to be interwoven to realize the full potential of a democratic society (Endres, 2010). There should be a sense that multiple perspectives have been considered and multiple sources used (Mileti et al., 1992a; Morgan & Lave, 1990), creating a sense of 'learned alliance' (Abrahamson, 1998, p. 446) or collaboration.

Citizens require information that is rich and heterogeneous (Shackley & Wynne, 1996). As discussed in Chapter 2, plurality of scientific viewpoints is increasingly accepted (Braun & Kropp, 2010) hence more than one facet of the complex reality of risk should be presented (Fischhoff, Slovic, & Lichtenstein, 1982). The public are said to consider frames more carefully when they are exposed to multiple and competing frames, therefore rather than communicating only one single frame aligned with a singular informational goal, multiple and diverse interpreting frames should be presented (Bier, 2000; Bosomworth et al., 2014; Bostrom, Atman, et al., 1994; Brugnach et al., 2011; Chong & Druckman, 2007a; Faulkner & Ball, 2007; Lowrey et al., 2007; Morgan & Lave, 1990; Porto, 2007a). Webb, Wachtendorf, and Eyre (2000) and Alexander (2007) emphasised that communications should acknowledge the different perspectives of various stakeholders in terms of culture, point of view, needs and constraints

### 4.2.10 Contextualised 3a) - Concerns of citizens should be addressed

> *When there is an event people have questions – at that point there need to be answers … instead of being told that EQC and insurance [companies] are working together we needed to know what it is they are working on, what are the road blocks, what are the implications, what are the options, what are they grappling with*
>
> Canterbury-based Recovery advocate I029

Citizen concerns need to be addressed. Matching scientific information provided with the information people say they require, to make or rate risk management decisions is critical (Sandman et al., 1987; Vogel et al., 2007). Science should be presented in ways that resonate with citizens (D. A. Scheufele, 2014). Decision-relevance should be made explicit (Bostrom, Atman, et al., 1994). Priorities other than commercial interests need to be communicated (Bucchi, 2008). Contextual information should consider folk wisdom, peer groups and traditions as well as appealing to authority and expertise (Brossard & Lewenstein, 2010; Plough & Krimsky, 1987). Explanation should also be given of how the issues have been prioritized and the time frames involved, the effects of economic or business focus, and any deficiencies in the regulatory environment (Stirling 2009). In this way communicated scientific information may become more socially Contextualised and socially robust (Gibbons, 1994) and thus better able to serve individual and societal decision-making processes and the actions that derive from them.

Survey and interview respondents in this research voluntarily suggested the way of achieving *concise,* yet contextually complete information in the media, is through provision of links to other information (see Table 4.5). This is easy in the digital age. It is suggested that very brief or *concise* communications should include links or hyperlinks to websites and other sources of additional information as a way of providing the supplemental contextual information (see also *confirmable* in section 4.2.16 below).

### 4.2.11 Contextualised - 3b) Local context is important

> *Scientists who communicate warning information to the media must recognise the background, commitments, values, needs and expectations of those they communicate with. Their efforts should be directed at conveying information in a way [that] is useful to the target population.*
>
> de Marchi (1991).

DRR research and its communication must be relevant to individual and collective needs (I. Davis & Bellers, 1995; Fothergill, 2000; Gori, 1991; Malone, 1993; R. S. Olson & Nilson, 1982; Wilkins & Patterson, 1987). Science tends to present the wider generalizable context, however more specific local or individual contexts have been shown to be more compelling and influential than outside expertise (Plough & Krimsky, 1987; Siegrist & Cvetkovich, 2000). Science information should have direct applicability to its audiences (Weichselgartner & Kasperson, 2010). Communicated content gains more attention when it portrays issues as having direct impact on the life of the audience, greater personal relevance or salience (Petty & Cacioppo, 1986; ter Huurne & Gutteling, 2009). Opinions and behaviour change are dependent on salience and accessibility of beliefs (Hastie & Park, 1986). When frames are both applicable, and accessible they are most like to influence opinions, beliefs, actions and or behavioural change (Chong & Druckman, 2007b; Price et al., 1997).

Many scholars stress that risk communication must address and consider audience perceptions, values, and information needs whether they relate to criticisms, concerns, or visions (Covello et al., 1989; Griffin, Dunwoody, & Neuwirth, 1999; Lumsden, 2003; Pidgeon, 1998; Renn, 1998b; Renn & Levine, 1991; Rohrmann, 2003a; Rowan, 1994a, 1994b; Seeger, 2006; Slovic, 1999; Tinker et al., 2001). These authors urge communicators to identify with citizens and personalize information, show how citizen points of view are understood, and concerns recognised, respected and addressed (Ball-Rokeach & Loges, 2000; Rowan, 1994b; Sandman, 1994). Culture-specific factors of risk evaluation should be acknowledged (Rohrmann, 2003a; Wilkinson, 2001). In particular, local relevance should be provided (Godschalk et al., 2003; Havídán Rodríguez et al., 2004; Sims & Baumann, 1983). Plough and Krimsky (1987) (Plough & Krimsky, 1987) suggest that it is important to personalise risks, and emphasise potential impacts on family and community, not only general statistical variation and probability. Personal relevance affects information seeking and decision-making behaviours (J. P. Robinson & Levy, 1986). As was discussed in the previous chapter, the audience's information needs should not be assumed, but should be regularly and proactively ascertained. That said, a study identified that citizen risk information needs in the US and Turkey were almost identical (Kasapoğlu & Ecevit, 2004).

Moving to the DRR-specific, if salience and relevance are not emphasized, media coverage of disasters and mitigation-preparedness information may not be 'heard' (Mileti & O'Brien, 1992; Perez-Lugo, 2004; Wilkins, 1985). If there is no local context, people will not necessarily recognise the relevance of a disaster elsewhere to their situation (Perez-Lugo, 2001). As discussed earlier, salience may be achieved through framing. It follows that if messages portray (frame) exposure to earthquakes and associated hazards as being salient or relevant, they will gain more attention. An example would be communicating that earthquakes are an everyday possibility anywhere in New Zealand. An added level of salience may be added by emphasizing the possible DRR actions that individuals and communities can take part in, rather than only mentioning the authorities' and institutional initiatives and undertakings (ter Huurne & Gutteling, 2009). Furthermore Paton, Bajek, et al. (2010) have shown that attitudes to risk and DRR solutions are influenced by others who share interests.

### 4.2.12 Contextualised - 4) acknowledge unCertainties

Another aspect of contextual information relates to uncertainties. Citizens are concerned about understanding uncertainties (Bier, 2000; Lowrey et al., 2007; Seville et al., 2011). There are many uncertainties in science (Nelkin, 1995) yet there has been a historical reticence to acknowledge uncertainty. This is partly because 'certainty rhetoric' implies importance, credibility or definitiveness (Amberg & Hall, 2010). Admission of uncertainty is viewed by some as signalling a lack of consensus of shared understandings about claims (Amberg & Hall, 2010). Some consider that 'the public' were and are intolerant of uncertainty even to the point of outrage (Sandman et al., 1987; Tully, 2007b). There is no discussion of how this intolerance compared and compares with that of scientists and engineers. The difference is simply implied. However, in any part of the globe, in any culture, science, risk and their communication are characterised by uncertainty (Paton, Bajek, et al., 2010). Citizen reactions to newspaper and television reports of natural hazards are greatly affected by the degree of ambiguity (or uncertainty) in the reports (Spencer, Seydlitz, Laska, & Triche, 1992). Consequently there is a need for scientists, policy- and decision-makers and public alike to share common understandings of uncertainty.

There are increasing calls to acknowledge and accommodate the limits of scientific knowledge and associated uncertainties and 'tell it like it is' (e.g. Braun & Kropp, 2010; Carvalho, 2007; B. B. Johnson, 2003; Likens, 2010; Wynne, 1992). The limitations of science need to be acknowledged (S. Miller, 1997; Oki & Nakayachi, 2012). The public need to know that *"there are no simple or definitive answers in risk assessment*" (Friedman, 1994, p. 205). Information is needed, says A. Stirling and Scoones (2009), that explains not only the interpretation of results but acknowledges uncertainties and the potential for errors.

(Friedman, 1994, p. 207) stated citizens *"need to know what was known, what data were missing, what the scientific consensus was."*

Many scholars emphasise that communication of the uncertainties of science should occur alongside communication of scientific facts and suggest ways that this occurs, or should occur (Brugnach et al., 2011; Hornmoen, 2009; Marx et al., 2007; Mellor, 2010; Nigg, 1982; Patt & Dessai, 2004; Shackley & Wynne, 1996; A. Stirling & Scoones, 2009; Stocking, 1999; Zehr, 1999). For a review of research relating to seismic risk and uncertainty see Bostrom et al. (2008). In summary there are three types of uncertainties and their disclosure in communications is needed: a) science is always provisional knowledge, b) risk models and assessments come with many inherent limitations and uncertainties and yet those models are still valuable in decision-making; (uncertainties relating to the choices and the potential effects of risk management must also be recognized), and c) linguistic uncertainties.

Firstly there is a need for experts in any field to acknowledge and communicate that science is provisional, not definitive knowledge (Burkhart, 1987; J. Gregory & Miller, 1998; Keey, 2000; Patt & Dessai, 2004; Rohrmann, 2003a; J. Weber, R. & Word, 2001). As was written two decades ago *"when state-of-the-art knowledge about the probability of aftershocks is [being explained], the public, including the victims, is quite capable of understanding that science does not have all the answers"* (Denis, 1995, p. 17).

Then there is a need to acknowledge and accept the particular limitations associated with the identification and assessment of risk (S. Miller, 1997). Faulkner and Ball (2007, p. 76) suggest that there is a need for risk communication to support the notion of *"joint (mutual) ownership of the embedded uncertainties of risk assessment"*. (Otway & Wynne, 1989) refer to such communication, where uncertainties and difficulties in managing risks are recognised, as 'authentic communication'.

There are many uncertainties relating to hazard occurrence, including timing, magnitude and the spatial extent of the hazard's impact (Dwyer et al., 2004). Scientists need to remember representations of uncertainty and risk do not reflect a reality of objective knowledge, but are constructed by those who discuss them (Shackley & Wynne, 1996). There is a need to acknowledge where scientific findings have been subjectively extrapolated into assumptions, assessments and models or where scientists' value judgments have been integrated with the science (Cohn, 1990; IFRCRCS, 2005; S. Miller, 1997). If the science, or data are inconclusive this should be acknowledged (Burkhart, 1987). Uncertainty due to variability in findings or disagreements should also be disclosed (Finkel, 2008; Stirling, 2008; Tucker & Ferson, 2008). Expert biases should be acknowledged, (Bradbury, 1989; Plough & Krimsky, 1987; J. Weber, R. & Word, 2001) and uncertainties that potentially lead to ambiguities need to be clarified. For example, stories about worst-case scenarios in risk estimations (Alexander, 2007; Brugnach et al., 2011; Carey & Burgman, 2008; Tucker & Ferson, 2008b; X. Wang, 2008). There may also be unanticipated or unarticulated risks (Bradbury, 1989; Plough & Krimsky, 1987; Seville, 2009; J. Weber, R. & Word, 2001). Such 'unknown unknowns' also known as 'ontological uncertainties' should be communicated (Seville, 2009).

Linguistic uncertainty should also be considered (Amberg & Hall, 2010). Examples of linguistic uncertainty, such as ambiguity, vagueness of terminology, under-specificity and context are discussed in Carey and Burgman (2008). A combination of both negative and positive framing may cause ambiguity that in turn may lead to ambivalence and inaction (Wang, 2008). For recommendations about communicating degrees of (un)certainty and use of calibrated language see for example guidelines of the Intergovernmental Panel on Climate Change IPCC (2010) or Doyle, Johnston, McClure, and Paton (2011).

### 4.2.13 Counteract; use Rowan's four steps to avoid myths and misconceptions

> *A core competency in responsible [DRR] communication is the ability to recognize likely [DRR] myths and to avoid perpetuating them. A closely related competency is the ability to limit oneself to describing accurately what is known and to avoid speculating about an uncertain future, unless that speculation is based on a body of evidence about past events that are relevant to the present one. Members of the media have the additional responsibility of being able to detect and expose DRR myths as they are being generated through thoughtful questioning or astute commentary (e.g., "What is the [evidence] basis for your statement that ...?").*
>
> (Arnold, 2006, p. 2)

Addressing or counteracting certain topics or explanations that provide little evidence basis, and therefore do not serve society well has been identified as important in both science- and risk communication. Dispelling 'misconceptions' and 'myths' is of concern to both physical, social health and scientists at a hazard, disaster and risk issue-specific (e.g. Kirkis, 2006; Tierney et al., 2006; Wenger et al., 1975 - see also section 2.4.5). As a result some suggest that the eradication of myths and misconceptions should occur through 'education' of the public and media (e.g. Kirkis, 2006). The desire is a 'rational' approach to risk communication. The suggestion here is that if an 'educative' approach is taken it must be done considerately with no suggestion of ignorance. The scientific approach has been to provide information in a ‘myths-versus-facts’ format. Whitney et al. (2004) suggested use of this format to explicitly challenge previous misconceptions about earthquakes. This has been done on websites where they are available for media to use (e.g. USGS and GNS). It does not appear however that the value of a ‘myths versus fact’ format has been empirically tested, and certainly not in terms of implications for DRR (as opposed to background knowledge of earth science). Oates, Pinkey-Drobnis, Reeves, Wilson, and Gravley (2012) is an example of a study of, as it is titled *“... how well the media educated the public on geoscience during the 2010-2011 earthquake sequence in Christchurch”*. The goal in that study is citizen knowledge of earth science, not of their knowledge of DRR or other DRR-related sciences.

Arnold (2006) suggested that the eradication of myths and misconceptions is the joint responsibility of scientists and media. Such a multi-stakeholder approach to improving communication will become familiar throughout this thesis research, as it is applied to all aspects of communication improvement. The goal in explaining difficult information is not to make precise claims, but to anticipate likely confusions and facilitate further learning (Rowan, 1994b). Rowan (1994b, p. 372) presented four steps that should be followed in explaining science- and risk-related information. Step A: state the erroneous but plausible notion. Step B: acknowledge its apparent plausibility. Step C: demonstrate its inadequacy by noting inconsistencies between it and evidence familiar to the audience but not yet considered. Step D: present the more accepted view and demonstrate its greater adequacy.

### 4.2.14 Comprehensible; avoid complex language and technical jargon

Most of the above features of ‘best-practice’ science- and risk communication are often repeated in scholarly and ‘grey’ literature, but perhaps none so often as the need to avoid technically complex language and technical or beaurocratic accounts that may be used to enhance the stature of experts (A. Anderson, 1997; Atman et al., 1994; Ball-Rokeach & Loges, 2000; Barnes et al., 2008; Bowers, 1980; De la Cruz-Reyna & Tilling, 2008; Rojecki, 2009; Rowan, 1994b; Sandman, 1994; Tinker et al., 2001; Tully, 2007a; J. Weber, R. & Word, 2001). Alexander (2007) refers to giving interpretable information rather than raw information or theoretical information. Citizens will value ease of comprehension more than establishment of expertise through the use of complex language. This aspect of content has neither been discussed in detail nor analysed for in this research. This is because it is a relatively frequently cited required aspect of good science- and risk communication not only in academic research but also in the media itself, as well as in survey and interview. If it is necessary to use a technical term Rowan (1994b) recommended giving examples and 'non-examples' of the term's use. Most importantly terms should be defined by attributes that are always present and variable attributes should be represented as such.

### 4.2.15 Concise; simplify data and complex information without trivialising to avoid information overload

*"When you have a piece of data worth showcasing - which happens much less often than you think - use every strategy to simplify it."* (Sandman, 1994, p. 260).

One of the significant challenges for science- and risk communication lies in communicating complexity concisely. This is particularly so when one includes the layer of complexity added by communicating contextual information and in particular, uncertainty (see above). Kahan (2010) also suggested that the prevailing approach has been simply to communicate 'more' volumes of 'sound data'. Those communicating science need to be mindful of the crowded evidence and option space into which they are providing scientific information (Bielak et al., 2008). This is because detailed hazard information is not well retained (Julia S. Becker, Johnston, Paton, & Ronan, 2009) and also there is a need to counter a public perception of technical complexity in risk analysis (Godschalk et al., 2003). Maintaining an air of complexity may promote scientific authority but it does not assist citizens in understanding risk concepts. Complexity also adds to information overload (Castells, 2010).

Complex information needs to be simplified without making it trivial (Cuzens et al., 2007; Funtowicz & Ravetz, 1993; Godschalk et al., 2003; Major, 1998; Sandman et al., 1987). Alexander (2007) refers to giving interpretable information rather than raw information or theoretical information. While communications should be clear and simple and avoid superfluous information, they should not be condescending, or patronizing through oversimplification (A. Anderson, 1997; Blanchard-Boehm, 1998; Bostrom, Atman, et al., 1994; Bowers, 1980; Cuzens et al., 2007; Faulkner & Ball, 2007; Fischer, 1994; Keey, 2000; Keselman et al., 2005; Major, 1998; Mileti et al., 2006; Mileti, Drabek, & Haas, 1975; Mileti & Fitzpatrick, 1992; Havidán Rodríguez & Dynes, 2006; Rohrmann, 2003a; Rowan, 1994a; Sims & Baumann, 1983; Tinker et al., 2001).

Providing clear links to further information, or to diagrams or info-graphics that summarise information will also assist in reducing communication volume. There is further discussion of the provision of links in the following section, to the visual information in section 4.2.5. Some sections of the results chapters discuss the links provided for different story types.

### 4.2.16 Confirmable; provide advice that is evidence-based - links to other information

What is communicated should be able to be confirmed. Communications should *"facilitate access to previously acquired knowledge"* (de Marchi, 1991, p. 298). Paton, Sagala, et al. (2010) found that individuals when given risk information are likely to seek further information from community members and civic agencies. Therefore additional information to that being communicated should be easily accessible. Individuals first seek information to determine whether a potential threat is relevant, and, if that is the case, they seek information about actions they can take to remedy the threat (various in Kuttschreuter, 2006). Other research has also highlighted the importance of information-seeking behaviour and the availability of links to in-depth supplemental and supporting information (Griffin et al., 1999; Hart & Leiserowitz, 2009; Mileti & Darlington, 1995; Mileti et al., 1992a; Neuwirth et al., 2000; Nigg, 1982; ter Huurne & Gutteling, 2009; Valenti & Wilkins, 1995). Paveglio et al. (2011) refers to the provision of 'detail in a sidebar'.

Some research highlights the fact that individuals in minority communities are less likely to accept a risk or warning message as credible without confirmation of the message from known others, specifically interpersonal networks (Spence, Lachlan, & Griffen, 2007). The more frequent the links to evidence-based information in the mass media are, the more likely interpersonal networks will refer to it.

Communications that enhance information-seeking have been shown to be associated with greater levels of DRR preparedness. For example Mileti and Fitzpatrick (1992) found that if information generates a desire to seek more information it is more likely to result in action outcomes, for example greater levels of preparedness. The scholars mentioned above in this section clearly see information-seeking as a desirable stage in a series of stages that ideally end with a DRR action. However other studies into citizen's risk-related information-seeking practices suggest that they are a reaction to 'information dearth' and associated uncertainty about scientific findings, threats, or response alternatives (Eiser et al., 2012; Griffin et al., 1999; Nigg, 1982, 1987; Weinstein, 1989; J. White & King-Wa, 2012). White (2012) referred to 'information authentication'. Information seeking and information authentication are linked to risk perception, affective response, perceived susceptibility, and also to building social trust (Griffin et al., 2008; Hart & Leiserowitz, 2009; Kuttschreuter, 2006; J. White & King-Wa, 2012). Each affects the other. Whether they are linked to information, the solution to a problem of information deficit, a trigger for action, or a way of providing the contextual information without making the basic message long (section 4.2.12 and sections 4.6.6-4.6.9) these links are clearly important in science-, risk- and DRR-communication.

Whatever the reasons for information-seeking are, links are a way of achieving a balance between the two commonly-cited yet diametrically opposed challenges in communication; lack of information, and/or information overload (Castells, 2010). The provision of links to additional information is a way of satisfying citizen needs for further information by directing them to evidence-based sources, leaving the information-seeker less 'prey' to claims that are not able to be substantiated.

*Confirmable* information may be the result of *collaboration* and co-ordination but is not necessarily consistent. Co-ordination and *collaboration* between credible sources is considered important (Cuzens et al., 2007) to ensure that messages are *concise, clear* and cover the most essential aspects of DRR knowledge (i.e. are *comprehensive* and *comparable*). However building trust through a contrived consistency is considered to be at odds ethically with transparent communication. Consistency is a risk communication recommendation made by a range of scholars and risk communication practitioners (Fischer, 1994;Mileti, 1982;Mileti, 1993;Nigg 1987;Lowrey et al., 2007;Lumsden, 2003;Rodríguez et al. 2006; Perez-Lugo, 2004;Cuzens, 2007). At high levels this is evidenced by directives such as the one to *"speak publicly with a single scientific voice, especially when forecasts, warnings, or scientific disagreements are involve"* such as in the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) guidelines (Newhall et al., 1999, p. 323). The rationale for this repeated recommendation is to avoid a perceived loss of credibility and trust, and the erosion of confidence by lay public and stakeholders where uncertainty and differences of opinion among scientists may be interpreted as a sign of incompetence (IAVCEI 1999;Barclay et al 2008;Barnes et al 2008;Solana et al 2008). Experts and officials alike express concerns about the threat of confusion, and the potential for citizens to become alarmed when experts do not agree (Mazur, 1984). Palttala, Boana, Kund, and Vos (2012) mentioned the need for co-ordination and cooperation between response organisation in crisis communication.

The need for transparent and open communication about unknowns, and any disagreements about risk assessments and risk reduction options and decisions was a repeated feature of responses to the survey and interviews conducted as part of this research, and is considered more important than consistency.

It is important that advocates are ready to provide messages to media and sources when disaster occurs. This is particularly so because G. Su et al. (2008) found that survey respondents indicated that they learnt much of their earthquake knowledge and disaster coping skills subsequent to the Sichuan earthquake. Needham and Nelson (1977) suggested that government agencies and academic institutions should prepare and publish information in such a way as to counterbalance the limitations of newspapers.

The New Zealand strategy "Working from the same page" developed by CDEM would appear to be based on the concept of consistent messaging. Having reviewed its content, the approach seems more to reflect the co-ordination and *collaboration* relating to *concise*, *clear* and *complete* communication. It is this style of information that this research seeks to build upon and improve, with the simple statements being ones that media and sources can use and repeat. This requires interagency collaboration and possibly Memoranda Of Understanding (MOU).

According to Kreps (1980) interagency MOU to assist in timely and coordinated DRR content have been recommended since 1957. MOU were also recommended by (Cate, 1994) and MOU between government experts and media in the public health space were discussed by Keselman et al. (2005). Arnold (2006) recommended offering evidence-based training in disaster risk communication for public officials and members of the media before emergencies occur. No other scholarly literature referring to the development, successful or otherwise, of MOU in relation to aspects of DRR has been found. The author was told about templates that were used in relation to the Canterbury earthquake (pers. comm. I022 June 2012). Media can and do rally support and promote solidarity in response (see section 2.4.2 on media utility), so this may be extended in relation to other parts of the DRR cycle. The intent for greater collaboration between all DRR advocates and the media is certainly the intent of the Sendai Framework (UNISDR, 2015).

### 4.2.17 Concrete; advice should be linked to solutions and action

Thompson (2012) emphasises the need for communicators to suggest possible solutions, responsibilities for solutions, concrete action, or opportunities for intervening and developing solutions. Decision-relevant information should be provided (Fischhoff, 2006) and action should be recommended Mileti and Fitzpatrick (1992), citizens can be given something to do (Quarantelli, 1980), backed by evidenced-based information. Also there is a need for ideas of what to do and responsibilities for this (Mileti & O'Brien, 1992; Seeger, 2006; Thompson, 2012). Citizens look for advice in risk messages - cues concerning how to react and tangible, behavioural actions that can be taken (Lachlan & Spence, 2007; Sandman, 2003). For Turner, Nigg, and Paz (1986) and Major and Atwood (2004) provision of the 'necessary information' for 'rational decision-making' means including interpretations and advice as to what to do. It is suggested here that to be ethical statements should be prefaced with either the evidence-basis itself, or a statement to the effect of 'commonly agreed' recommendations. It should be noted though that while 50% of citizens surveyed by Haynes et al. (2008, p. 264) agreed that *"individuals should have the freedom to make their own risk decisions".* Just over half of the respondents also admitted that they were pleased that the decisions were made for them.

McClure (2006) suggested that any 'behavioural change interventions' i.e. communications, will be more effective if they focus on DRR solutions rather than problems:

- focus on specific, rather than broad actions
- specify how those actions may be carried out in a specific timeframe; and
- foster problem-solving focussed coping, rather than emotion-focused coping that focuses on negative emotions related to problems.

That said, there should be an offer to work toward mutually satisfactory solutions rather than pre-manufactured ones (Rowan, 1994b). In reporting the outcome of collaboration this should be highlighted (cf. sections 2.5.8 and 4.2.6 and 4.2.13). Communication of DRR actions is the focus of section 6.6.

### 4.2.18 Credibility; source expertise, source reliability, transparency and trust are intertwined

> *In the absence of having strong leadership, that someone knows what's going on everybody has felt the need for us to become experts in everything – in insurance law, policy, DBH guidelines, and building codes and consenting; because we don't have anybody we can trust telling us that actually, you're not being ripped off … People in institutions and organisations need to know how to listen to the questions people are asking in response and recovery … and to respond to citizen's questions in a way that builds trust.*
>
> Canterbury-based recovery advocate I029

Credibility, transparency and trust are integral, albeit complex, and inter-related parts of risk communication. Frame effects have been shown to be highly dependent on trust

(Chong & Druckman, 2007a; Lecheler et al., 2009). Risk communications must be believable and credible, as the 'effectiveness' or 'success' of risk communication under any communication model, is highly dependent on trust (Julia S. Becker, Paton, Johnston, & Ronan, 2012; Blanchard-Boehm, 1998; Fischhoff, 2006; Frewer, Scholderer, & Bredahl, 2003; Kasperson, Golding, & Tuler, 1992; Longstaff & Yang, 2008; Mileti, 1982; Mileti et al., 2006; Paton, 2008; R. G. Peters, Covello, & McCallum, 1997; Renn & Levine, 1991; Seeger, 2006; Sims & Baumann, 1983; Slovic, Fischhoff, Lichtenstein, Corrigan, & Combs, 2000; ter Huurne & Gutteling, 2009; Trumbo & McComas, 2003; Voorhees et al., 2007; Wynne, 2006). Communities are more resilient to disaster and disaster recovery is likely faster where communities have access to trusted information (Longstaff & Yang, 2008). Previous research on how risk interpretations, trust, and DRR actions are inter-related is summarised in (Eiser et al., 2012).

Trust counters the likelihood of feeling overwhelmed due to complexity and uncertainty (Paton, 2008). This holds true regardless of whether media emphasis is on collectivised responses to risk or it places responsibility on individuals or institutions (Bakir, 2010, p. p11). As a result risk reduction measures are more likely to be adopted if the source of communication is trusted (Paton et al. 2006; Paton, 2007; Becker, 2012). Communities are said to be more resilient to disaster where information is trusted, in particular disaster recovery is more likely and faster where communities have access to trusted information (Longstaff & Yang, 2008). Few of the aforementioned scholars extend their discussions far beyond warning and crisis communication. Trust and credibility nevertheless also have a role in recovery or communication about risk reduction.

Trust relates to more than the provision of scientific information and perceptions about hazard and risk problems. Trust also strongly influences perceptions of individual coping, and other broader perceptions of DRR, such as citizen assessments of risks, and the costs and benefits of risk reduction. Many have shown that if information is trusted and therefore believed it is more likely to result in preparedness actions. Part of the reason for this is that citizens will not need to spend time verifying information. In contrast censorship for example in totalitarian states is said to destroy trust (Sjöberg, 1998).

According to Frewer et al. (2003) there are two aspects of trust, source reliability and social trust. However review undertaken as part of this research shows that scholars appear to refer to four inter-twined aspects of *credibility* and *trust* in terms of communicated content and its sources. The four aspects are: 1) information content, 2) source expertise, 3) source reliability, and 4) social trust[12].

[12] 1) Information content - the inherent nature of the information – how reliable or (un)certain it is. Many of the concerns mentioned relating to mass media accounts conveying inaccurate, biased or sensationalistic information relate to the potential undermining of trust in scientific methods, explanations and evidence (Fischer, 1994; Nigg, 1987; Perez-Lugo, 2001; Plough & Krimsky, 1987; Wenger et al., 1975). This aspect differs significantly from the following three, and was discussed as part of *contextualised* communication. Information content is trusted more if uncertainties are addressed (section 4.2.9). Trust may also be improved by including links to other verifiable sources of information (see 4.2.16).

2) Source expertise – 'source credibility' is linked to source expertise in either or both of the generation of information and/or its translation (communication) (R. G. Peters et al., 1997). Frewer et al. (2003) refers to source credibility in terms of an individual or institutional information source's knowledge about an event or issue and its solutions or management. (In this research the issue and its management is earthquakes, disasters and/or DRR). Arlikatti, Lindell, and Prater (2007) referred to interpersonal trust, where an institution provides people with information they need to decide whether and how they manage the risks themselves. Establishing source expertise can be achieved by describing how judgements were reached, describing the source's personal successes and relevant background in solving similar problems, indicating knowledge of and an appreciation for local expertise and describing ways that the source benefits from serving the audience's best interests (Rowan, 1994b).

3) Source reliability – a form of source credibility related to how the (in)*complete* the information content, or alarming or reassuring is, or is perceived to be because of framing or perceived framing to serve the source's interests. This form of source *credibility* is influenced by perceptions of trustworthiness, in terms of honesty, transparency, and completeness of information content (Arlikatti et al., 2007; Frewer et al., 2003). *Transparency* of information and other evidence of accountability and *credibility* of communicated content positively influences trust (N. Brown, 2003; Chryssochoidis, Strada, & Krystallis, 2009; Stenekes et al., 2006; Zhang & Wang, 2010; Zhu, Xie, & Gan, 2011). If the source(s) are perceived to be, open, honest, transparent, concerned and caring, risk-related communications are more likely to be believed and trusted (R. G. Peters et al., 1997). Communicators are encouraged to be honest, frank, open, not hide adverse information and only promise what they can deliver (Cuzens et al., 2007; Keey, 2000; Lumsden, 2003; Rohrmann, 2003a; Tinker et al., 2001). Openness is essential for citizen participation (Guobin, 2008).

Acknowledging benefits and harms is part of achieving this form of credibility and trust (Rowan, 1994a, 1994b). Openly offering anecdotes to illustrate success or failure of solutions (Hoskin, Day, & Elms, 2007) is another feature that is said to inspire trust. This is referred to in the strategy below as *telling it like it is* (section 4.3.2). Part of believability, and *telling it like it is* relies on not implying that everything is safe (Paling in Lumsden, 2003). Citizens are "*not to be reassured at all costs"* (Denis, 1995, p. 17), because the public will not necessarily panic (Quarantelli, 1988) depending on how the information is framed. This is discussed further in Chapter 7.

4) Social trust is *trust* in those attributed with responsibility in managing or communicating about an issue (Paton, 2008). A range of risk management scholars cited in ter Huurne and Gutteling (2009) consider that the greater the degree of trust the public have of risk communicators and risk management institutions, the greater the likelihood that 'co-operative action' is generated. However ter Huurne and Gutteling (2009) cautioned that the emphasis on generation of trust is often part of a communication strategy aligned more to the prevention of outrage rather than generating co-operative action. Part of building trust requires communicators to be aware of framing effects. In particular communicators should be transparent about the philosophical and ethical assumptions behind the judgments and pronouncements they make. Recognizing and being transparent about the aims and goals of risk communication and DRR-communication requires clearly presenting options and views arising from professional experience rather than 'packaging proven knowledge' (H. P. Peters et al., 2008; Trench, 2008). These authors suggest that the evidence-basis for the options, or views (advice) should arise from professional experience for which the evidence-basis is provided.

Social trust relates to willingness to let institutions manage risks (Frewer et al., 2003). Social trust involves trust in the political culture and democratic process (Plough and Krimsky, 1987). Siegrist and Cvetkovich (2000) referred to trust in those who are responsible for considering the risks, and managing them. Trust is shaped in part by informational support from government (Zhang & Wang, 2010). Zhang and Wang identified that the more that people trust, the more resources they will be willing to allocate to communal facilities. Trust is thus involved whether responsibility for the management of risk is placed on individuals, institutions or collectivised responses to risk (Bakir, 2010). Social trust is thus related both to citizen perceptions of institutional performance in disaster, and of community participation in decision-making (Paton et al. 2006; Becker, 2012). How source reliability and source credibility are framed, and whether reasons for social trust are in evidence in absence of media communications will affect how these elements are perceived, and thus ultimately influence the reaction to any risk communication.

-blank-

## 4.3 A solutions-focussed strategy for DRR-communication

### 4.3.1 Strategies for risk and science communication are uncommon

It is uncommon to find the recommendations translated in one place into a content-focussed strategy or a set of strategies. As part of this research a range of general recommendations in science- and risk- communication have been condensed into sixteen features of 'effective' (16Cs). The following discussion leads in to the presentation of an overall strategy for science- and risk communication content.

Lumsden (2003) noted that while guidelines for risk assessment have existed since the 1960s, risk communication received far less attention until the late 1990s. Trench and Bucchi (2010) observed that there were no books providing coherent, theoretically unified frameworks for guiding studies of key issues in science communication. S. Miller (2008) identified that very few strategies for science- or risk communication exist, before going on to discuss examples. Some examples were identified in this research that were not referred to by Miller. For example Rowan (1994b) described a solutions-focussed strategy that she said had been recommended by risk communicators for centuries. Lumsden (2003) summarised the strategies of three major US-based risk communication consultants. Tucker and Ferson (2008a) summarised risk communication recommendations stemming from studies on risk perception, neuroscience and evolutionary social science presented at the Montauk symposium on risk communication. A more recent risk communication strategy by Smillie and Blisset (2010) posed a series of questions as pre-communicative reflection on risk, situation and role in risk issues and communication that are linked to the importance of acknowledging goals and ethical and moral considerations in risk communication.

Comparing the above-mentioned strategies, the following five points should be noted. 1) The strategies may contain reference to elements of third order communication, but often fail to make a key goal-framing distinction. That is to disclose whether the intention is to advocate for the issue, for example of DRR, or whether it is to promote certain risk management practices over others. 2) The rhetoric of deliberative inclusive practices is often applied, but only to the point that someone wishes to apply the technique as a new form of 'persuasive social marketing' (e.g. Steelman & McCaffrey, 2013). 3) Rowan's (1994b) strategy clearly provides solutions to match all the groups of identified problems, but Steelman's strategy has been applied in an analysis of DRR-communication. 4) The strategies were focused on the scientist, rather than all stakeholders involved in communication. 5) None of the above-mentioned strategies are content-focussed. Finding general strategies for communicating content rather than practice, is challenging. Although Smillie and Blisset (2010) also offer some direction in terms of content, their strategy is more practice-, than content-focussed. The same may be said for strategies of Ball-Rokeach and Loges (2000), Bier (2000) and Sellnow, Ulmer, Seeger, and Littlefield (2009).

In relation to natural hazard communication itself Haynes et al. (2008, p. 259) referred to a *"limited literature ... heavily based on documentary analysis and retrospective accounts by [geoscientists]".* Liverman, Pereira, and Marker (2008) provides a compendium of such accounts. The concluding remarks in such studies typically contain generalised calls, citing others, for a new type of scientist trained in communicating, presentation of scientific findings in 'novel and interesting ways', simple jargon-free communication and the building of relationships with media and journalists (e.g. Pasquarè & Oppizzi, 2012; Pasquarè & Pozzetti, 2007).

Clearly a strategy that would hold for science- and risk- and DRR-communication should address all that has been discussed already in this chapter. Miller promoted one strategy in particular.

> *[Weingart et al, 2000] gives a clear communication strategy for the person given the task of explaining risk to their fellow citizens: tell the story, touching base with the audience, and give them some idea, at least, of what to do about it.*
>
> (S. Miller, 2008, p. 285)

The strategy prepared by Weingart, Engels, and Pansegrau (2000) has served as the basis for the 7Ts content-related science- and risk–communication strategy devised as part of this research (Table 4.4) and discussed in the following section.

### 4.3.2 A content-related science- and risk communication strategy (7Ts) is presented here

> *Understanding why they've made decisions makes you feel less powerless… then you can go 'I don't like the decision, but I do understand it'. It's almost like you can then take some responsibility for it. Us not knowing about it we just get to hate it and complain about it' ... Tell it like it is – we will understand.*
>
> Canterbury-based citizen recovery advocate I029

This section describes and discusses the elements of a strategy based on the findings of this research; the '7Ts' content-related science- and risk communication strategy. The strategy is aligned to the '16Cs' as shown in Table 4.4, and is supported by the references cited in section 4.3 as well as from survey and interview results, an example of which is given in the quote above.

1) Tell the story as a sequence of events. One school of thought suggests it is a good idea to begin with an unfolding narrative about the problem. This may be the short-term and longer term consequences, the cause(s), then move to providing the solutions and who is responsible for them (Weingart et al., 2000). Alternatively, as Mileti and Darlington (1995) recommended, the 'how to' information could be presented before giving scientific information. No research has been identified that has found which order citizens prefer. A goal-related suggestion is to start by identifying what the question is that is being answered (section 4.2.10).

2) Theoretically robust – evidence-based, holistic, integrated. *Tell the story completely*, explain how risks were identified, analysed and evaluated (A. Stirling, 2008b). Scientist sources should be communicating how results were obtained, why they believe them and how controversial issues have been argued (S. Miller, 1997). The story should acknowledge citizen risk concerns, how the implications of citizen evaluations were incorporated into the risk analysis, and any risk management decisions made (Fisher, 1991). The story should also provide additional information, or links to that information and/or where citizens can get information about risk assessment processes (section 4.2.14).

3) The whole story. Communicators should provide more than one point of view, and discuss risks and benefits (Amberg & Hall, 2010; Zaksek & Arvai, 2004). They should acknowledge if experts are divided in their opinions, and what has been decided. Trust is critical and

> *... must be a two-way street. The local population needs a trusted source of information, and that source is more likely to be trustable if they trust the people with whom they will communicate; for example, "I will trust [local government] if it trusts me enough to be prepared to tell me the whole story".*
>
> (Longstaff & Yang, 2008, p. Discussion)

4) Touch base with the audience.

a) *Identify goal.*

b) Establish salience. Show the relevance. Using the risk terminology from

Extrapolating from the discussion in section 2.3 this will require communication about exposure and vulnerabilities as well as probabilities, with links to everyday experience.

Comparisons need to be made with more familiar risks and there needs to be clarity about the need or lack of need for alarm (Weingart et al., 2000).

5) Tell them what they want to know. Individuals wish to understand what might happen, what has been decided, possible DRR actions and likely results (A. Stirling, 2008b). Then they can base their choices and actions on who best serves their interests (Öktem, 2010). *"Make available not only a particular view but also the sources of that view and the means for continuing dialogue"* (Valenti & Wilkins, 1995, p. 187).

6) Tell it like it is. Find the balance between alarm and reassurance. Acknowledge uncertainties (section 4.3.10) and ensure the communications are credible, i.e. transparent and believable (see section 4.3.15). *"Knowledge is power - New Zealanders don't need the facts sugar-coated*." - Prof Kevin Furlong, seismologist source in media article (L. Risk, 2011).

7) Talk about tangible action. Begin with, conclude with or at least include tangible action. This means providing ideas of what to do. Suggest possible solutions – recommend *concrete* action (see section 4.2.14), giving rise to opportunities for intervening and developing solutions as well as responsibilities for solutions (Mileti & O'Brien, 1992; Seeger, 2006; Thompson, 2012) backed by evidenced-based information.

## 4.4 General science- and risk- communication recommendations have been grouped into 16 features a 7-element strategy

General recommendations in science- and risk communication have been condensed into sixteen key features of good practice science communication and risk communication (16Cs); that communication should be considerate, complete, comprehensive, comprehensible, captivating, credible, confirmable, clear, counteract myths and be contextualized; acknowledge uncertainties, provide local context, address local concerns and communicate complexity at the same time as being concise and providing concrete advice.

An overall content-focussed strategy for risk and DRR-communication was also presented in this chapter. The seven elements of this 'best-practice' strategy begin with the letter T for easy recall. The strategy is; to tell a story, the whole story, making sure it's theoretically robust, touching base with the audience, telling people what they want to know, and 'telling it like it is' and beginning, including or concluding with tangible action. The '7Ts' strategy is as applicable to the journalist as it is to scientists, or decision-makers.

As there is also a need to consider issue-specific problems in communicated content issue-specific recommendations have been collected, synthesized and are presented, along with new results and recommendations, in the following chapters. Recommendations related to DRR-related media story types and the portrayal of the sciences of DRR are presented in Chapters 5 and 6 respectively. DRR-topic-specific recommendations are presented in Chapter 7.

-blank-

# 5 Stories, Science and DRR

*The science is being recognised at the high levels of government. The answers to issues regarding city planning and rebuilding are at the interface of science, government, insurance companies, and public perception*

Dr Mark Quigley in "The year the earth shook" (Dudding, 2011)

## 5.1 Investigating the science in earthquake-related stories

This chapter considers:

- a variety of DRR- and science-related frames that made or did not make earthquake-related news (all sections)
- the event frames that have been used to research and communicate earthquake-related science (section 5.2).
- the issue frames that were used in earthquake-related media, and how these changed over time (section 5.2)
- New Zealand earthquake-related media story types in DRR generally (section 5.3)
- New Zealand earthquake-related media story types relating to the portrayal of the sciences of DRR (section 5.3)
- the proportion of science in New Zealand earthquake-related media stories (section 5.4)
- the role of science as portrayed in New Zealand earthquake-related media (section 5.5)

Previous research has identified the following event-related biases toward;

1) disaster-related harm (not issues – section 5.2.2)
2) geographic bias (section 5.2.9)
   d) cities' interests over rural areas (section 5.2.10)
   e) coverage by local media (section 5.2.10)
   f) international events in countries that are close by with which there are trade, other political, or tourist links (section 5.2.11, 5.2.15 and 5.2.16)
3) story types (section 5.3)

The biases, related findings and conclusions from this analysis of New Zealand media are further discussed in the sections indicated above.

Other biases were identified in this research, such as toward certain DRR-science-related issues in the media (discussed in section 5.4) are also presented in this chapter.

Codes used in this research to quantitatively analyse the media were developed as per section 3.6, and summarised in Table 3.12.

Recommendations are made to counter what were identified as one or more of media, media source, or research biases. A combination of one or more of the following supports the conclusions and the associated recommendations made in this chapter (and following results chapters 6 and 7):

- observations, conclusions and recommendations from previous social-psychological-, media- or earthquake-related research
- what New Zealand survey and interview respondents indicated as important in relation to these topics; and
- how the topics were discussed in the New Zealand mass media in the years 2008-2012, before, during and after the Canterbury earthquakes.

Unlike most previous research the recommendations therefore do not favour one stakeholder group's needs over the others. With the recommendations supported in quite different ways their relative value is undefined. What this research has done is to bring the full range of recommendations together under the clearly stated contemporary goal frameworks of considerate communication and DRR through sustainable development situated in a public participatory democracy paradigm. It is recognized that many of the recommendations have not yet been the subject of media effects research, however they are a starting point for improving issue-related aspects of DRR communication. It is expected that future researchers will test the value and success of any or each of the recommendations to DRR.

It is suggested then that previous research that suggest a media focus on harms should not be considered such a concern for DRR. The following sections 5.2.1 and 5.2.2 explain why.

## 5.2 DRR, science-, risk- and disaster story frames

### 5.2.1 Events and issues are both 'news pegs' – opportunities to discuss DRR

> *Unless you have someone who is itching to get these messages across, they're not going to get led down that path [by the journalist]. So if there are scientists or experts who are being consulted they need to be considering it [a disaster event] as a rare opportunity.*
>
> Interviewee I019 - Science Communicator, Wellington

Portraying the need to take risk reduction actions is said to be problematic in the absence of 'news' about risk, a hazard event or disaster. The media, however, focus on 'events' and 'harms' rather than other issues, according to previous studies (e.g. Singer & Endreny, 1994; Tully, 2007b). Media personnel, when interviewed, have stated that events cost less and take less time to report on than issues (Sood et al., 1987).

This section discusses the fact that the framing of media as having an events and harms focus is not helpful in terms of value of the media and DRR. The following discussion shows that there are many existing stories published before, as well as in and after disasters that are opportunities to communicate aspects of DRR. The above-mentioned concerns may be partly due to a lack of clarity in previous studies about what constitutes an 'event frame' or an 'issue frame', as these 'news pegs' (as they are referred to by Cooper & Yukimara, 2001) are the events or issues that trigger media stories.

Analysis of academic research article headlines reveals similar 'biases' to those previously highlighted in the media. Furthermore this research has shown that 1) there are a variety of different event types; 2) the distinction between event- and issue-basis made by Singer and Endreny (1987) and other researchers is rather unclear; and 3) events can be used to introduce issues. When combined these three things suggest that event-focused-framing may work for, rather than against DRR.

### 5.2.2 Both event frames and harms frames scaffold issues

The coding used in this research illustrates how previous research appears unclear about the distinction between events and issues. Many of the articles analysed in this research considered issues in response or recovery for a particular event. In some literature it is unclear how previous scholars coded these articles. In others such articles have been coded either as issue- or event-focused. Further, some arguably event-related stories are focused on a possible future event; in other words a risk issue (e.g. articles discussing Canterbury residents' or earth scientists' on-going concern about earthquakes). For this reason article headlines were coded in this research according to whether they were about a) an event-related issue b) harms associated with an event (either an occurrence or disaster) or c) an issue with no event (e.g. no earthquake occurrence). The prevalence of each type of article is shown Table 5.1.

**Table 5.1: Event-related issue, harms and issue with no earthquake event**
Comparison of percentage of articles in the two Stuff datasets before and after the Darfield earthquake (STUFF-Pre and 1000-STUFF respectively) and percentage of television (TV1) items that relate to a) harms associated with an event (either an occurrence or disaster), b) an event-related issue that does not only relate to harmsor c) an issue with no event.

| Event, Issue, Harms | % Stuff articles | | % TV1 items | |
|---|---|---|---|---|
| | Pre-Darfield | Post-Darfield | Pre-Darfield | Post-Darfield |
| Disaster/Event Harms | 49.2 | 21.6 | 28.6 | 14.1 |
| Event-related Issue | 46.9 | 75.4 | 71.4 | 85.2 |
| Issue with no earthquake occurrence | 3.9 | 3.0 | 0.0 | 0.7 |
| No. of articles or items | 774 | 1000 | 91 | 1406 |

Clearly both print media and television focused on disaster events and harms, rather than just issues. Both media focused more on event-related issues after the Darfield earthquake. Television focused on event-related issues both before and after the Darfield earthquake. However, even the print media discuss issues in at least 50% of their coverage between local disasters. During, and after disasters this rose to over 70%. Each of these articles contributes knowledge to society about one or more aspects of DRR.

Categorising articles as having an event-, harms- or issue-focus may be interesting this categorisation may perpetuate the framing of the media as harms-focused, and is not necessarily a robust way to measure the value of media articles to DRR. Knowledge about disaster event consequences is vital to understanding DRR, as will be further discussed in Chapter 7.

### 5.2.3 Only a dozen specific earthquakes generated more than ten media articles

Depending on the corpus analysed, the categorization of events that may, or do, cause harm relate to different types of hazard occurrence or disaster event triggers such as flood, or hurricane. In this research events that may or do cause harm were categorised as follows:

- by the earthquake events; whether occurrences (caused by plate tectonics or associated with volcanoes) disasters, or references to future events (Table 5.2)

- specific earthquakes (occurrences or disasters); by geographic location and date (Table 5.3, Table 5.4, Tables 5.7a, b, c, Table 5.8, or Table 5.10); and
- by the type of disaster; such as international disasters triggered by earthquakes, or earthquakes that occurred in New Zealand that triggered disasters, or non-earthquake disasters in New Zealand or internationally that triggered mention of earthquakes (e.g. Table 5.11).

**Table 5.2: Earthquake event pegs as occurrences, disasters or future events**

Percentage of total articles analysed (before and after the Darfield earthquake in the Otago Daily Times or on television) that a) disasters (all tectonically caused) b) mentions of earthquake occurrences caused by plate tectonics or c) associated with volcanoes, or whether they were d) or e) references to future events or f) a historic disaster. The relevance of the tectonic/volcanic distinction is discussed in section 7.4.8.

| Earthquake event type on which articles pegged | % ODT | % TV1 |
|---|---|---|
| Disaster at the time of writing article | 86.2 | 95.1 |
| Occurrence not disaster - tectonic earthquake | 5.25 | 1.6 |
| Occurrence – not disaster - volcanic earthquake | 0.8 | 0 |
| Future event | 3.58 | 0.8 |
| Disaster plus future event | 1.82 | 1.8 |
| Historic disaster | 0.8 | 0 |
| Not evident from headline | 1.85 | 0.8 |

While the focus of an article may be on a particular disaster type or on no disaster at all (for example a disaster that is not related to an earthquake, or an article where there is only a brief mention of an earthquake – Table 5.4) the specific earthquake mentioned may be different (Table 5.3). These tables show that most earthquake-related reporting was disaster-related reporting.

Only a dozen specific earthquake events generated more than 10 articles or items (Table 5.3). With few articles mentioning previous events little learning could occur, as is further discussed in section 5.2.13.

There were examples where one medium reported an overseas event but another did not. For example on 20 March 2009 television covered an earthquake in Tonga that the print media did not. The greatest range of events was covered by the ODT.

In New Zealand between 2008 and 2012 less than 4% of articles focused on future events, print-media articles about historic events were rare, and television items non-existent (Table 5.2 and 5.4). The set of New Zealand risk related articles is more voluminous than the set of articles relating to any single disaster events, except those related to the Sendai or Canterbury earthquakes.

**Table 5.3: Attributing a specific earthquake event to each ODT article**

Each of the 4837 earthquake-related articles in the Otago Daily Times between 01 February 2008 and 03 January 2012 either focused on the following earthquakes (in date order), mentioned those earthquakes when another disaster occurred, mentioned an earthquake event non-specifically, or in 70 instances did not mention an event at all (issue-only articles).

| Earthquake | Number of articles |
|---|---|
| 1906 San Francisco | 1 |
| 1931 Napier, New Zealand | 6 |
| 1968 Inangahua, New Zealand | 2 |
| 1987 Bay of Plenty, New Zealand | 1 |
| 1995 Kashmir | 3 |
| 2004 Sumatra - Indian Ocean Tsunami | 2 |
| 2005 Pakistan | 11 |
| 2006 Yogyakarta | 1 |
| 2007 Bengkulu | 1 |
| 2007 Gisborne, New Zealand | 3 |
| 2008 Balochistan | 2 |
| 2008 Hastings, New Zealand | 2 |
| 2008 Sichuan | 63 |
| 2009 Fiordland, New Zealand | 41 |
| 2009 Java | 1 |
| 2009 L'Aquila | 12 |
| 2009 Padang | 12 |
| 2009 Samoa-Tonga | 69 |
| 2010 Chile | 46 |
| 2010 Haiti | 115 |
| 2010 Mentawai | 13 |
| 2010 Yushu, China | 7 |
| 2010-2011 Canterbury, New Zealand | 3627 |
| 2011 Auckland, New Zealand | 1 |
| 2011 Sendai | 185 |
| 2011 Van-Ercedis, Turkey | 9 |
| Future Canterbury | 10 |
| Future International | 13 |
| Future New Zealand General | 48 |
| Future New Zealand Regional not Canterbury | 142 |
| Occurrence International | 77 |
| Occurrence New Zealand | 172 |
| Other Disaster International | 9 |
| Other Disaster International Historic | 9 |
| Other Disaster New Zealand Historic | 1 |
| Other Occurrence New Zealand Historic | 6 |
| Other Volcanic New Zealand | 9 |
| Other Volcanic International | 15 |
| General | 20 |
| None, issue only | 70 |

**Table 5.4: Disaster types that triggered earthquake articles**

Number of earthquake-related articles from Otago Daily Times (ODT) dataset that related to the below disaster types: 1) a) related to specific disasters (all rows eaxcept bottom and ‘future earthuakes’; or b) related to the risk of future earthquakes (rows beginning with “Future Earthuake’); or c) ) didn’t relate to disasters or future earthquakes (bottom row). 2) Disaster types were either a) specific earthquake-related disasters; b) disasters not-related to earthquakes; c) about earthquake occurrences - events that did not cause significant damage; d) a future earthquake event; or e) about disasters generally. 3) Each of 2) was about an earthquake event located i) in Canterbury; ii) in NZ but not Canterbury; iii) internationally. NZ = New Zealand.

| Disaster types | Number of ODT articles | | Contribution from brief mentions |
|---|---|---|---|
| Earthquake Disaster NZ Canterbury | 1993 | | |
| Earthquake Disaster NZ not Canterbury | 34 | 2482 | 65 |
| Earthquake Disaster International | 455 | | |
| Earthquake Occurrence NZ Canterbury | 20 | | |
| Earthquake Occurrence not Canterbury | 187 | 271 | 1 |
| Earthquake Occurrence International | 64 | | |
| Future Earthquake NZ Canterbury | 21 | | |
| Future Earthquake NZ not Canterbury | 133 | 159 | 29 |
| Future Earthquake International | 5 | | |
| Non-Earthquake Disaster NZ | 128 | | |
| Non-Earthquake Disaster International | 55 | 183 | 177 |
| Disaster General | 10 | 10 | 9 |
| None i.e. not disaster or earthquake event | 1732 | 1732 | 1705 |

These are all interesting ways of understanding and showing which specific events and what types of events have been considered in the media. The above way of presenting data ‘frames’ the media as being hazard- or disaster-event focused. However it is also possible for the reader to obtain information unrelated to hazard or disaster research from these articles.

### 5.2.4 Science- and DRR-events in the New Zealand media collectively triggered nearly 20% of articles

On reflection there are three quite distinctly different DRR-related science communication-event-based triggers of earthquake-related articles. These are a) earthquake events that did or may cause harm; b) science-related media events that relate to earthquakes; and c) DRR-media-events that relate to earthquakes.

DRR-media- or science-related events that trigger media stories may be considered non- or ‘pseudo-event’s. This research has shown that DRR-media and science-events that trigger media stories may include such events as a media release regarding planned research, an interview conducted during the research phase, the publication of research findings, a presentation to a conference community group or hearing, commentary on an issue raised in the media, an announcement of funding or awards for specific research (Table 5.5). For example, two events this research identified as having triggered science articles containing references to DRR solutions were 1) a psychology conference in Queenstown in August 2011 (e.g. Beech, 2011), and 2) the release of findings about micronutrients, by Christchurch academic Prof. Julia Rucklidge (reported in Stylianou, 2011b). If the analysis had not sought to identify DRR-events, these two articles could arguably have been coded as triggered by the Canterbury earthquakes, and therefore classified as disaster-focused, with an implication that they were harms-focussed.

So, scholars from different disciplines develop very distinctive sets of categories or codes for the same articles. These codes or categories are frames that generate different narratives about the events covered. The researcher intent in exploring science/experts might code the above articles according to the scientists involved, as being related to a conference, or perhaps the conclusion of research. An example of an item triggered by planned research was television item "Geologists drill for answers" about the Deep Fault Drilling Project that highlighted the likelihood of an Alpine Fault earthquake (TV1, 2011-01-27).

Just over 50% of the earthquake-related articles analysed here related to some sort of expert announcement (Table 5.5). The most common announcements related to findings or calculations, warnings, forecasts or experts' advice or recommendations. Less than 1% of announcements related to each of: the beginning of studies, report releases, funding, or reaction to some sort of debate in the media (e.g. reassurance after warnings or defence of scientists' knowledge).

Collectively though, approximately 19% of the articles were triggered by a conference, workshop or lecture, a report release, an expert's involvement in an inquiry or hearing, or the announcement of a study proposal or funding (or the need for it). Approximately 2.5% related to DRR mitigation technologies. Of the other approximately 37% of articles where there was no 'science/expert event', the trigger was either an earthquake occurrence, or an event or announcement associated with earthquake disaster recovery, or response. All but one of those headlines coded as recovery event or the announcements related to Canterbury. (This one related to the anniversary of the Chilean earthquake). This suggests that without a 'newsworthy' deliberately generated event, or waiting for an earthquake or disaster to occur, valuable research may not reach the public.

However it is not known whether an individual scientist initiated the announcements, the organisation they worked for did, or whether a journalist initiated the article.

**Table 5.5: Earthquake-related science events**

Results of analysis of the 1000-STUFF article dataset (which covered the period 04 September 2010 to 03 January 2012) for the different triggers of science-related earthquake articles. Note that five of the announcements of findings/calculations related to revisions of previous findings. 'Announcement-study/research beginning' included one announcement of a new university course. 'Defending knowledge' included forecasting, not having a secret agenda for hazards research, and the role of engineers being misunderstood. The distinction between an announcement with scientist's opinion and an expert providing comment is that opinion articles emphasise expertise but do not provide an evidence basis in the commentary and articles in which experts provide comments an do provide an evidence basis.

| Expert/science events-earthquake-DRR-related | No. of Stuff articles |
|---|---|
| Focus on announcements | |
| Findings/calculations (not uncertainty or challenge or report release) | 203 |
| Warning, prediction or forecast | 93 |
| Opinion (not evidence-based knowledge, advice or recommendation) | 73 |
| Advice/recommendation | 72 |
| Study/research beginning (not funding or proposal) | 23 |
| Uncertainty/challenge (not definitive finding or calculation) | 10 |
| Plan or vision | 8 |
| Report release | 7 |
| Defend knowledge/actions | 7 |
| Funding | 6 |
| Study proposal (not funding) | 4 |
| Focus on expert(s) who (was) | |
| Provided comment | 34 |
| Involved in inquiry/commission/inquest/hearing/trial | 24 |
| Awarded/commended | 12 |
| Attending conference, workshop, lecture etc. | 8 |
| Something (else) happened to | 8 |
| Other (not focus on science announcement or expert(s)) | |
| Other - announcement re DRR mitigation/preparation | 39 |
| Other - earthquake occurrence | 192 |
| Other - recovery event/announcement (no science/scientists) | 177 |

Another set of event types that are more meaningful for DRR-related science communication, not just DRR, or science, or 'about earthquakes', are not overly complex but still somewhat unwieldy, are shown in Table 5.6.

This means that DRR scientists should recognise and identify the opportunities for DRR messaging associated with each of wide-ranging science- and DRR- event types as per recommendation 1 (top p193). This also links to recommendation 2 on p. 205.

**Table 5.6: Earthquake-related DRR science communication events in the media**
Combinations of earthquake-, forecasting- (warning), scientific-research- and DRR-events in the 1000-STUFF articles published after the Darfield earthquake (between 04 September 2010 and 03 January 2012).

| Media event | # of articles | Description |
|---|---|---|
| Earthquake event and recovery | | Did cause harm (consequence-focused) |
| | 496 | Researcher observations/opinions |
| | 12 | Media event summaries |
| | 22 | Response to citizen questions on event |
| | 70 | Authorities assessments/decisions |
| | 26 | Criticism of authorities (not communication) |
| | 20 | Recovery – withholding info |
| Earthquake anniversary | 8 | Anniversary coverage of Darfield |
| | 11 | Lessons/reflections (scientists) |
| Pseudo-event - Warning/Forecast – 10.2% | | Might cause harm (focus identifying risk) |
| | 7 | Building vulnerability, fire |
| | 22 | Health-public/environment on event |
| | 1 | Health-psychosocial |
| | 30 | natural - weather, flooding, tsunami, landslides, liquefaction, volcanic eruption |
| | 18 | Natural - earthquake |
| | 13 | Predictions - Ring (NZ), Rome (Italy) |
| | 11 | Reported citizen reactions to warnings |
| Research-focused event - 16.4% | | |
| | 5 | Research beginning (most hazard related) |
| | 79 | Research finding |
| | 6 | Research funding – mostly Canterbury |
| | 21 | Experts doing/authorities announce |
| | 29 | Reviewing performance incl. communication |
| | 8 | Conference or talk |
| | 16 | Award, commendation or scientist death |
| DRR-event (solutions-focused) – 6.8% | | |
| DRR-preparation (announcement) | 12 | Exercises, collective memory, household results of study about preparedness |
| DRR-mitigation project or technology | 4 | Boulders/rock-fall risk reduction |
| | 26 | Available, possible, successful measure to be applied, successful project or technology |
| Inquest/inquiry/trial | 24 | Royal Commission/L'Aquila trial |
| None-issue only | 2 | Fracking, reading signs before quake |

**Recommendation 1 (any aspect of DRR):** All - DRR advocates should recognise that there are in fact a wide range of science- and DRR-events that are opportunities to advocate for DRR in the media.

### 5.2.5 A range of DRR events triggered earthquake-related-articles

A simple set of codes or frames to represent DRR-events would be a classification in terms of one of the four phases of the DRR cycle. An alternative would be to compile an exhaustive list of the variety of announcements during each of the four phases of DRR. This list could include: announcements about search and rescue, about economic decisions in response, land decisions in recovery, upcoming Civil Defence exercises or drills, or the decision to close a building or retrofit it. Another way of categorising DRR-related events might be to group different stakeholder/social actor group activities. From Table 5.6 one can see that there were few DRR-media events that were not earthquake- or earthquake-triggered-disaster events themselves, or scientists commenting about them.

Table 5.6 shows the codes settled on here. Table 5.6 shows that only 4% of announcements in the New Zealand media related to DRR mitigation or preparation (e.g. a new building technology or design innovation or the release of a DVD for school-children showing them how to be 'turtle-safe'), or were about a project to enhance collective memory of earthquakes. Example headlines were: "$6m event centre to pioneer quake rods" (Newton, 2011c) "Costly hi-tech systems vital to sewer rebuild" (M. Wright, 2011e) and "Poles option for dams in quake-hit suburbs" (Heather, 2010a), "Aucklanders 'least prepared' for disaster: study" (S. Hopkins, 2011), "'Turtle safe' DVD for pre-schoolers"(Fairfax NZ News, 2011h), "Nationwide tsunami exercise underway" (NZPA, 2010h), "In an earthquake - drop, cover, hold" (Newton, 2011b) and "Quakes many stories to go on the record" (Matthews, 2011).

Another type of DRR event that has not been the focus of much disaster media analysis, are announcements in response and recovery. These are announcements such as "Quake land report released" (Cowlishaw, 2010). There are also events that are a key part of recovery that the media writes about. These include leader visits, memorial events, anniversaries, and a 'return to normal'. Such events are invisible under the framing and coding in Tables 5.5 and 5.6. These events are also rarely associated with expert commentary despite being a focus of attention in response and recovery. This drove the search for other, simpler ways to represent disaster- or DRR-related science articles discussed here and in section 5.4. First though earthquake story timing is presented, and timelines of the earthquake and warning events in the New Zealand news analysed are presented in Table 5.7a-c) and Table 5.8.

### 5.2.6 Earthquake story timing shows coverage spikes and tails differed for print and television news

Earthquake-related print news (ODT) and television (TV1) broadcasts were analysed. Coverage volume over time is shown for print news (Figure 5.1) and television broadcasts (Figure 5.2). There are obvious coverage spikes associated with both international and domestic events. This contrasts with the waxing and waning of disaster media stories over time noted in Caldwell et al. (1979) and other more recent studies. Figure 5.3 shows trends for different story categories over time. Although not illustrated here, the recovery tail was shorter for the ODT and TV1 than for Stuff coverage (which is still presenting related stories). This is probably because the former two media channels are located further from Canterbury.

### 5.2.7 Stories about the Canterbury earthquakes flooded the news

The Canterbury earthquakes created the largest coverage spike and tail in New Zealand earthquake-news between 04 May 2008 and 03 January 2012 (Figure 5.1). The Canterbury earthquakes were still prevalent in the news at the time analysis ended 15 months after the first earthquake occurred in September 2010. This is probably because a) of the nation-wide significance of the event, b) noticeable aftershocks were still occurring then, and c) because the Canterbury earthquakes were the most costly disaster events in New Zealand history.

Most print articles and television items captured in the 5 year period for this research related to either or both of 1) the earthquake at 04:25 on the morning of September 4 2010 (the Darfield earthquake) and 2) an earthquake at 12:51pm on February 22 2011 (the Port Hills earthquake) that was an aftershock to the Darfield earthquake. Some of the articles also related to one of thousands of other aftershocks. The most notable Canterbury aftershocks and their magnitudes are shown on Table 5.7c.

In Otago, a region some distance from where the Canterbury earthquakes occurred there was a ten-fold increase in the number of earthquake-related articles published over the 12-month period after the Darfield earthquake. (There were 3604 ODT articles from September 4 2010 to September 4 2011, whereas for the same 12-month period previously (2009/2010) there were only 376 articles, and between September 2008 and September 2009 there had only been 221 articles).

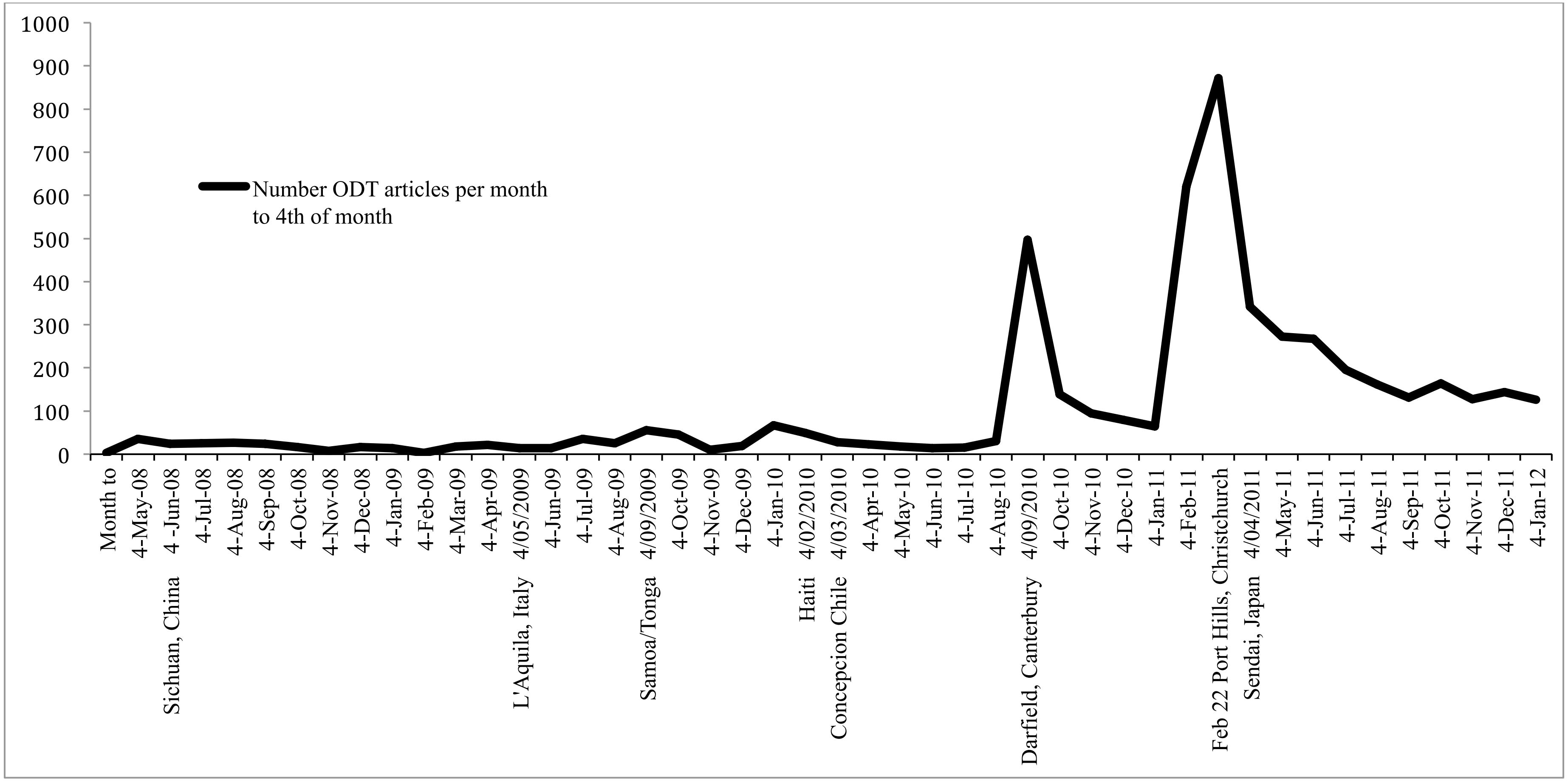



**Figure 5.1: Earthquake-related media coverage over time - ODT**
New Zealand online print articles that included the keyword ‘quake’ published by the Otago Daily Times.

Television broadcasting after the Darfield earthquake peaked on the second day then dropped to background levels within a few weeks of the event (Figure 5.2). The coverage 'tail' of the 22 February Port Hills earthquake lasted longer than for the Darfield earthquake. However it was only approximately 5 weeks until coverage fell to background levels.

Aftershocks caused coverage spikes, as did secondary events and pseudo-events. Examples of such secondary events are the TV1 telethon to raise funds for Canterbury (e.g. TV1, 2010-09-24a), and a report on land damage caused by the Darfield earthquake and its aftershocks (e.g. TV1, 2011-06-23c; TV1, 2011-06-23e).

In contrast, in print news (ODT) coverage dropped off after the Darfield earthquake, but had not returned to background levels when the Port Hills earthquake occurred.

These results generally accord with those of previous researchers; as McKay (1983) identified print media reporting of a major or local disaster typically reached a peak one day after the disaster. On television and on the internet there was typically a 'coverage spike' immediately afterward that tailed off within weeks of the event (Lobb et al., 2012; Souza & Martínez, 2011). Coverage recession was typically observed in the third week after the disaster (Kodrich & Laituri, 2005; Lobb et al., 2012). Coverage faded during the fourth week and almost disappeared, with stories only emerging occasionally thereafter. This is part of the rationale for recommendation 7 at the end of this chapter.

### 5.2.8 What events made the news; timelines of earthquake coverage are shown in Tables 5.7a-c)

Timelines of earthquakes, tsunami warnings and other warnings and predictions are presented in the Tables 5.7a-c) and 5.8. These tables demonstrate what the articles analysed related to, and which events did not make the news. The tables are:

- two pre-Darfield timelines, one covering the period from 1692 to 1990 (Table 5.7a) the other from 1991 to the day before the Darfield earthquake 03 September 2010 (Table 5.7b)
- a post-Darfield timeline Table 5.7c; and
- a table of warnings and predictions in the media: Table 5.8.

(A timeline of articles relating to land-use decisions is presented in Chapter 7 (Table 7.27)).

**Figure 5.2: Timeline of television coverage 04 September 2010 – 03 December 2011**

Shows key earthquake events (left rotated text) and other earthquake-related media (television) events (right rotated text) such as 24 September 2010 Breakfast for Canterbury telethon. Note also that the 17 March Memorial Service which Prince William attended drew more television coverage in terms of number of items than either the Port Hills or Sendai earthquakes, n = 1407.

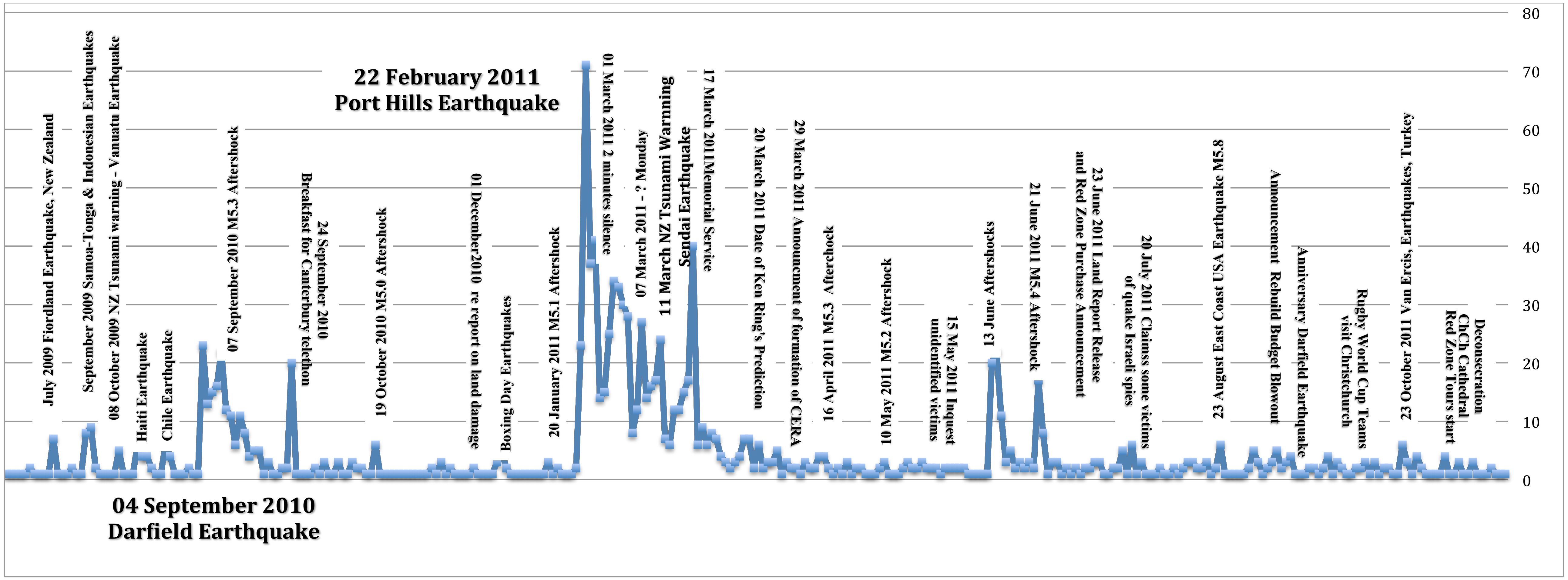
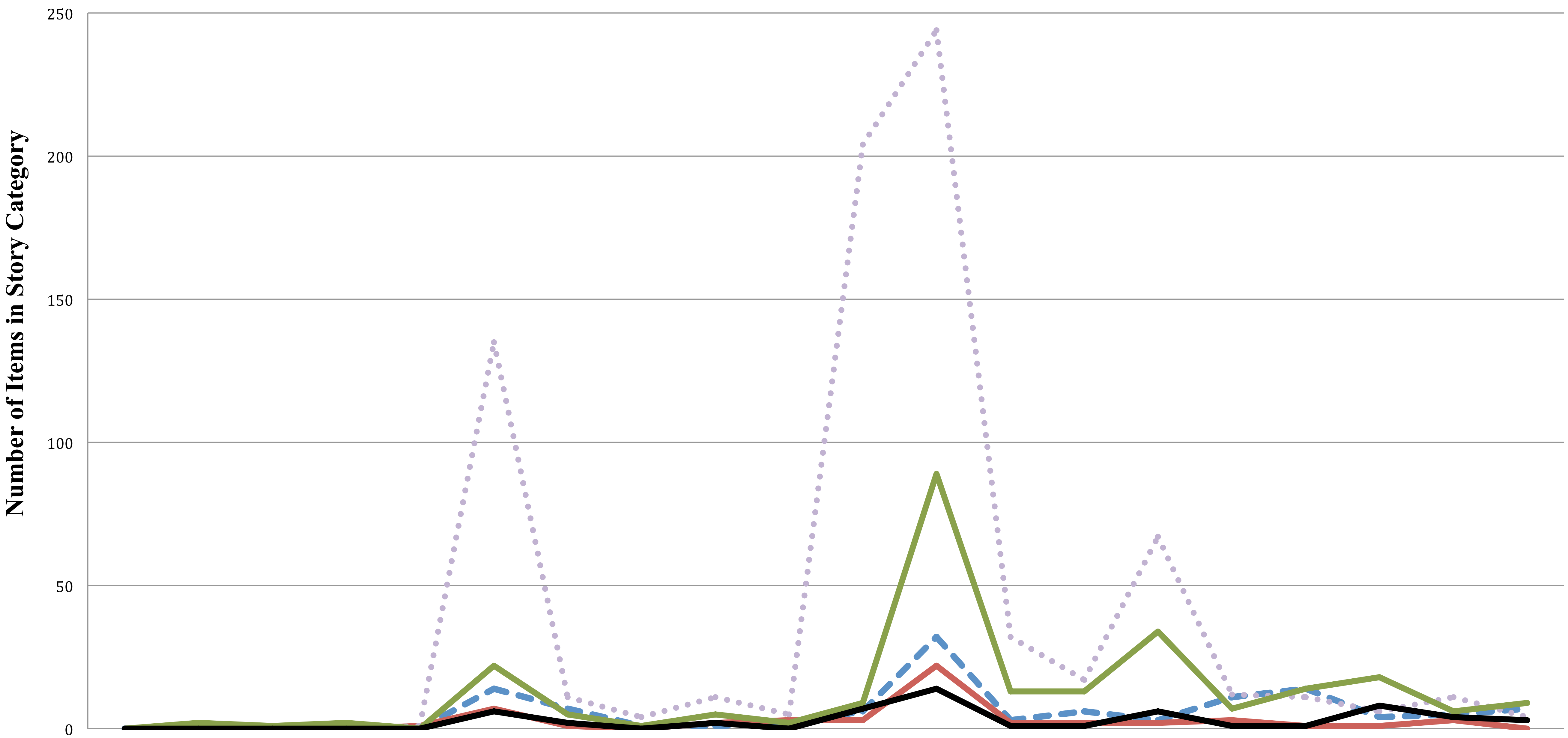


**Figure 5.3: Earthquake-related television coverage – story categories over time**

Prevalence of TV1 news and current affairs story categories over time (01 April 2010 – 30 November 2011). This shows coverage spikes for television coverage are similar to those presented for the Otago Daily times in section 5.2.5. As expected most stories at the time of the Darfield and Port Hills earthquakes and major aftershocks are of the Earthquake! Disaster! Story category. DRR options story types are the least prevalent. Recovery-related stories are the second most prevalent of the five categories.




| | Apr-10 | May-10 | Jun-10 | Jul-10 | Aug-10 | Sep-10 | Oct-10 | Nov-10 | Dec-10 | Jan-11 | Feb-11 | Mar-11 | Apr-11 | May-11 | Jun-11 | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disaster Cause/DRR Review | 0 | 1 | 0 | 1 | 0 | 14 | 7 | 1 | 1 | 2 | 6 | 32 | 3 | 6 | 3 | 11 | 14 | 4 | 5 | 7 |
| Disaster Risk | 0 | 0 | 1 | 0 | 1 | 7 | 1 | 0 | 2 | 3 | 3 | 22 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | 0 |
| Earthquake! or Disaster! | 0 | 0 | 1 | 0 | 1 | 135 | 11 | 4 | 11 | 5 | 204 | 244 | 32 | 17 | 67 | 12 | 11 | 6 | 11 | 4 |
| Road to Recovery | 0 | 2 | 1 | 2 | 0 | 22 | 5 | 1 | 5 | 2 | 9 | 89 | 13 | 13 | 34 | 7 | 14 | 18 | 6 | 9 |
| DRR Options | 0 | 0 | 0 | 0 | 0 | 6 | 2 | 0 | 2 | 0 | 7 | 14 | 1 | 1 | 6 | 1 | 1 | 8 | 4 | 3 |

## Table 5.7a: Timeline of earthquakes 1692-1990 and mentions in the NZ media

Timeline of earthquakes and aftershocks 1692-1985. The three right hand columns indicate article numbers in Otago Daily Times in the period 2008-2012 relating to international (I), national (N) and Canterbury (C) events. Where there were no articles dedicated to a particular earthquake this is represented as '•'.

| Day | Mth | Yr | International, New Zealand and Canterbury Earthquake Events | I | N | C |
|---|---|---|---|---|---|---|
| 7 | Jun | 1692 | Port Royal, Jamaica M8 (2500 deaths) | • | | |
| 1 | Nov | 1755 | Lisbon, Portugal M>8 | • | | |
| | | 1793 | Dusky Sound, New Zealand - first recorded | | • | |
| 6 | Oct | 1848 | Marlborough, New Zealand M7.5 | | • | |
| 23 | Jan | 1855 | Greater Wellington Region, New Zealand M8.2 - Largest in NZ since European colonisation | | • | |
| 23 | Feb | 1863 | Hawkes Bay, New Zealand M7.5 | | • | |
| 19 | Oct | 1868 | Cape Farewell, New Zealand M 7.5 | | • | |
| 16 | Nov | 1869 | Addington, Christchurch, New Zealand M5 | | | • |
| | | 1870 | Ellesmere, Canterbury, New Zealand M5.5 | | | • |
| | | 1881 | Cass, Castle Hill, New Zealand M6.5 | | • | |
| 1 | Sep | 1888 | Amuri, North Canterbury, New Zealand M7.1 | | | • |
| 12 | Feb | 1893 | Nelson, New Zealand M6.9 | | • | |
| 16 | Nov | 1901 | Cheviot, Canterbury, New Zealand M6.9 - toppled the steeple of the Christchurch Cathedral | | | • |
| 18 | Apr | 1906 | San Francisco, US (2500 deaths) | 1 | | |
| 28 | Dec | 1911 | Otago, New Zealand | | 2 | |
| | | 1910 | Manawatu, New Zealand | | 1 | |
| | | 1920 | Kansu, China M6.5 (200,000 deaths) | | • | |
| | | 1922 | Motunau, Canterbury, New Zealand M6.4 | | | • |
| 23 | Sep | 1923 | Tokyo, Japan (123,000) M8 | • | | |
| 9 | Mar | 1929 | Arthur's Pass, Canterbury, New Zealand M 7.1 | | | • |
| 17 | Jun | 1929 | Murchison, Buller, New Zealand M7.8 | | 2 | |
| 3 | Feb | 1931 | Napier, Hawkes Bay, New Zealand M7.7 | | 2 | |
| 5 | Mar | 1934 | Pahiatua, Lower North Island, New Zealand M7.6 | | • | |
| 24 | Jun | 1942 | Wairarapa, Wellington, New Zealand M7.0 | | • | |
| 2 | Aug | 1942 | Wairarapa, Wellington, New Zealand M7.2 | | • | |
| 21 | May | 1960 | Valdivia, Chile M9.5 | • | | |
| 27 | Mar | 1964 | Anchorage, Alaska M9.2 | • | | |
| | | 1966 | Tashkent, Uzbekistan M 7.5 (500,000+ homeless) | • | | |
| 24 | May | 1968 | Inangahua, West Coast, New Zealand M 7.1 | | 8 | |
| 31 | May | 1970 | Yungay, Peru M7.9 (30,000 deaths) | • | | |
| | | 1971 | San Fernando California, United StatesM6.6 | • | | |
| | | 1972 | Managua, Nicaragua M6.2 | • | | |
| | | 1974 | Dunedin, Otago, New Zealand M7.5 | | 1 | |
| | | 1976 | Tangshan, China (240,000 deaths) M7.8 | 1 | | |
| | | 1976 | Italy | • | | |
| | | 1976 | Guatemala | • | | |
| 24 | Nov | 1976 | Van-Muyadije, Turkey | • | | |
| | | 1979 | Imperial Valley California | • | | |
| | | 1980 | Algeria | • | | |
| | | 1980 | Iran | • | | |
| 27 | May | 1984 | Nihonkai-Chuubu Japan (plus tsunami) | • | | |
| 19 | Sep | 1985 | Mexico City, Mexico M7.0 (10,000 deaths) | 3 | | |
| | | 1986 | San Salvador, El Salvador M 5.7 | 1 | | |
| 2 | Mar | 1987 | Edgecumbe, Bay of Plenty, New Zealand M6.5 | | • | |
| 21 | Jun | 1990 | Iran | • | | |

**Table 5.7b: Timeline of earthquakes 1991-2010 and mentions in the NZ media**

Timeline of earthquakes and aftershocks 1986 to 03 September 2010. Three right hand columns indicate article numbers in Otago Daily Times in the period 2008-2012 relating to international (I), national (N) and Canterbury (C) events. No articles is represented as '•'.

| Day | Mth | Yr | International, New Zealand and Canterbury Earthquake Events | I | N | C |
|---|---|---|---|---|---|---|
| | | 1989 | Loma Prieta California, United States M6.9 | 1 | | |
| | | 1994 | Northridge, California, United States M6.7 | • | | |
| | | 1994 | Arthur's Pass, Canterbury, New Zealand M6.7 | | • | |
| | | 1995 | Kashmir, Pakistan | 11 | | |
| 17 | Jan | 1995 | Kobe, Japan M7.2 (5,000 deaths) | 1 | | |
| | | 1997 | Umbria, Italy | | | |
| | | 1998 | Papua New Guinea M7.0 | • | | |
| 17 | Aug | 1999 | Izmit, Turkey M7.6 (17,000 deaths) | • | | |
| 22 | Aug | 2003 | Fiordland, New Zealand M7.1 | • | | |
| 26 | Dec | 2003 | Bam, Iran M6.6 (26,000 deaths) | • | | |
| 23 | Nov | 2004 | Puysegur Trench, New Zealand M7.0 | • | | |
| 26 | Dec | 2004 | Sumatra & Indian Ocean Tsunami (227,000 deaths) M9.1 | • | | |
| 8 | Oct | 2005 | Kashmir, Pakistan M7.6 | 11 | | |
| 26 | May | 2006 | Yogyakarta, Indonesia M6.4 | 1 | | |
| 17 | July | 2006 | Java, Indonesia M7 | • | | |
| 2 | Apr | 2007 | Solomon Is., Pacific Is M8.1 (52 dead) + tsunami (1.1m) | • | | |
| 15 | Aug | 2007 | Pisco, Peru M8 | | | • |
| 12 | Sep | 2007 | Bengkulu, Indonesia (large events 12th and 13th Sep) M8.5 | • | | |
| 30 | Sep | 2007 | Auckland Islands, New Zealand M7.3 | | | • |
| 20 | Dec | 2007 | Gisborne, Hawkes Bay, New Zealand M6.8 - offshore | | • | |
| 3 | Feb | 2008 | Lac Kivu Dem, Republic of Congo M5.9 | • | | |
| 12 | May | 2008 | Sichuan, China M7.9 | • | | |
| 13 | July | 2008 | Hamner Springs, Canterbury, New Zealand (M4.1) | | | • |
| 25 | Aug | 2008 | Hastings, Bay of Plenty, New Zealand (M5.91 30 km depth) | | • | |
| 26 | Sep | 2008 | Kaikoura, Canterbury, New Zealand M5.2, 19:23pm 25km depth, 100s of kilometres from Christchurch CBD | | | • |
| 6 | Oct | 2008 | Chechnya, Kyrgystan, M6.3 | • | | |
| 28 | Oct | 2008 | Balochistan Pakistan M6.4 | • | | |
| 20 | Mar | 2009 | Tonga Pacific Islands M7.9 210 km from Nuku'alofa depth 10km tsunami, no damage, no connection to volcanic eruption | • | | |
| 13 | Apr | 2010 | Gisborne, Hawkes Bay, New Zealand M6.8 - offshore | • | | |
| 6 | Apr | 2009 | L'Aquila, Italy M5. | 12 | | |
| 29 | Jun | 2009 | Waihi Village, Taupo, NZ – associated with volcanic activity, land slide and evacuation | | | 7 |
| 15 | Jul | 2009 | Resolution Is Dusky Sound, Fiordland, New Zealand M7.9@21:22pm 100km, 12km depth tsunami warning | 43 | | |
| 04 | Aug | 2009 | Warning - tsunami NZ, Fiordland, NZ | 1 | | |
| 2 | Sep | 2009 | Java, Indonesia M7 | 1 | | |
| 30 | Sep | 2009 | Tsunami Warning, NZ, Samoa-Tonga, Pacific Islands | 75 | | |
| 30 | Sep | 2009 | Padang, Indonesia M7.6 | 15 | | |
| 8 | Oct | 2009 | Warning tsunami, NZ, Vanuatu | 3 | | |
| 5 | Jan | 2010 | Solomon Is., Pacific Is M7.2@09:30AM + tsunami + aftershocks | 2 | | |
| 12 | Jan | 2010 | Port au Prince, Haiti M7 | 116 | | |
| 28 | Feb | 2010 | Concepcion, Chile M8.8 (tsunami 11, earthquake 48) | 59 | | |
| 8 | Mar | 2010 | Eladig, Turkey M7 | • | | |
| 10 | Mar | 2010 | Tsunami warning, NZ | 1 | | |
| 20 | Mar | 2010 | Warning - tsunami NZ, Tonga, Pac. Is. M7.9@07:17am, 10km | 1 | | |
| 5 | Apr | 2010 | Pegasus Bay Canterbury, New Zealand (*M3.8) widely felt* | | | • |
| 13 | Apr | 2010 | Yushu, China <6.9 | 7 | | |
| 10 | Aug | 2010 | Vanuatu | • | | |

**Table 5.7c: Timeline of earthquakes 2010—2011 and mentions in the NZ media**

Timeline of earthquakes and aftershocks in the Otago Daily Times September 4 2010 to 7 January 2012. Three right hand columns indicate article numbers in Otago Daily Times in the period 2008-2012 relating to international (I), national (N) and Canterbury (C) events. No articles dedicated to a particular earthquake is represented as '•'.

| Day | Mth | Yr | International, New Zealand and Canterbury Earthquake Events | I | N | C |
|---|---|---|---|---|---|---|
| 4 | Sep | 2010 | Darfield, Canterbury (M7.1@04:35, 11km depth, 40km to CBD, 0 deaths Major aftershocks M5.6 04:56 depth 10km, M5.4@16:55 5km depth, M5.3@11:12 9km depth) 7th largest NZ earthquake in recent history. | | | 778 |
| 6 | Sep | 2010 | Aftershock Canterbury NZ M5.4@23:40 6km depth | | | 1 |
| 7 | Sep | 2010 | Aftershock Canterbury NZ M5.3@03:24 15km depth | | | 1 |
| 28 | Sep | | Iran (1 death headlined in Stuff) | 0 | | |
| 19 | Oct | 2010 | Aftershock Canterbury NZ (M5.0@11.32am 10km from CBD, depth 9km. | | | 3 |
| 25 | Oct | 2010 | Mentawai, Indonesia | 13 | | |
| 14 | Nov | 2010 | Aftershock Canterbury NZ M4.7( 01.34am 20km from CBD depth 7km STUFF '*Experts warn [aftershocks] could continue for some time*' | | | 2 |
| 22 | Dec | 2010 | Hosseinabad, Iran (M6.5 7 deaths) – Stuff ODT reports occurrence in Japan | 1 | | |
| 26 | Dec | 2010 | Aftershocks – Boxing Day, Canterbury (STUFF cluster-swarm M4.2@ 2.07am, M4.9@10.30am close to CBD-damaging <5km depth) | | | 2 |
| 26 | Dec | 2010 | Vanuatu M7.3 - no tsunami threat | 2 | | |
| 20 | Jan | 2011 | Aftershock, Canterbury NZ M5.1 (6.03 am 10km from CBD) | | | 1 |
| 22 | Feb | 2011 | Aftershocks – Port Hills, NZ M6.3@12.51pm 5km depth, M5.8 13:04pm 6km depth, 185 deceased | | | 2010 |
| 11 | Mar | 2011 | Yingjiang China M5.8@13.00pm 10km depth | 1 | | |
| 11 | March | 2011 | Warning - tsunami NZ, earthquake and tsunami Sendai, Japan | 22 | | |
| 16 | Apr | 2011 | Aftershock Canterbury NZ M5.3@17:49 9km depth | | | 2 |
| 10 | May | 2011 | Aftershock Canterbury NZ M5.2@15:04pm 12km depth | | | 1 |
| 6 | Jun | 2011 | Aftershock Canterbury NZ - (M5.5@09:09) 10km depth | | | 2 |
| 13 | Jun | 2011 | Aftershocks – June 13 Canterbury, NZ M5.8@13:01 9km depth and M6.3(4)@14:20 7km depth, 6 injured | | | 829 |
| 21 | Jun | 2011 | Aftershock Canterbury NZ - (M5.4@22:34) 9km depth | | | 2 |
| 3 | Jul | 2011 | Auckland NZ M2.9 1 possible death from rockfall | | 1 | |
| 7 | Jul | 2011 | Warning - Tsunami/Sea Surge -NZ - Kermadec Is Pacific Islands M7. | 2 | | |
| 22 | Jul | 2011 | Aftershock Canterbury NZ - M 5.1 (5.3@05:39am) 12km depth | | | 1 |
| 19 | Aug | 2011 | Warning-tsunami - NZ, after Japan earthquake | 1 | | |
| 23 | Aug | 2011 | East Coast, USA M5.8, Mineral, Virginia 145km SW Washington | 6 | | |
| 19 | Oct | 2011 | Aftershock Canterbury NZ M5.5@20:35 8km depth - not on TV | | | 9 |
| 23 | Oct | 2011 | Van-Ercis Turkey M7.2 and aftershock 10 Nov 2011 | 9 | | |
| 23 | Dec | 2011 | Aftershocks - Dec 2011, Canterbury NZ - one >M6, three earthquakes >M5 | | | 17 |
| 2 | Jan | 2012 | Aftershock Canterbury NZ M5.3@05:45 9km depth - top 25 | | | 0 |
| 7 | Jan | 2012 | Aftershock Canterbury NZ M5.3@01:21 8km depth - top 25 | | | 0 |

### 5.2.9 Geographic biases can affect reputation and may impact on response and recovery

The name used to describe where disaster has occurred affect ‘reputation’ and may impact relief and aid in response, and recovery (Rovai & Rodrigue, 1998) and tourism (Chacko & Marcell, 2008).

Note that earthquake-related disasters are often referred to by more than one name, particularly where people associate the earthquake with a city or region (for example see the range of names used for international events in Table 3.7). In geological and geotechnical literature earthquakes are typically named after a location close to the epicentre of the earthquake, but this is not usually how the media or the public refer to them.

Journalists and media sources alike should be aware that Rovai and Rodrigue (1998) showed that how frequently particular geographic localities within a disaster area are mentioned in the media affects response attention and rates of reconstruction and other aspects of recovery. On a wider scale there is concern that geographic bias in the media negatively impacts levels of disaster aid (Eisensee & Strömberg, 2007; Moeller, 2006; Van Belle, 2000) and relative recovery time frames between areas of affected regions that were more or less frequently mentioned in the news. Bias that might affect disaster aid has typically been researched by assessing levels of coverage of disasters in foreign countries (see section 5.2.15 for further discussion).

### 5.2.10 Differences between local and distal print news and television coverage can mean those without benefit of experience of an event miss out on valuable knowledge

Previous research has found that cosmopolitan and rural or local disaster effects are treated differently in the media (Needham, 1986). In particular the non-local consequences of environmental events were defined differently to local ones (Spencer & Triche, 1994), who also noted that there was more attention on the cause of non-local events.

Coverage of the Canterbury earthquakes by Stuff, especially pieces contributed by the major local online print news medium The Christchurch Press was greater than coverage in distal news media such as the ODT, particularly in the recovery period. This accords with findings that coverage is typically higher in local communities (Needham, 1986; Needham & Nelson, 1977; Wenger & Friedman, 1986; Wenger & Quarantelli, 1989).

Total numbers published on Stuff cannot be presented for reasons given in Chapter 3 but the 1000 articles identified from Stuff alone show that there were more articles with potential

**Table 5.8: Timeline of selected media events - warnings and predictions in the media March 2008 to September 2010**

This table covers the period from 04 March 2008 to 04 September 2011. Three right hand columns indicate whether articles relate to international (I), national (N) and Canterbury (C) events.

| Day | Mth | Yr | Warning and prediction events | I | N | C |
|---|---|---|---|---|---|---|
| | Jan | 2008 | "Quake rumour rattles Gisborne residents" (The Dominion Post, 2008a) just weeks after damaging event. (Exact date unknown as all articles from early 2008 on Stuff website 01 Jan 2009) | | • | |
| 16 | May | 2008 | "Rumours fly as China quake victims seek news" (in World News in Stuff - Reuters, 2008a). | • | | |
| 17 | May | 2008 | "China teacher sacked for running from quake school" (Reuters, 2008b) - teacher dubbed "Running Fan" and criticised in international media for running out of school building before helping students. | • | | |
| 8 | Jun | 2008 | Gisborne CD spokesman re tsunami self-evacuations after 2007 event (The Dominion Post, 2008b). | | • | |
| 6 | Jun | 2008 | "Earthquake advice a bit shaky" (The Press, 2008) - re email advising people against taking cover under desks when New Zealand Ministry of Civil Defence and Emergency Management advice is to "Drop, Cover and Hold". | | • | |
| 3 | Oct | 2008 | "Apparent tsunami sighting sparks panic in Canterbury" (NZPA, 2008) - self-evacuations due to sea fog optical illusion. Not published on Stuff, but in ODT. | | | • |
| 8 | Oct | 2008 | Screening of 'Aftershock' docudrama re aftermath of Wellington, NZ during Disaster Awareness week. | | • | |
| 1 | Apr | 2009 | "Quakes 'no cause for worry" (NZPA, 2009a) re possibility of Wellington earthquakes[1]. | | • | |
| 7 | Apr | 2009 | "Scientist muzzled for Italy quake warnings" (Reuters, 2009a) prediction weeks before L'Aquila earthquake[2]. On the following day Stuff published a more detailed articles about the Giuliani prediction ("Scientists dismiss prediction" Reuters, 2009b). | • | | |
| 8 | May | 2009 | A sequence of earthquakes in Wellington is not a precursor for a large earthquake ("'Big one' not coming yet" byField, 2009) | | • | |
| 16 | July | 2009 | "Are we ready for a huge earthquake?" | | • | |
| 27 | Aug | 2009 | "Big earthquake well overdue" (Connell, 2011) relates to a speech in Havelock by Dr Tim Davies of Canterbury University speaking of Marlborough's earthquake risk. (See 07 September following year). | | • | |
| 18 | Sep | 2009 | "Research halves risk of big quake hitting Wellington" (TV1, 2009-09-18). | | • | |
| 1 | Oct | 2009 | "Civil Defence review over tsunami warnings" (NZPA, 2009b) related to an earthquake in Vanuatu. | • | | |
| 30 | Oct | 2009 | "Media did Civil Defence's job on tsunami" (TV1) - re Samoa-Tonga warning. | • | | |
| 01 | Mar | 2010 | "The boy who cried tsunami" (Espiner, 2010) – an article suggesting the warnings regarding a possible tsunami from the Chile earthquake were a case of "cry wolf"[3]. | • | | |
| 20 | Apr | 2010 | "Prediction" by President Ahmadinejad of Iran "could not give an exact date" - in "Scanty clothing causes – earthquakes - cleric" (Reuters, 2010a). On April 22 "'Evacuate Tehran' says Ahmadinejad" (Reuters, 2010b)[4]. | • | | |
| 28 | May | 2010 | "Fire Service apologises over tsunami alert" (NZPA, 2010c) advisory of M7.2 offshore Vanuatu not sent to media. | • | | |
| 23 | Jun | 2010 | Prediction -response to - "Fiji quake prophesiers seized"[5] (Field, 2009). In Stuff, not picked up by ODT or TV1. | • | | |
| 05 | Sep | 2010 | The Darfield event the day before was not the large Alpine Fault earthquake forecast (Bigger earthquake predicted to come" Pepperell, 2010). | | • | • |
| 07 | Sep | 2010 | "Big earthquake is due to rock Marlborough" (Wardle, 2010a). (Note that a damaging earthquake and aftershocks did occur in 2013). | | • | |
| 26 | Sep | 2010 | "The next one" (The Press, 2010) - about likely NZ earthquakes and forecasting versus prediction[6]. | | • | |
| 7 | Feb | 2011 | "Quake prophecy will come true ... eventually" (Newton & Steward, 2011) relates to Anglican Minister Gray Theodore (born Te Keriei Tiatua) a Maori kaumatua (elder) who spoke during Waitangi Day (national day) celebrations of a vision of earthquake devastation and a tsunami in Wellington in a June. | | • | |
| 18 | Feb | 2011 | Ken Ring's earthquake prediction was on the Stuff website in a Marlborough Express article "Quake prediction 'like a horoscope'" (Butterfield, 2011)[7]. | | | • |
| 28 | Feb | 2011 | Interview on TV3's "Campbell Live" programme with Ken Ring "The Moon Man" | | | • |
| 01 | Mar | 2011 | "John Campbell 'sorry' for Ken Ring interview" (Schulz, 2011)[8]. | | | • |
| 05 | Mar | 2011 | "Baker who predicted quake a 'great guy': colleague" (Cowlishaw, 2011)[9]. | | | • |
| 17 | Mar | 2011 | Former USGS geologist "US quake predictor Jim Berkland" (TV1, 2011-03-17) and "Ken Ring's Christchurch earthquake claims 'terrifying people" (Woods & Johnson, 2011). | • | | |
| 31 | May | 2011 | "Big earthquake risk put at 23 percent" (Gorman, 2011f) re risk of large Canterbury aftershock. | | | • |
| 20 | Aug | 2011 | Article mentioned a historic prediction of 'another 'big earthquake' by Cantabrian Halkett Dawson after the magnitude 7.1 in Canterbury on September 1, 1888 ("Early quake forecast faulted" by Lynch, 2011b). | | | • |
| 24 | Aug | 2011 | "Romans flee predicted quake" (Reuters, 2011). | • | | |

[1] *"Earthquake watchers may have been struck by the large number of sizeable tremors over the past fortnight but seismologists say they're not leading up to the "big one". If anything, the long-anticipated quake for which Wellingtonians are told to prepare for is looking less likely."* Lara Bland GNS geoscientist says"

[2] "*An Italian scientist predicted a major earthquake around L'Aquila weeks before disaster struck the city yesterday, killing dozens of people, but was reported to authorities for spreading panic among the population. ... Vans with loudspeakers had driven around the town a month ago telling locals to evacuate their houses after seismologist Gioacchino Giuliani predicted a large quake was on the way, prompting the mayor's anger. Giuliani, who based his forecast on concentrations of radon gas around seismically active areas, was reported to police for "spreading alarm" and was forced to remove his findings from the Internet. Italy's Civil Protection agency held a meeting of the Major Risks Committee, grouping scientists charged with assessing such risks, in L'Aquila on March 31 to reassure the townspeople" "Scientist muzzled for Italy quake warnings" (Reuters, 2009a)*

[3] "Civil Defence Minister John Carter said people who didn't heed the national tsunami warning needed to realise it was a serious event. … apart from the usual nutters and survivalists packing their cars and heading for the hills proceeded pretty much as business as usual for a sleepy Sunday. Go for a walk, have a coffee, ignore the fuss."

[4] Iran's President Mahmoud Ahmadinejad had warned his people to evacuate the capital, given understanding of the city's seismological vulnerability. This was in fact a leader's attempt to reduce the numbers vulnerable in Tehran through reduction of population. The articles were not picked up by ODT or TV.

[5] *"Two men are in Fiji military custody over a failed prediction that the Pacific nation was to be hit by a natural disaster at 2.30 pm today. ... Fiji Rugby Union chairman Bill Gavoka and pastor Laione Lutumaimuri Nacevamaca have been seized by the military regime for spreading rumours."*

[6] *"International earthquake expert Robert Yeats, professor emeritus in geoscience at Oregon State University – "call me Bob"... made headlines earlier this year when he was credited with predicting the magnitude 7.0 quake that ripped through Haiti. "I was interviewed a few days before that earthquake by Scientific American. I did identify Port-au-Prince at that time. People say I predicted the earthquake but I didn't. I just said that there will be one in the future and it will be catastrophic … anyone who says they can predict is a Charlatan".* "The next one" (The Press, 2010).

[7] The Christchurch Press deliberately did not publish about the prediction (pers comm Paul Gorman (I010) in interview).

[8] In link in article John Campbell issued an apology for not having let 'weather forecaster' Ken Ring speak, and for having shown he did not credit Ken Ring with the ability to predict in the belief that Cantabrians did not need the stress of a prediction.

[9] Told of baker Shane Tomlin a victim of the February 22 Port Hills who *"came in [to work] and he said, `Bevie, there's going to be an earthquake today.' I was like `What?'. He said, `There's been a big one in Argentina, and all the whales have beached themselves'."*

-blank-

science coverage published on the Stuff website in October to December of 2011 than in the ODT overall. The recovery tail relating to the Canterbury earthquakes is on going in the local media (on Stuff). However on non-local regional or national coverage the ODT and television typically only continue to report on or about commemorative events, anniversaries and in relation to rebuild milestones.

Specific information about the earthquake consequences and DRR actions will therefore have only been reported in local press; for example Stuff article "Quake: what's working" (Fairfax NZ News, 2010c). This type of information is likely to have been primarily seen by Cantabrians, not necessarily by those elsewhere in New Zealand limiting what non-Cantabrians may have learned about the event (see section 6.7.15).

### 5.2.11 Most international events in the news were covered only on one day; before contributing causes could be known

Before the Canterbury earthquakes there were typically 10-20 articles per month in New Zealand on-line print-media (ODT and Stuff) unless there was a major international disaster. Then the coverage might as much as double (for example when the 2009 Samoa-Tonga and 2010 Haiti earthquakes occurred). Most international earthquake events were covered only on one day in New Zealand. This equates with Eisensee and Strömberg (2007)'s finding that in the United States (US) 85% of international disasters were covered for a day only.

This means though that most articles will have reported will have reported the event before causes were known rather than explaining the factors that contribute to disasters. Discussion of the cause of disasters is continued in section 7.4. In contrast major US disasters remained in US news far longer (Wenger & Quarantelli, 1989). Major US disasters were in US news on average for one year (Houston et al., 2012).

### 5.2.12 Coverage of international earthquakes and non-Canterbury New Zealand earthquake occurrences was similar before and after the Darfield earthquake

After the Darfield earthquake the proportions of coverage changed (Table 5.9) to a focus on New Zealand earthquakes (mostly Canterbury earthquakes and aftershocks rather than international events). However the number of articles in the ODT relating to international earthquake events remained essentially the same (365 articles in the 18 month period before the Darfield earthquake compared with 303 articles in the 15 months afterward).

**Table 5.9: Coverage of international and New Zealand earthquakes in ODT**
Percentage of coverage in Otago Daily Times before (pre) the Darfield earthquake (04 April 2008 to 03 September 2010 - 18 months) and after (post) the Darfield earthquake (04 September 2010 and 03 January 2012 - 15 months).

| | % coverage | | |
|---|---|---|---|
| | **Pre-Darfield** | **Post-Darfield** | **Overall** |
| International | 52.9 | 7.3 | 13.8 |
| New Zealand (mostly occurrences) | 42.2 | 91.3 | 84.3 |
| Both | 4.9 | 1.4 | 1.9 |

### 5.2.13 Canterbury coverage was extremely high compared with other New Zealand earthquakes; at the expense of broad understanding of, and lessons identified from a wider range of events

The level of disaster coverage of the Canterbury event was very high, nationally and regionally. This was not the case for the Gisborne event in December 2007 or the Cook Strait events in 2013, even though the latter were felt and caused damage in New Zealand's capital city, Wellington. Both of these events received proportionally far less coverage than the Canterbury earthquakes. This is probably because the Canterbury events were of nation-wide, rather than only regional significance. (The Port Hills earthquake resulted in the declaration of national state of emergency until May 1 2011). Combined the Canterbury earthquakes were the single-most costly disaster events in New Zealand history 15.3% of GDP, and almost 302,000 people affected (EM-DAT, 2014). However this means that attention to, understanding from a variety of events was not achieved.

This feeds into recommendations 2 and 3 (p. 205 and 207 respectively).

### 5.2.14 Neither academic nor media articles typically relate to or provide evidence from multiple events

Arguments that provide multiple pieces of evidence or evidence drawn from multiple events are more compelling than those that don't.

Print media articles, television items and academic research articles analysed in this research were typically related to a single earthquake occurrence or single disaster event. Of the ODT articles 97.7% related to only one event (Table 5.10).

Most occasions that media articles discussed multiple earthquake events that had already occurred coincide with when multiple earthquake events occurred in one or more geographic locations on the same day (e.g. on 13 April 2011 there were earthquake events in two places, for example in both Tohoku, Japan, and Alaska on the same day.

**Table 5.10: ODT articles relating to multiple earthquakes**

| Earthquakes | No. of articles | % |
|---|---|---|
| Multiple historic (non-Canterbury) | 15 | 13.6 |
| Canterbury 2010-2011 and Sendai | 36 | 32.7 |
| Canterbury 2010-2011 and other event (not Sendai) | 6 | 5.5 |
| Future plus historic non-Canterbury | 6 | 5.5 |
| Future Canterbury event and 2010-2011 Canterbury event(s) | 11 | 10.0 |
| Future New Zealand event and 2010-2011 Canterbury event(s) | 36 | 32.7 |
| Total number of ODT articles/percentage of total coverage | 110 | 2.3 |

Over half of media articles covering multiple events linked a Canterbury event to a Canterbury or other New Zealand a future event.

Similarly the percentage of academic research that involved multi-event studies was less than 0.4% (Appendix Table 7.3). Even fewer (only 21 academic articles) related to more than three events. As a result there is no published research relating to multiple events available for sources or journalists to use in media stories.

This recommendation also links to recommendations 3 and 50.

**Recommendation 2 (events):** DRR advocates & scientists – Compile existing results and conduct multi-event research to build the evidence basis for media resources.

### 5.2.15 Lessons from overseas events were rarely discussed in the NZ media

Occurrences in New Zealand and internationally were reported at least every few days throughout the period of analysis. This seemed to provide a picture of continual seismicity occurring somewhere on the planet.

However the detail about disasters and their recovery (before the Canterbury earthquakes) could only really have come from five events for which there were many media articles published: Sichuan, Haiti, Chile, Samoa-Tonga and Fiordland (Table 5.7b). It was from these events that citizens could have learnt about the consequences of earthquakes. For example from the Sichuan earthquake in 2008, that landslides and school collapses are possible. The Samoa-Tonga earthquake in 2009 and Haiti and Chile kept earthquakes in mind in 2010. A major global earthquake event, the Tohoku (Sendai) earthquake and tsunami, occurred just a month after the Port Hills earthquake. The need for resilience to tertiary technological consequences (such as the damage to the Fukushima nuclear plant) was a key lesson from Sendai. The consequences of mitigating for less than the maximum credible earthquake and associated tsunami (or other secondary effects) were shown there; tsunami barriers had not been built high enough. (In Sendai lack of understanding of the maximum credible earthquake affected the level of funding applied to the building of tsunami barriers).

As stories about overseas events rarely remained in the news more than a few days to weeks there was very little recovery-related coverage. Even after the Darfield and Port Hills events there was no application of lessons identified and knowledge from overseas to New Zealand. This will be discussed further in section 7.5.

### 5.2.16 Geographic bias in disaster media research matches what is claimed of the media

This research identified some biases in New Zealand coverage of international disasters that match what was observed in previous research. In the four years of disaster coverage analysed earthquakes in New Zealand or neighbouring Pacific nations were afforded more media attention than Asian earthquakes in which far more people were killed and affected. With all eyes on the Samoa-Tonga disaster (which had included a tsunami warning for New Zealand) the first mention of the 2009 Indonesian earthquake came buried as one sentence at the bottom of an article about the Samoa-Tonga earthquake. Thereafter there was only one article per day in the ODT on the Padang (Indonesian) earthquake (cf. 12 on 2nd, 4 on 3rd, 3 on 4th, and 7 on the 5th September about the Samoa-Tonga earthquake). By the time there was a further Pacific tsunami warning due to an earthquake occurrence in Vanuatu on the 8th September, the Indonesian coverage had ceased.

This is likely because Samoa and Tonga are closer to New Zealand in distance and because there are many Samoans and Tongans living in New Zealand. The fact that both the Pacific Islands and Indonesia are travel destinations for New Zealanders, may generally explain why coverage of Indonesian earthquakes (including occurrences with no fatalities) is greater than for other countries further from New Zealand, with which we have few ties. For example on the 31st of July 2010 there were 110 injured in a quake in Iran, many more injuries than occurred in the Darfield event, but only one article about this appeared in the New Zealand media.

Comparing coverage of the Yushu earthquake in April 2010 with that of the Concepcion (Chile) earthquake two months earlier; there were only 7 articles in the ODT relating to Yushu compared with 46 articles relating to the Chilean earthquake, even though the death toll in Yushu was four times that in Chile. The findings of previous research (discussed below) suggest this was because Chile historically has closer ties with New Zealand than China, and is more aligned with "Western" thinking.

Elsewhere, while some have found no geographical bias (e.g. Gaddy and Tanjong (1986) and Singer and Endreny (1994)) have found coverage to have been associated with distance (Adams, 1986) politico-economic relations between countries (Keshishian, 1997; J. Park, 2003) or 'Western countries' self-interest (Franks, 2006). Western countries have typically covered disasters of other Western nations, where nations have given foreign aid, or nations where their citizens are on holiday or are otherwise affected (Adams, 1986; CARMA, 2006; Eisensee & Strömberg, 2007; Kivikuru, 2006; Lewis, 1979; Mason, 2011; Van Belle, 2000; Wrathall, 1988). In media coverage of foreign disasters Western locals were seen to be taking an active part in response and recovery but 'other' communities were portrayed as passive victims who were not in control (Joye, 2010).

CARMA (2006, p. 6) noted that there was little media coverage of disasters where the perceived economic impact on the US was low. Even when a humanitarian crisis was not of economic importance, the perspective of politics and economics remained the West's key interest, not human suffering. This was not the case in New Zealand's portrayal of international earthquake disasters. For those earthquake events that were covered in the New Zealand media, the stories were mostly of human-interest and aid.

Two conclusions stemming from the above discussion, including previous sections, are:

**Recommendation 3 (earthquake events**): All - Sources and the media should make efforts to communicate about a variety of earthquake events; previous damaging events in New Zealand, events distant from New Zealand and multiple events.

**Recommendation 4 (location of events):** All - When discussing a particular region or area that has experienced disaster, consider how much coverage that area has received and whether another area might be mentioned to balance coverage.

### 5.2.17 There is geographic bias in disaster science (academic earthquake) research

Throughout this research, biases identified by previous researchers have been assessed to see whether the biases were solely 'media' biases. To achieve this the research outputs of

20 earthquakes were analysed. As Table 5.11 shows that none of a) the energy magnitude of the earthquakes, b) the number of fatalities, or c) the economic losses, account well for the level of research attention. However the numbers of people affected do show similar trends with the number of articles published Figure 5.4. This might be expected since Gaddy (1986) showed that the human and physical consequences determined news coverage volumes. I conclude that earthquake research shows similar bias to previously identified media biases.

The high numbers of academic articles for both the Sichuan and Yushu events may be related to the high researcher population base in China, the country of the event. This is arguably also the case for Sendai (although note that the article total is only for part of one year). With the exception of the Canterbury earthquakes, events with less than 200 fatalities generated fewer than 40 articles apiece. Conversely the Haiti and Kashmir earthquakes were high fatality events that generated large numbers of research outputs. US medical aid workers (who had travelled to Haiti or Kashmir to assist during the response phase) wrote most of the health-related academic articles. It is reasonable to say then that health-related disaster scientists/practitioners, not only the media, focus on dramatic events.

Two Indonesian events do not show this correlation – Padang and Yogyakarta. These generated only 18 and 25 research articles apiece, suggesting that disaster scientists focus on certain countries' disasters, as was the case for the media.

For example, bias against African and Asian nations was noted by Eisensee and Strömberg (2007) and Wrathall (1988) had found that there was little coverage of the USSR, South America and the Third World. The moderately high research attention to the L'Aquila, Concepcion and Canterbury earthquakes, despite their comparatively low death rates, may be accounted for by the fact that they are 'Western' events (Figure 5.4).

**Table 5.11: Scale of the 20 earthquakes for which research outputs were analysed**

This table shows the scale of some of the effects of the earthquakes that were the subject of the 20-earthquake research dataset. The right hand column indicates the percentage of academic articles that related to each event. See Tables 3.7 and 3.8 for more details about these events.

| Event | Magnitude (USGS) | Fatalities (USGS) | Fatalities | People Affected | USM$ | %GDP | % articles |
|---|---|---|---|---|---|---|---|
| | earthquake.usgs.gov | | | (EMDAT, 2014) | | Swiss Re Sigma Database, 2014) | |
| Kashmir, Pakistan | 7.6 | > 86000 | 73,338 | 156,622 | 1,000 | | 2.8 |
| Yogyakarta, Indonesia | 6.3 | 5,749 | 5,778 | 3,177,923 | 3,100 | | 0.4 |
| Java, Indonesia | 7.7 | 730 | 802 | 35,543 | 55 | | 0.3 |
| Pisco, Peru | 8.0 | 514 | 593 | 658,331 | 600 | | 1.0 |
| Bengkulu, Sumatra | 8.5 & 7.9 & 7.6 | 25 | 25 | 459,567 | 500 | | 0.7 |
| Gisborne, NZ | 6.6 | 1 | - | - | - | | 0.1 |
| Sichuan, China | 7.9 | 87, 587 | 87,476 | 45,976,596 | 85,000 | | 57.3 |
| Balochistan, Pakistan | 6.4 | 166 | 166 | 75,320 | 5,200 | | 0.1 |
| Lac Kivu, Dem Rep of Congo | 5.9 | 44 | 47 | 17978 | 7 | | 0.1 |
| L'Aquila, Italy | 6.3 | 295 | 295 | 56,000 | 2,500 | 0.2 | 5.3 |
| Fiordland, NZ | 7.8 | 0 | - | - | - | | 0.2 |
| Java, Indonesia | 7.0 | 79 | 128 | 339,792 | 160 | | 0.0 |
| Samoa/Tonga | 8.1 | 192 | 182 | 8592 | 159.5 | | 0.6 |
| Padang, Indonesia | 7.6 | 1117 | 1195 | 2,501,798 | 2,200 | | 0.3 |
| Port au Prince, Haiti | 7.0 | 316 000 | 222,570 | 3,700,000 | 8,000 | 121.0 | 9.9 |
| Concepcion, Chile | 8.8 | 547 | 562 | 2,671,556 | 30,000 | 18.6 | 3.9 |
| Yushu, China | 6.9 | 2968 | 2968 | 112,000 | 500 | | 1.9 |
| Mentawai, Indonesia | 7.7 | 435 | 530 | 11864 | - | | 0.2 |
| Canterbury, NZ (Darfield/Port Hills) | 7.0/6.1 (*7.1/6.3*) | 0/185/0/1 | 181 | 301,845 | 24,500 | 5.3 /10 | 1.8 |
| Sendai, Japan | 9.0 | 15,836 | 19,846 | 1,427,232 | 210,000 | 5.4 | 10.8 |

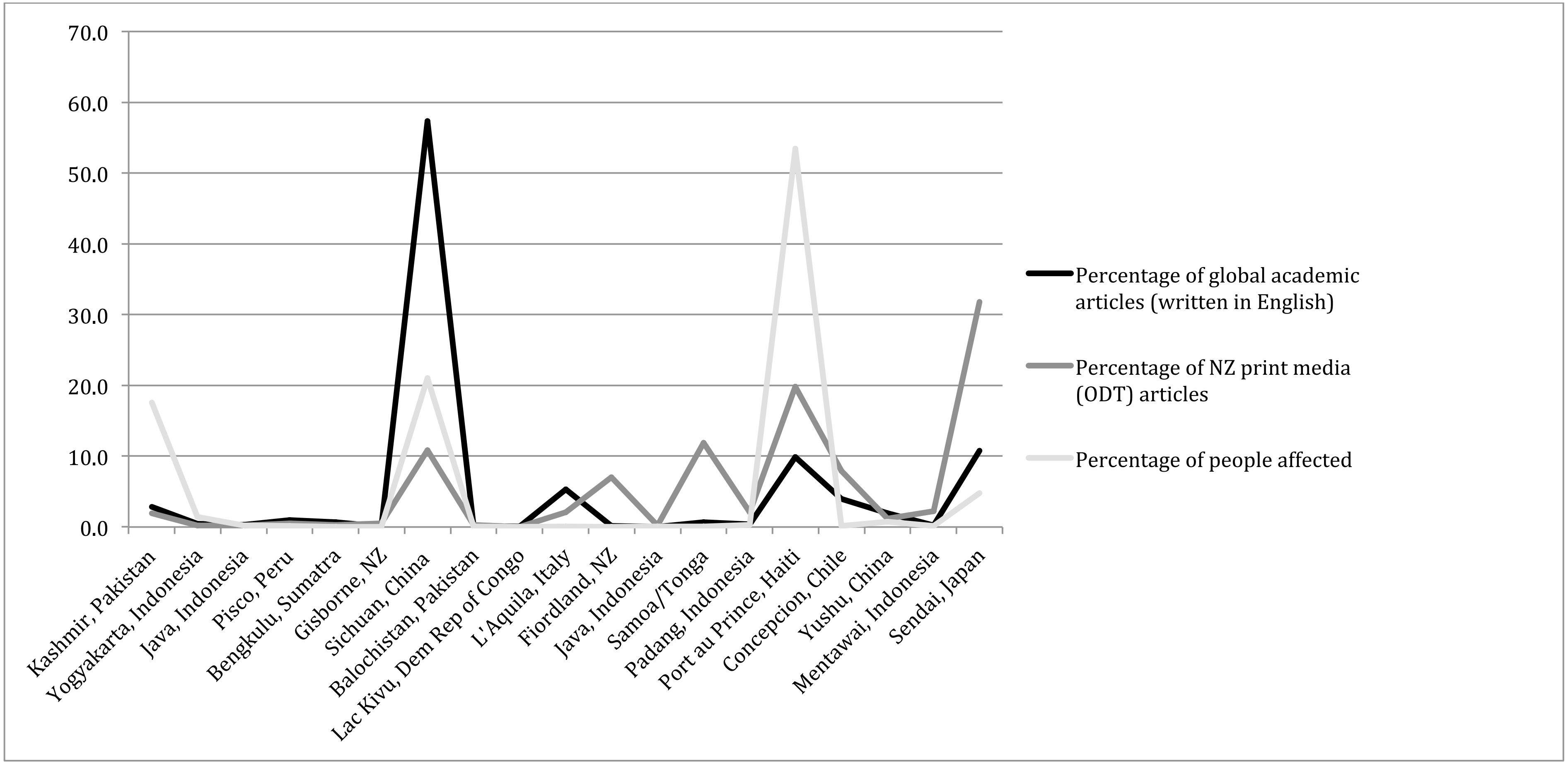



**Figure 5.4: Proportions of total academic and print media articles, and people affected for each earthquakes the articles covered**

This plot relates proportions of academic and print media articles and people affected to the 20 earthquakes (except Canterbury). This plot shows that there is broad correlation between the number of people affected by a disaster and either proportions of academic research or New Zealand print media articles. Exceptions are where the event occurs close to the media's origin (e.g. Fiordland or Samoa-Tonga for New Zealand media) or close to a large population of researchers (e.g. L'Aquila or Sichuan).

## 5.3 Earthquake-related story types

### 5.3.1 Earthquake-related media headline story types were coded to better understand how DRR is being communicated

The rationale for analysing story types, codes and categories and the development and coding of earthquake-related media headlines, and brief mention stories was described in sections 3.6.7 and 3.6.8. (Brief mention stories are found in the body of print articles or television items).

Story-categories that fit with the four phases of DRR, groups, subgroups and types were described. In this research 5 categories, 11 groups, and 32 subgroups were identified. Tables 5.12-5.16 show the story types in each of the five story categories. These categories are an artificial DRR-related construct or framing that broadly equate to the 4Rs in the following way:

- Response - Earthquake!/Disaster category
- Recovery – Road to Recovery/Reduction category
- Readiness (warning only) - Disaster Risk category
- Reduction and readiness - DRR Options and Disaster Cause/DRR Review categories

The 'Earthquake!/Disaster!' category equates with response stories. As the second category name suggests 'Road to Recovery' stories related to recovery. The 'Disaster Warnings/Risk' category of stories were about understanding of risk or warnings, and were therefore readiness-related stories, although they were written about communities experiencing any phase of the DRR cycle. 'DRR Options' category stories were about risk reduction in any phase of the DRR cycle. 'Disaster Cause/Reviewing DRR Measures' stories were about understanding why disasters occur, or are exacerbated; these media stories could be written in any phase of the DRR cycle but were typically written immediately after or in the early recovery phase a disaster event.

The story types identified in this research (155 of them) relate as well to articles that were focused on earthquakes, as well as those in which there were only brief mentions of earthquakes. The exception is the '*Miscellaneous'* or 156$^{th}$ type, which relates only to brief mentions. *'Miscellaneous'* story types cover references either a) to earthquakes occurring in a certain location, b) to someone having been present when a particular event occurred, c) to the date an earthquake occurred because that date was significant for another reason, or they were d) earthquake similies or metaphorical references to earthquakes.

**Table 5.12: Disaster Readiness category story types**

The 20 'Disaster Readiness' (warning) stories of the 155-related media headline story types identified in the New Zealand mass media. These are separated into two groups a) 'Research and Findings' and b) 'Warnings/Risk'. The latter group is split into subgroups according to the four environments while the 'Research and Findings' group includes stories explaining or summarising events issues or research findings.

**a) Research & Findings Group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 1 | About any of 4Rs | Background/Expectations |
| 2 | | Research Plans |
| 3 | | Researchers/Researching |
| 4 | | Research Findings (Research of Event/Research Future Event) |
| 5 | | Historic (Earthquake) Events |
| 6 | | Historic Event Lists |
| 7 | Anniversary | This Day in History |
| 8 | | Historic Commemoration |
| 9 | | End of Year |

**b) Warnings/Risk Group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 10 | Warning-natural environment | Forecasting or Prediction |
| 11 | | (Animals) Sensing Earthquakes |
| 12 | | More to Come? Link? |
| 13 | | Volcanic Eruption |
| 14 | | Tsunami Warning |
| 15 | | Weather Worries |
| 16 | | Secondary Land Threats |
| 17 | Warning-built environment | At Risk: Buildings (or Infrastructure) |
| 18 | Warning-economic environment | Economic Vulnerability |
| 19 | Warning – social environment | Other Health Warnings |
| 20 | General Warnings | At Risk: Cities, Regions/Scenarios |

**Table 5.13: Earthquake!/Disaster! category story types**

This table presents the 'Earthquake!/Disaster!' subset of the 155 media headline story types identified in the New Zealand mass media. There are 62 story types in 2 groups and 11 subgroups. These story types are response stories. In a) are the 'Event & Effects' group, in b) overleaf are the 'What's Happened/Being Done?' group of story types.

Event & Effects stories are about the consequences of earthquakes (topic 7 on the DRR-topics wheel – Figure 3.5). The 'Event & Effect's story subgroup separate 20 of the Earthquake!/Disaster! group of stories into general stories about disaster (in this case earthquake) events. The sub-groups differentiate stories about social effects (separated into New Zealanders or 'others' to enable comment on this), the effect on the built environment, nature and the economic effects. This allows comment on which of the four environments media headlines, and by implication the stories themselves emphasise (Chapter 7).

Similarly the 'What's Happened/Being Done?' group of stories in b) overleaf is separated into general activities or actions being undertaken in response (predominantly topic 9 of the DRR topics). For these stories the subgroups separate general activities from activities that focus on each of the four environments. Again the social environment is split into two subgroups; one related to health care and the other to behavioural aspects.

Note that there is no clear story type focused on response needs assessments (topic 8) as will be discussed further in Chapter 7.

**a) Event & Effects Group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 21 | Event & General Effects | Felt Occurrence |
| 22 | | Felt Occurrence-multiple |
| 23 | | Aftershock(s) |
| 24 | | Disaster Occurrence |
| 25 | Effect on Built environment | Damage/Devastation |
| 26 | Foreigners Affected | Foreign Survivor/Victim Story |
| 27 | New Zealanders Affected | Survivor/Victim Story |
| 28 | | MFAT info/Missing New Zealander(s) |
| 29 | | New Zealanders flown home |
| 30 | | Other Effect on New Zealand(er) |
| 31 | | Stressed, Scared, Struggling |
| 32 | | Other Social Effects |
| 33 | Effect on Nature | Understanding Natural Hazards/Aftershocks |
| 34 | | Associated Natural Phenomena (Liquefaction, Silt, Flooding, Rock-fall, Quake Lakes, Landslides, Tsunamis, Rupture etc.) |
| 35 | | Strange Phenomena |
| 36 | | Other Environmental Effects |
| 37 | Economic Effects | (Un)Employment |
| 38 | | Insurance Claim Numbers or Costs |
| 39 | | Business or Industry Effects |
| 40 | | Impact on Economy |

**Table 5.13: cont/- b) What's Happened/Being Done? group of story types**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 41 | General Effects & EM | Death Toll or Injured |
| 42 | | Latest Update - Live Update, News |
| 43 | | Authorities Update |
| 44 | | State of Emergency |
| 45 | | General Emergency Management |
| 46 | | Political in Crisis (includes TV1's "Q+A") |
| 47 | | Victim ID or Name Release |
| 48 | | Antisocial Behaviour & Law Enforcement |
| 49 | | Sport |
| 50 | Health in Response | Environment & Public Health |
| 51 | | Infrastructure and Public Health |
| 52 | | Search & Rescue |
| 53 | | Emergency Medical Treatment |
| 54 | | Burying Dead |
| 55 | Environment in Response | About or Assisting Animals |
| 56 | | Other Environmental Response |
| 57 | Economic Response Initiatives | Business Response Initiatives |
| 58 | | Government Assistance |
| 59 | Response-Built+ | Schools Closed, to reopen |
| 60 | | Disruption |
| 61 | | Infrastructure Damage/Restoration |
| 62 | | Cleaning Up |
| 63 | | Building Assessment & Decisions |
| 64 | | Insurance Claims Process or Repairs |
| 65 | | Housing, Homelessness or Shelter |
| 66 | Aid, Volunteers or Solidarity | Fundraising/Donations by New Zealanders |
| 67 | | Outstanding International Individuals |
| 68 | | International Aid |
| 69 | | New Zealand Authorities' Aid |
| 70 | | New Zealander Relief Volunteers |
| 71 | | Leaders & Aid |
| 72 | | Celebrity Involvement |
| 73 | | Businesses Helping Out |
| 74 | | Schools Pastoral Care |
| 75 | | Accommodation/Break Away |
| 76 | | Military or Police Relief/Aid |
| 77 | | NGOs and Aid |
| 78 | | Leader Condolences |
| 79 | | International Solidarity |
| 80 | | Solidarity, Compassion & Community Spirit |
| 81 | | Remembering |
| 82 | | Thanks for Relief |

**Table 5.14: Road to Recovery category story types**

This table presents the 'Road to Recovery' subset of the 155 media headline story types identified in the New Zealand mass media. There are 23 story types in two groups and 5 subgroups. The first group of stories 'Recovery Assessment & Initiatives' exhibit a combination of long-term consequence (topic 10) immediate recovery needs assessments (part of topic 11) and typically also imply some sort of recovery activity will occur (topic 12). As for the 'Earthquake!/Disaster!' category of stories (the response stories) the 'Recovery Assessment & Initiatives' recovery-related group of story types have been arranged into subgroups reflecting the four environments.

The second group b) are event-based stories, the 'Recovery Milestones'.

**a) Recovery Assessment & Initiatives**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 83 | Environment in Recovery | Environmental Rehabilitation |
| 84 | Social Issues & Adaptation | Staying/Going |
| 85 | | Students Staying/Going |
| 86 | | Injury Rehabilitation |
| 87 | | Ways to Feel Better |
| 88 | | Aid Projects in Recovery |
| 89 | | Citizens in Recovery |
| 90 | Issues & Adaptations Built+ | Rebuild: Plans & Vision |
| 91 | | Land Decisions |
| 92 | | Recycling Earthquake Waste (or not) |
| 93 | | Rebuild Logistics/Rebuild Progressing |
| 94 | | Skills Shortage |
| 95 | Economic Recovery & Adaptation | Business Recovery |
| 96 | | Economy in Recovery |
| 97 | | Business Recovery Initiatives |
| 98 | | Government Recovery Initiatives |

**b) Recovery Milestones Group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 99 | Events in Recovery | Leader Visit |
| 100 | | Celebrity Visit |
| 101 | | Return to normal/resilience |
| 102 | | Commemoration or Memorial |
| 103 | | Change in Luck |
| 104 | | Double Disaster |
| 105 | | Political in Recovery |

**Table 5.15: Disaster Cause/DRR Review category story types**

This table presents the 'Disaster Cause/DRR Review' subset of the 155 media headline story types identified in the New Zealand mass media. There are 18 story types.

The first of the subgroups relate to those that consider the cause of the hazard, earthquake, or the cause of disaster ('Contributing Factors'). The other subgroups relate to the review of DRR measures in each of the four phases of the DRR cycle. These story types assess performance with respect to DRR activities. Findings may be positive.

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 106 | Contributing factors | Reflecting on History, Cause |
| 107 | | Fatalistic Beliefs |
| 108 | | Liability, Litigation or Inquiry |
| 109 | | Inquest/Cause of injury |
| 110 | Reviewing DRR Measures | Reviewing Communication |
| 111 | | Lessons or Reflections |
| 112 | Reviewing DRR Measures - preparation | (Un)prepared Citizens |
| 113 | | Reviewing Authorities' Preparation |
| 114 | | Citizen Awareness & Cultural Memory |
| 115 | Reviewing DRR Measures - response | Doing Better/More in Response |
| 116 | | Aid Issues |
| 117 | Reviewing DRR Measures – reduction | Awards, Commendations or Thanks |
| 118 | | Reviewing Construction & Codes |
| 119 | | Heritage Building Matters |
| 120 | | Reviewing Land Use |
| 121 | Reviewing DRR Measures-recovery | Insurance Problems |
| 122 | | Recovery Progress |
| 123 | | Recovery Legislation |

**Table 5.16: DRR Options category story types**

This table presents the 'DRR Options' subset of the 155 media headline story types identified in the New Zealand mass media. There are 32 story types in three groups (a)-c) and seven subgroups below. The 'Approach to DRR' group relates to the stories that headline DRR strategies goals or aims (cf. discussion in Chapter 2). The 'Reactions to Warning/Risk' group of stories records general attitudes, access restrictions put in place to reduce risk ('Evacuation' subgroup), and reactions to warnings by citizens or indeed authorities ('Discounting Risk' subgroup). The 'New Policies and Procedures' group is split according to the four environments.

**a) Approach to DRR group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 124 | General DRR | Supporting Research or not |
| 125 | | Sustainability |
| 126 | | DRR is costly/Good Investment |

**b) Reactions to Warning/Risk group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 127 | Evacuation | Restricted Access |
| 128 | | Fear, Flee or Panic |
| 129 | | Rational Reaction |
| 130 | | Code compliance |
| 131 | Discounting Risk | (In)action |
| 132 | | Don't Worry (Authorities/Experts Denial of Risk) |

**c) New Policies or Procedures group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE |
|---|---|---|
| 133 | Built Mitigation | Construction methods or materials |
| 134 | | Safety Assessments/Soil reports |
| 135 | | Strengthening |
| 136 | | Codes, Standards, Policies |
| 137 | | Closure |
| 138 | | Development Hearings |
| 139 | | Infrastructure Upgrade |
| 140 | | Securing Contents |
| 141 | DRR in the Environment | Making the Natural Environment Safer |
| 142 | | Land Use & Zoning |
| 143 | | Monitoring or Warning Systems |
| 144 | Social Preparations | Fostering Awareness |
| 145 | | Communication in Response |
| 146 | | Recording for Posterity |
| 147 | | Household Preparations |
| 148 | | Authorities Response Planning |
| 149 | | Drills |
| 150 | | Community/Health Preparations |
| 151 | | Technology! |
| 152 | Economic Preparations | Future Insurance or Reinsurance |
| 153 | | Development, Levies & Financial Incentives |
| 154 | | GDP/Development Saves Lives |
| 155 | | Financial Planning & Preparation |

### 5.3.2 155 earthquake-related media story types were identified: all provide opportunities to communicate about earthquake-related DRR

One of the key findings of this research has been to discover how wide the variety of media stories relating to earthquakes is when the time period analysed is long, and includes a major disaster. Of all online, print, magazine and television articles analysed that focused on or mentioned earthquakes, 155 distinct media headline story types were found (these story types are identifiable in text as they are italicised). These 155 story types as listed in Table 5.12-5.16 were identified from print media or television articles over the period from February 2008 to 03 January 2012 (see Table 3.6 for dataset descriptions)

Prior to the Canterbury earthquakes there were approximately half as many (88) story types that included the keyword 'quake'. This still constitutes a wide range of different opportunities to introduce different aspects of DRR as is discussed in the following sections.

### 5.3.3 There were significant differences in the story types in the media before and after the Canterbury earthquakes

A summary of what aspects of earthquake-related DRR a New Zealand citizen could have learned from a year's coverage of earthquake-related articles prior to the Darfield earthquake is presented in Table 5.17. Story types in the media before the Canterbury earthquakes focused on earthquake occurrences or disaster events, often forgetting recovery.

The relative proportions of media story types relating to each of the five categories (Table 5.18) shows clearly that the media stories were disaster- rather than hazard- or risk-focused as also found by Smallman (1997). There were far fewer recovery-related story types and stories which compares well with the findings of Cox et al. (2008).

The pre-Darfield event coverage in both the Otago Daily Times and on television was notably different from that afterward in three ways 1) proportionally there were more stories afterward the Darfield earthquake about 'Recovery Assessments and Initiatives' and 'Recovery Milestones', 2) the proportion of warnings was fewer after the Darfield earthquake (although in fact there were twice as many risk stories in the ODT after the Darfield earthquake than before), 3) after the Darfield earthquake the stories were less about the consequences (the 'Event & Effects') and more focussed on what was being done in response. Overall though the number of articles in each story group and subgroup was significantly increased after the Darfield earthquake. The one exception to this was that there were no stories of the 'Approach to DRR' group on television either before or after the Canterbury earthquakes.

**Table 5.17: Summary of ODT articles for the year February 2008 - February 2009**
One year of articles (195 in total) in print media ODT (01 February 2008-31 January 2009), including brief mentions. Indication of story types in italicised text, bm = brief mention.

| Article story description | No. articles | No. articles in story group |
|---|---|---|
| **Earthquake!/Disaster!** | | |
| About International events – Historic Events and Death Toll and Injured, Fundraising and Donations by New Zealander, Search & Rescue, Political in Crisis, Secondary Land Threats, New Zealand Authorities Aid MFAT/Missing New Zealander stories, Tsunami Warnings triggered by overseas events and Survivor/Victim and occasionally About Aftershocks | 54 | 96 + 58bm |
| Brief mentions of international events – e.g. 11 related to the Sichuan earthquake, another to 2005 Pakistan event (referring to good character of the subject of the article as they assisted in that event) | 54bm | |
| *Felt Occurrences* – mostly national (not international) 'events' ranging from magnitude 3.0 to 5.8 – only four of which were articles on the Mag 5.8 event in Gisborne that caused $6 million damage. | 42 | |
| Brief mentions of a North Shore Slip that killed a woman and may have been caused by a minor earthquake | 4bm | |
| **DRR Options** | | |
| *Heritage Building* story types told about building vulnerability - unsafe buildings and building safety | | 4 |
| *Strengthening* story types, about structural mitigation - engineered buildings (4 retrofitting, 1 to regulations and 1 to study Eden park) | 5 | 12 |
| Mitigation of infrastructure (4 relating to the Young Dam others to geo-technology) | 7 | |
| Opening of *Restricted Access* to hiker in Young Dam area | | 2 |
| **DRR preparation** – the need to cope alone after an event, warning messages from MCDEM/CDEM, or references to planning exercises (1 Port Tauranga tsunami gauge *Monitoring or Warning Systems*) | | 6 |
| Other – 3 planning (2 Dunedin, 1 Wellington motorway), 1 recovery update as to repair and demolition in Gisborne, 1 false tsunami sighting with some DRR comment) | | 7 |
| Brief mentions of the EQC fund in reporting of NZ budget | | 2 |
| Brief mentions with no relevance to an earthquake event, earth science or DRR discussion, e.g. *Similistic or Metaphorical* | | 10 |

### 5.3.4 Many aspects of earthquake-related DRR can be learned from brief mentions

Different demographics potentially learn about DRR from brief mentions of earthquakes, not only from the articles focused on natural hazards, disasters or DRR (section 3.5.6). This section shows what impressions about earthquakes and related topics a reader of general news, rather than earthquake-disaster-specific news might have gained.

**Table 5.18: Prevalence of story groups in print and broadcast media before and after the Darfield earthquake**

The left hand column of this table shows the relationship between the four phases of the DRR cycle, story categories (bold) and story groups (not bold text). The right hand columns of this table show the percentage of total print media articles or broadcast items before (pre) and after (post) the Darfield earthquake within each story group. Print media analysed were online articles from stuff.co.nz and the Otago Daily Times (ODT – odt.co.nz) and women's magazines Next and the New Zealand Women's Weekly (NZWW). Broadcast items were from the TV1 dataset.

| Story groups | Percentage of total articles/items | | | | | | |
|---|---|---|---|---|---|---|---|
| | **TV1 Pre** | **1000-Stuff (Post)** | **TV1 Post** | **ODT Post** | **ODT Pre** | **NEXT all** | **NZWW all** |
| **DRR Options (reduction/readiness)** | | | | | | | |
| Approach to DRR | 0.0 | 0.0 | 1.9 | 0.6 | 0.3 | - | - |
| New Policies or Procedures | 3.3 | 8.0 | 2.7 | 3.4 | 2.5 | - | - |
| Reaction to Warning/Risk | 1.1 | 1.3 | 1.6 | 0.9 | 1.0 | - | - |
| **Disaster Risk (readiness)** | | | | | | | |
| Research & Findings | 4.4 | 1.2 | 4.0 | 0.9 | 1.2 | 5.5 | 4.5 |
| Disaster Summaries | 0.2 | 0.0 | 0.1 | 0.1 | 0.1 | - | - |
| Warning/Risk | 12.1 | 9.9 | 2.3 | 1.8 | 4.5 | - | - |
| **Earthquake! /Disaster! (response)** | | | | | | | |
| Event & Effects | 31.9 | 36.0 | 21.5 | 11.4 | 32.3 | 22.2 | 44.8 |
| What's Happened/Being Done? | 28.6 | 16.3 | 36.6 | 23.8 | 19.7 | 38.8 | 25.4 |
| **Road to Recovery (Recovery)** | | | | | | | |
| Recovery Assessments & Initiatives | 2.2 | 12.6 | 11.5 | 6.1 | 0.9 | 22.2 | 20.9 |
| Recovery Milestones | 0.0 | 1.7 | 8.4 | 3.5 | 1.0 | - | 1.5 |
| **Disaster Cause/DRR Review** | | | | | | | |
| Criticism, Praise or Finding | 8.8 | 5.3 | 7.5 | 4.0 | 4.8 | 11.1 | 2.9 |
| Reflecting on Responsibility | 0.0 | 2.4 | 1.3 | 0.7 | 0.9 | - | - |
| **Other** | | | | | | | |
| Mention Only | 7.7 | 0.5 | 5.3 | 42.9 | 30.9 | | |

In this research 41% (1986 out of 4837) Otago Daily Times articles that included the keyword (earth)'quake' contained only brief mentions of or reference to earthquake-related topics or issues (Table 5.19).

Looking at the article types in which brief mentions occur (Tables 5.20 and 5.21 for television and print media respectively) it is clear that the profile of the reader of these articles is likely to be quite different to that of articles dedicated to earthquake-related and particularly disaster coverage.

**Table 5.19: Print media articles and television items focused on versus brief mentions of earthquakes**

| Story Types | Focused ODT | Focused TV1 | Brief ODT | Brief TV1 | Brief % ODT | Brief % TV1 |
|---|---|---|---|---|---|---|
| Pre-Darfield | 476 | 85 | 214 | 6 | 10.8 | 7.6 |
| Post-Darfield | 2374 | 1243 | 1772 | 73 | 89.2 | 92.4 |
| Total | 2850 | 1328 | 1986 | 79 | | |

Perusal of the brief mention story types lists Tables 5.22-5.24 provides an impression of what the reader or viewer who was not watching an overtly earthquake-related item might have learnt or had reinforced about earthquakes. For example from the ODT before the Darfield earthquake (Table 5.22) the impressions (from stories about non-earthquake accidents, weather worries, and disasters in New Zealand and internationally and other World News, Current Events, Sports and Tourism and Travel Stories) would include: that events have occurred in the past (*Historic Events*), that insurance premiums contain levies to build up New Zealand's earthquake (EQC) insurance fund (*Future Insurance or Reinsurance*), that earthquakes involve shaking and are disruptive (earthquake similies or metaphorical references), that earthquakes occur (*Fostering Awareness*), a little about the earth science of the hazard (*Background/Expectations*), that there are ways to strengthen buildings (*Strengthening*) including heritage buildings, that strengthening is likely to be costly (*Heritage Building Matters*), and so on down the list of brief mention types.

**Table 5.20: Television news item types that earthquake brief mentions appear in**
News item types (left-hand column) that brief mentions of earthquakes relate to in items broadcast before (column 2) and after (column 3) the Darfield earthquake. The right hand column indicates the number of TV1 news items for each news item type. Bm = brief mentions.

| Item Type | % TV pre-Darfield bms | % TV post-Darfield bms | Total no. of bms pre & post Darfield |
|---|---|---|---|
| News - non-earthquake disaster | 6.8 | 50.0 | 8 |
| Financial | 21.9 | 16.7 | 17 |
| Politics | 21.9 | 16.7 | 17 |
| Current events | 17.9 | 16.7 | 14 |
| Arts history or culture | 5.5 | 0.0 | 4 |
| Education | 1.4 | 0.0 | 1 |
| End of year | 5.5 | 0.0 | 4 |
| Sport | 13.7 | 0.0 | 10 |
| Travel/tourism | 1.4 | 0.0 | 1 |
| Weather | 4.1 | 0.0 | 3 |

After the Darfield earthquake (starting at the top of Table 5.23 with the most prevalent mention types) the impression from the ODT (from the 'Financial news', 'Sports', 'Current Events' and 'Politics' – see Table 5.21) would have been of disruption, and of businesses and the economy both adversely affected in recovery and recovering. Fundraising efforts by New Zealanders for Cantabrians by individuals, businesses and sporting groups were promoted and noted. The reader or viewer would have become aware of the formation of the Canterbury Earthquake Recovery Authority (CERA) and other political involvement in recovery. Various social effects were recorded, many through stories about survivors or victims. An impression of historic events would have also been gained.

**Table 5.21: Print media article types earthquake brief mentions appear in**

Numbers of article types in Otago Daily Times that include a brief mention of earthquake. Total number of brief mention articles is 1986 (41% of total articles analysed). Non-earthquake disasters or accidents are accident/fire/weather worries, international or New Zealand disasters unrelated to earthquakes. Bm = brief mentions.

| Article Type | % of Pre Darfield bms | % of Post Darfield bms | Total number of bms pre & post |
|---|---|---|---|
| Financial | 7.0 | 34.7 | 630 |
| Sports | 5.1 | 19.8 | 361 |
| Current events | 4.2 | 9.4 | 176 |
| Political | 3.3 | 7.5 | 140 |
| Health and wellbeing | 1.9 | 3.1 | 59 |
| Council | 7.5 | 3.0 | 69 |
| Non-earthquake disaster | 30.8 | 5.6 | 165 |
| Education | 2.3 | 2.5 | 50 |
| Crime/courts | 2.3 | 2.3 | 46 |
| Lifestyle | 1.4 | 2.3 | 44 |
| Media/entertainment | 3.7 | 2.0 | 44 |
| Art, history or culture | 3.7 | 1.9 | 42 |
| Travel/tourism | 6.1 | 1.6 | 42 |
| Heritage buildings | 4.7 | 1.1 | 29 |
| End of year | 0.5 | 0.8 | 19 |
| World | 9.3 | 0.7 | 33 |
| Emergency services or military | 2.3 | 0.3 | 11 |
| Religion | 0.0 | 0.3 | 6 |
| Farming/rural | 0.0 | 0.3 | 5 |
| End of Year | 0.0 | 0.2 | 19 |
| Book review/book launch | 0.9 | 0.2 | 5 |
| Science & Technology | 2.3 | 0.2 | 8 |
| Editorial | 0.0 | 0.1 | 1 |

### Table 5.22: Prevalence of pre-Darfield print-media story types

The numbers of Otago Daily Times articles published before the Darfield earthquake that contained more than two brief mentions of earthquake (middle column) that told a particular story type (left-hand column). Brief mention types (codes) are the same as media story headline type codes for articles focused on earthquakes described in Tables 5.12-5.16. The total number of brief mention story types in the ODT was 56 (cf. the 155 identified overall).

There were only five brief mention story types on television before the Darfield earthquakes (see right-hand column)

| (Brief mention) story types | No. of mentions ODT | No. of mentions TV |
|---|---|---|
| Historic Events | 31 | |
| Future Insurance or Reinsurance | 29 | |
| Similistic or metaphorical references | 16 | |
| Fostering Awareness | 10 | |
| Background/Expectations | 9 | |
| Strengthening | 9 | |
| Heritage Building Matters | 7 | |
| Felt Occurrence | 5 | |
| NGOs & Aid | 5 | |
| Construction Methods or Materials | 4 | |
| Double Disaster | 4 | |
| Fatalistic Beliefs | 4 | |
| Forecasting or Prediction | 4 | |
| Political in Recovery | 4 | |
| Reviewing Construction & Codes | 4 | |
| Whether tertiary effect | 4 | |
| Antisocial Behaviour & Law Enforcement | 3 | |
| Celebrity Involvement | 3 | |
| Commemoration & Memorial | 3 | |
| Drills | 3 | |
| Fundraising/Donations by New Zealanders | 3 | 1 |
| Other Social Effects | 3 | |
| At Risk: Buildings/Infrastructure | 2 | |
| Authorities Response Planning | 2 | |
| Development Hearings | 2 | |
| Disruption | 2 | |
| Monitoring or Warning Systems | 2 | |
| New Zealander Relief Volunteers | 2 | |
| Outstanding International Individuals | 2 | |
| Research Elsewhere | 2 | |
| Associated Natural Phenomena | 0 | 1 |
| Economy in Recovery | 1 | 2 |
| Future Insurance or Reinsurance | 0 | 1 |
| Researcher/Researching | 1 | 1 |

**Table 5.23: Most prevalent brief mentions in ODT after the Darfield earthquake**
Brief mention story types in at least 6 similar post-Darfield-earthquake Otago Daily Times articles that briefly mentioned (rather than focused) on earthquakes. Brief mention type codes are identical to media headline story type codes for articles focused on earthquakes described in Tables 5.12-5.16. The code relates to the 'story' the brief mention told. The total number of mention types was 137 (cf. 155 story types for articles focused on earthquakes). Shading indicates the story types that also existed in television coverage.

| (Brief mention) story type | No. of ODT articles |
|---|---|
| Disruption | 311 |
| Business in Recovery | 284 |
| Economy in Recovery | 271 |
| Fundraising/Donations by New Zealanders | 102 |
| Other Social Effects | 91 |
| Political in Recovery | 84 |
| Survivor/Victim Story | 50 |
| Historic Events | 42 |
| Staying or Going | 26 |
| Solidarity, Compassion & Community Spirit | 25 |
| Future Insurance or Reinsurance | 22 |
| Stressed, Scared, Struggling | 21 |
| Business or Industry Effects | 20 |
| Fostering Awareness | 17 |
| Similistic or metaphorical reference to earthquake | 14 |
| NGOs & Aid | 14 |
| Strengthening | 13 |
| Ways to Feel Better | 12 |
| (Un)employment in Recovery | 11 |
| Double Disaster | 11 |
| Government Recovery Initiatives | 11 |
| Rugby World Cup decision | 11 |
| Damage/Devastation | 10 |
| Leader Visit | 10 |
| Return to normal/resilience | 10 |
| Background/Expectations | 9 |
| New Zealander Relief Volunteers | 9 |
| Awards, Commendations or Thanks | 8 |
| Closure | 8 |
| Codes, Standards or Policies | 8 |
| Heritage Building Matters | 8 |
| Construction Methods or Materials | 7 |
| Felt Occurrence | 7 |
| Lessons or Reflections | 7 |
| New Zealand Authorities Aid | 7 |
| (Un)employment | 6 |
| Fatalistic Beliefs | 6 |
| Financial Effects | 6 |

**Table 5.24: Most prevalent brief mention types on television after the Darfield earthquake**

Numbers of post-Darfield television (TV1) story types that contained brief mentions of earthquakes. Brief mention type codes are the same media story type codes as articles focused on earthquakes. The code relates to the brief mention story. The total number of mention types in television broadcasts was 28.

| Story type | No. of TV items |
|---|---|
| Political in Recovery | 16 |
| Government Recovery Initiatives | 6 |
| Other Social Effects | 6 |
| End of Year | 4 |
| Impact on Economy | 4 |
| Ways to Feel Better | 4 |
| Area's History & Culture | 3 |
| Business or Industry Effects | 3 |
| Celebrity Visit | 3 |
| Commemoration or Memorial | 3 |
| Disruption | 3 |
| Economy in Recovery | 3 |
| Damage/Devastation | 2 |
| Forecasting or Prediction | 2 |
| Fundraising/Donations by New Zealanders | 2 |
| Return to normal/resilience | 2 |
| Weather Worries | 2 |
| (Un)employment | 1 |
| Associated Natural Phenomena | 1 |
| Awards, Commendations or Thanks | 1 |
| Business Recovery Initiatives | 1 |
| Celebrity Involvement | 1 |
| Doing Better/More in Response | 1 |
| Double Disaster | 1 |
| Future Insurance or Reinsurance | 1 |
| Leader Condolences | 1 |
| Rebuild: Plans & Vision | 1 |
| Researcher/Researching | 1 |

The impressions gained from television would have been somewhat different. The viewer of ‘Financial news’ or ‘Politics’, ‘Current Events’ and ‘Sport’ prior to the Darfield earthquake might have caught the six mentions of earthquake, or not (cf. Table 5.21 and 5.22). After the Darfield earthquake any mention of a disaster elsewhere typically triggered a mention of the Canterbury earthquakes, and Financial and Political news also emphasised the Canterbury earthquakes each time there was an announcement about the national economy or interest rates.

Brief mention story types on television differed from those in the online print media, both before (Table 5.22) and after the Darfield earthquake (compare Table 5.23 with 5.24). An example of a brief mention article is "Science show now not likely to tour" (Gibb, 2011). The article included just one statement about the disruption to the tour schedule of a Dunedin science and technology show as a result of the Port Hills earthquake.

### 5.3.5 Over 20% of articles that included a brief mention of earthquake were finance or sports-related

More than one fifth of articles analysed containing a brief mention of earthquake were sport or finance-related articles. This observation illustrates the Western habit of considering issues in terms of their economic impact over and above other aspects (discussed in section 5.2) as well as the strength of New Zealand's sporting culture. If a nation's history is largely defined by its mass media commentary then the media legacy from the earthquakes in Canterbury in 2010 and 2011, shows how much rugby and sport define New Zealanders.

The reader of the sporting articles would have gained impressions of disruption, of event cancellation or postponement as a mark of respect or venue damage, consequential venue changes (often to other regions), effects on training programmes (particularly the Commonwealth Games in September 2010), effects on the lives of players and officials of various sports, their homes, and/or the effect on their families by one, the two most damaging, or the collective swarm of earthquakes. Other articles recorded commemoration at sporting events, or sport as a fundraiser (e.g. an item in the Motorsport section of the ODT "Rally legend raising funds for quake victim" Unattributed, 2011b). Sports that were related both to brief mentions and full articles included league, racing, football, athletics and swimming. Rugby was however the sport most frequently mentioned in connection with the earthquakes. The Rugby World Cup and the decision to transfer Christchurch games to other cities were the focus of almost 2% of all ODT articles published after the Darfield earthquake. Notably it was an article about the Rugby World Cup (copied from the weekend Herald) that contained the most detail regarding aftershock risk and forecasting in any media article analysed.

Almost 83% of earthquake mentions in financial articles were either *Business in Recovery* or *Economy in Recovery* brief mention story types, with another five per cent accounted for by story types *Business or Industry Effects, Future Insurance or Reinsurance* or *(Un)employment in Recovery*.

### 5.3.6 Pre-Darfield and post-Darfield story types were quite different

Table 5.25 shows that the most prevalent story types in the print media and on television before the Darfield earthquake were *Death Toll or Injured, Search and Rescue, Tsunami Warnings* and *Fundraising/Donations by New Zealanders* (print reported on *Felt Occurrence*s, television did not).

The claim that media focus on death toll and/or on injury holds only to an extent. However the argument is not as compelling if one considers the ten most common story types over the four year period from 2008-2012, as the *Death Toll or Injured* story type is not one of the most common for any of the media datasets analysed (Tables 5.26-5.28). The *Death Toll or Injured* story type is associated with reporting of foreign events. Television did not use the *Death Toll or Injured* story type after the Darfield earthquake (even for foreign events).

Notably each of the most prevalent story types in the ODT other than those of the *Death Toll or Injured* type were headlines in the category of 'What's Happened/Being Done'– and are about DRR actions in response as opposed to harmful consequences. This is important given that the media have been criticised for focussing on the harmful consequences of events (see section 7.5.4).

Table 5.25 shows that the ODT and television provided stories could have been useful in understanding quite different aspects of DRR. For instance television did not cover many *Felt Occurrence(s), Heritage Buildings, NGOs and Aid, Secondary Land Threats*, or *Fatalistic Beliefs* story types. Nor did television cover as wide a range of story types (meaning that many aspects of earthquake-related DRR were not introduced to citizens who only view television broadcasts). Notably television did not include many of the story types that suggested controversy in DRR. Only the ODT included *Aid Issues, Housing, Homelessness or Shelter* or *Heritage Building Matters* story types.

Figure 5.3 and Table 5.18 showed the prevalence of each media story category from 2008 to the end of 2011, both before and after the Darfield earthquake. Clearly, warnings and disaster consequences were reported before the Darfield earthquake, but very little else. After a disaster, when interest in DRR is heightened anyway there were 'DRR Options' stories.

**Recommendation 5 (story types):** All – Additional 'DRR Options' story types would be beneficial to DRR, particularly those publishable before disasters.

**Table 5.25: Pre-Darfield-earthquake print and television story types**

The 38 most prevalent pre-Darfield media headline story types in the ODT. Of the 88 story types identified in online print media coverage before the Darfield earthquake these are the stories where there were more than three print media (Otago Daily Times – ODT) or television (TV1) stories of a particular story type. The story types are presented in order of prevalence in the ODT.

| Number of Story Types | ODT Articles | TV items |
|---|---|---|
| Felt Occurrence(s) | 170 | 3 |
| Death Toll or Injured | 39 | 6 |
| Search & Rescue | 21 | 5 |
| Tsunami Warning | 18 | 9 |
| Fundraising/Donations by New Zealanders | 16 | 3 |
| New Zealand Authorities Aid | 13 | 2 |
| Survivor/Victim Story | 12 | 4 |
| MFAT info/Missing New Zealander | 11 | 1 |
| Reviewing Communication: Warnings | 9 | 2 |
| Foreign Survivor/Victim Story | 8 | 3 |
| Aftershock(s) | 7 | 0 |
| Aid Issues | 7 | 0 |
| New Zealander Relief Volunteers | 6 | 2 |
| Housing, Homelessness or Shelter | 6 | 0 |
| Research Plans | 5 | 2 |
| Military or Police Relief/Aid | 5 | 2 |
| Heritage Building Matters | 5 | 0 |
| Leader Visit | 5 | 0 |
| Associated Natural Phenomena | 4 | 2 |
| Fostering Awareness | 4 | 0 |
| NGOs & Aid | 4 | 0 |
| Secondary Land Threats | 4 | 0 |
| Political in Crisis | 4 | 0 |
| Doing Better/More in Response | 4 | 0 |
| Damage/Devastation | 3 | 7 |
| Household Preparations | 3 | 1 |
| Fatalistic Beliefs | 3 | 0 |
| Antisocial Behaviour & Law Enforcement | 3 | 0 |
| Cleaning Up | 3 | 0 |
| Stressed, Scared, Struggling | 3 | 0 |
| Emergency Medical Treatment | 3 | 0 |
| Insurance Claim Numbers or Cost | 3 | 0 |
| International Aid | 3 | 0 |
| Aid Projects in Recovery | 3 | 0 |
| New Zealanders flown home | 3 | 0 |
| Burying Dead | 3 | 0 |
| Latest Update | 0 | 5 |
| Understanding Aftershock/Earthquake | 0 | 4 |
| Of a total of | 476 | 81 |

### 5.3.7 Lists of 'common' story types from media research are of little value to DRR

Tables 5.26-5.28 show the variability of the ten most common story types in different New Zealand media, and that the variability depends on the criteria used for determining what is common. No comparison with other published studies such as Souza and Martínez (2011), Kodrich and Laituri (2005), Caldwell et al. (1979), C. Su (2012) is presented here, since this study has shown that listing the most common story types or frames in one or two media, and indicating that these are representative of 'what is in the media' does not hold.

The medium, its' location in relation to the disaster, whether the articles are fully focused on the earthquake or only make brief mention of an earthquake, whether one considers a full set of earthquake articles or a subset, or whether one considers science-related articles only plays a significant role in determining common story types. For example television did not report *Felt Occurrences* in the year after the Canterbury earthquakes, which in the print media were one of the most common-related story types in New Zealand in 2008-2012.

What the common story types tables (Tables 5.26-5.28) show is that where there has been a local or national disaster, while many articles may mention damage or death, neither *Damage/Devastation* nor the *Death Toll/Injury* are among the most prevalent headline story types as has often been claimed as a media framing bias. It is for international events only that such a bias applied (section 5.2.11 and Appendix 12). The two most-common story types in women's magazines were human-interest stories from response *Survivor/Victim stories*, and their recovery-related equivalent *Citizens in Recovery.*

### 5.3.8 Contrary to previous research findings, the detail of coverage in television was often greater in television than in print media

Print media has been described as having the ability to cover topics in greater detail than television. In this research there were a number of examples after the Canterbury earthquakes where television explored topics in greater depth, with more evidence-based information and or scientist sources than print media. This was particularly through current affairs programming, but also in the news. Examples were *Reviewing Construction & Codes, Rebuild Logistics* and *Ways to Feel Better* stories such as "What happened at CTV?" (TV1), "Huge job ahead a year on from quake" (TV1, 2011-09-03) and "Jock Matthews on quake stress" (TV1, 2011-04-18). A notable point of difference between the two on-line print media analysed (ODT and STUFF) was that STUFF in the same period continued to focus on events and effects whereas the ODT focused on what was being done (Table 5.18).

**Table 5.26: Most common earthquake story types in print and television 2008-2012**
Ten most common story types on television and in the Otago Daily Times 2008-2012 including both brief mentions or articles fully focused on earthquake. Note that the most common story type lists below are simple numbers of articles and/or items where there is no weighting to reflect that the duration of response (even when this includes multiple response periods to the various Canterbury earthquakes during 2010 and 2011) is far shorter than the recovery period.

| Story Types | Sum of articles & items |
|---|---|
| Disruption | 375 |
| Fundraising/Donations by New Zealanders | 310 |
| Economy in Recovery | 306 |
| Business in Recovery | 289 |
| Felt Occurrence | 261 |
| Survivor/Victim Story | 176 |
| Political in Recovery | 169 |
| Other Social Effects | 155 |
| Search & Rescue | 153 |
| Antisocial Behaviour & Law Enforcement | 144 |

**Table 5.27: Most common earthquake story types in women's magazines 2008-2012**
Ten most common story types in both women's magazines analysed (Next and New Zealand Women's Weekly) 2008-2012

| Story Types | Total articles |
|---|---|
| Survivor/Victim Story | 39 |
| Citizens in Recovery | 8 |
| Fundraising/Donations by New Zealanders | 5 |
| Latest Update | 5 |
| Search & Rescue | 3 |
| Stressed, Scared, Struggling | 3 |
| Solidarity, Compassion & Community Spirit | 3 |
| Ways to Feel Better | 2 |
| Household Preparations | 2 |
| Return to normal/Resilience | 2 |

**Table 5.28: Ten most common earthquake-related story types that discuss science or include the perspective of scientists from the 1000-Stuff-dataset**

| Story Types | Total articles |
|---|---|
| Felt Occurrence | 99 |
| Felt Occurrence-multiple | 24 |
| Forecasting or Prediction | 50 |
| Environment & Public Health | 48 |
| Aftershock(s) | 44 |
| Land Decisions | 40 |
| Research Findings | 31 |
| Researcher/Researching | 29 |
| Stressed, Scared, Struggling | 22 |
| Background/Expectations | 22 |

## 5.4 Media story issue and attention cycles; science- and DRR-cycles

Understanding the ebb and flow of earthquake-related issues presented in the media over time, and the attention to science has revealed how DRR-related-science contributed to the public discussion about earthquakes in the New Zealand media between 2008 and early 2012.

That earthquake events and disasters cause spikes and tails in related media coverage was established in section 5.2. Section 5.2.3 introduced the idea of science- and DRR-media-events. Rather than focusing on event-framing this section discusses the smaller scale cycles of coverage; issue frame cycles.

Downs (1972) described the life cycle of a topic in the mass media as an issue-attention-cycle, where issues, and the related frames develop through specific phases. Issues and attention cycles are related to journalistic norms and to sources and their strategies. It would seem logical that in respect of DRR-related science communication there might be two key issue-attention cycles, one related to DRR, the other to science.

### 5.4.1 General media story frames and their changes

Semetko and Valkenburg (2000) identified that the four most common media story type frames are conflict, human-interest, responsibility, economic consequences and morality. These story type frames are also included in Nisbet's (2010) list of common science frames. Likewise, according to Kitzinger and Reilly (1997) risk-related stories that attract most attention are when major organisations or governments are in conflict over the extent or nature of risk, human-interest stories (including those with a strong visual impact triggered by major disasters), responsibility (stories triggered by questions of blame or official reactions to risk), or where a large number of people are exposed to risk (which arguably is a form of morality). Other prevalent risk-related stories relate to decisive scientific statements. Coverage is only sustained for issues that fall into these categories.

This research could have analysed for the inclusion or exclusion of these five frames in terms of DRR, as did A. Yang (2008) in relation to the Sichuan earthquake. However, to a disaster researcher attempting to improve media content in respect of DRR, it is most important to note what story types are prevalent, and then focus on improving the DRR content of these stories. This research quickly identified that there were many stories that did not fall into any of the four common frames discussed above. While the implications of the above frames in relation to the Canterbury earthquakes might be interesting, using only these frame sets would not afford the opportunity to systematically analyse, compare and contrast media content with other non-media datasets to interrogate whether so-called biases are potentially attributable to media sources as well as media workers. There needed to be some other way of assessing the content, a way that would not only consider the science- but also the DRR communicated. Previous research was useful, but needed to be combined with observations from this research to achieve such assessment.

### 5.4.2 Previous research into science frame changes in the media is summarised in Figure 5.5

Aykut et al. (2012) combined the observations of Downs (1972) and Weingart et al (2000) to suggest that science mass-media issue-attention frames begin with alarm, controversy or over-dramatisation of scientific results by the media and politicians, followed by a backlash, and ending when citizens realize the costs and difficulties involved in the resolution of a problem. Alongside this the visibility of contesting actors changes in different phases. The more highly visible an issue becomes, the more actors join the 'framing contest' (Aykut et al., 2012).

The second or 'backlash' phase is said to involve a period where scientists become more discreet to avoid panic or questioning of credibility and where politicians fear voter reactions or panic. There might also be sensationalism about disagreements (William R. Freudenburg et al., 1996). This phase might also involve a new journalistic dramatization, during which non-scientific views are highlighted. In disaster reporting the possibility of inadequate forecasting can raise its head, including debate about the possibility of cover-up of inadequate forecast (Guobin, 2008); McComas and Shanahan (1999) termed this a 'sideswipe at science'. Other changing science frames from previous research (Table 5.29) are summarised in Figure 5.5. These types of stories and a similar flow of stories were observed in this research. How did this fit with what previous researchers had found about temporal changes in natural-hazard- or disaster reporting?

### 5.4.3 Temporal changes in reporting related to disaster and warnings have previously been identified but until now have not been extended to DRR

Combining previous research about temporal changes in science, disaster and warning reporting allowed a DRR-issue-cycle to be generated.

There has been little previous research interrogating the way DRR-issues are presented in the media. Few scholarly articles discuss media cycles, or other temporal variations in DRR-reporting outside of disaster and warnings. No studies except Quarantelli (1985) and Scraton (2004) were identified in this research as coming close to considering a cycle of media coverage across all phases of the DRR cycle. Other researchers have only considered one or a few stages of coverage (their work is referenced in Table 5.29).

Scraton's framework related to a likely temporal sequence of 8 kinds of information; namely 1) historical context 2) recent context 3) immediate circumstances 4) the moment 5) rescue and evacuation 6) immediate aftermath 7) short-term aftermath 8) long-term aftermath and implications. The nuances of coverage extending into the recovery period are not reflected in his cycle. Furthermore the cycle itself is heavily harms- and event- rather than issue-framed.

Understanding the temporal variations in reporting of science and issues in the media has been better understood in this research through articles such as Nisbet and Huge (2006)'s work on frames and attention cycles in relation to the plant biotechnology debate in the mass media, or the studies of cyclical patterns of information seeking and controversy in media reporting of climate change such as those by McComas & Shanahan (1999).

As was discussed in Chapter 3 considerable thought was given in this research to the variety of ways previous researchers had grouped disaster DRR topics or themes in the media. This led to the development of the 12-DRR-topics wheel, and led to attempts to situate the cycles observed by others in terms of these topics.

### 5.4.4 Issue cycles and story types were identified in this research

Combining the DRR wheel, and media issue cycles discussed in previous literature (Table 5.29) yielded a cycle that did not properly represent the repeated cycles of stories seen for events listed in the time-lines presented in Tables 5.7a-c. In terms of the large local events (the Canterbury earthquakes) there were story types that did not quite fit with the cycles constructed from previous research as depicted in Figure 5.5 and Figure 5.6.

Development story frames, groups and categories (section 5.3) assisted in highlighting aspects of the previous cycles not previously discussed. For example the frames identified from previous research were biased toward the problematic and critical; mention of the positive was rare. Yet, this research showed that there are not only 'blame and responsibility stories', but also praise, including thanks, awards and commendations for authorities and individual experts (see Tables 5.5 and 5.14).

Figure 5.7 is an example of a science issue type cycle where the issue is DRR.

The DRR-science issue story frames (codes) and the final cycle developed in this study (Figure 5.7) consider the results of both science- and DRR-media story types relating to earthquakes. They allow for stories that explain probability and the inability to predict to be located (see upper right hand quadrant of Figure 5.7).

Examples of media articles for each of the frame codes are presented in Figure 5.8.

Figure 5.7 also shows the prevalence of the DRR-science-issue-story types in the New Zealand media (from analysis of 1000-Stuff dataset). With media and editors increasingly signing up to MOUs relating to DRR coverage and the emphasis in the Sendai Framework on the need for such partnerships there is clearly scope for balancing the headline frames. For example rather than only alerting about 'Future Risk', there could be more framing headlines so that risk is explained ('Explaining Risk') or the 'Safety Reactions' (not inactions) are emphasised. While 7.7% of articles were headlined so as to indicate that science was informing (recovery) decisions analysis showed that this did not mean that science was presented in those articles. Stories headlined as 'Lessons Learnt' and 'Cause' were few.

The following recommendation suggests a way of remedying some of the observed imbalance in DRR-science issue media story types for the benefit of citizens and DRR.

**Recommendation 6 (story types):** Media - Editors with an interest in supporting DRR might frame headlines to achieve a balance of DRR-science issue types.

**Table 5.29: Previous research relating to media story cycles, issue cycles and time-related disaster-risk- and science-issue-related story frames**

This table summarises previous research relating to issue cycles and time-related frame changes relating to public sphere portrayal of disasters and other science-issues. The right hand column presents literature considered in the development of DRR-issue frames that fit with the DRR cycle as shown in Tables 5.14-5.18.

| **DRR-related media story frames as grouped in this research** | **Parts of story-, issue or disaster cycles referred to in previous studies of media and natural hazards or related disasters** |
|---|---|
| Event and effects | Human-interest (Turner, 1982)<br>Sensationalist (J. Cowan, McClure, & Wilson, 2002)<br>Seismological and geological back-grounding (Turner, 1982)<br>Sense-making (Lu & Yang, 2011) |
| What's Happened/? Being Done? | Damage and emergency response (Quarantelli, 1985)<br>Construct event and contemplate ruins (Adamo, 2006)<br>Historic context, recent context, immediate circumstances, the moment, rescue and evacuation, immediate aftermath, short-term aftermath (Scraton, 2004) |
| Reflecting on Responsibility | Cause (Quarantelli, 1985)<br>Fatalistic (J. Cowan et al., 2002)<br>Theorize nature (Adamo, 2006)<br>Location of responsibility for risk (Billet, 2010)<br>Economics and cost (Aykut et al., 2012; Downs, 1972; K. McComas & Shanahan, 1999) |
| Criticism/Praise/Finding | Agency responsibility and blame (Quarantelli, 1985)<br>Controversy /science moving into the dock (K. McComas & Shanahan, 1999)<br>Scientists become discreet to avoid panic or questioning of credibility (Aykut et al., 2012) |
| Recovery Assessments and Initiatives | Residual effects (Quarantelli, 1985)<br>Public concern and collective enthusiasm to solve problem (K. McComas & Shanahan, 1999)<br>Euphoric enthusiasm to solve problem (Downs, 1972)<br>Long-term aftermath and implications (Scraton, 2004) |
| Recovery Milestones<br>Anniversaries | Restoration and recovery (Quarantelli, 1985)<br>Anniversary coverage (J. Cowan et al., 2002; C. Su, 2012) |
| Approach to DRR | Lessons learnt (J. Cowan et al., 2002)<br>Review of impacts and measures (Aykut et al., 2012) |
| New Policies/Procedures | Announcements of legislation or policy change (Turner, 1980b) |
| Research & Findings | Nature of the hazard (Quarantelli, 1985)<br>Over-dramatisation of scientific results (Aykut et al., 2012) |
| Warning/Risk | Pre-problem stage (Downs, 1972; K. McComas & Shanahan, 1999)<br>Nature of the hazard (Quarantelli, 1985)<br>Warning (Quarantelli, 1985)<br>Implied danger due to triggering event (K. McComas & Shanahan, 1999) |
| Reaction to Warning | Criticism of scientists about warning (S. Miller, 1997)<br>Information-seeking (Hart & Leiserowitz, 2009)<br>Alarmed discovery (Downs, 1972)<br>Alarm/reassurance (Aykut et al., 2012; Turner, 1982)<br>Gradual decline of intense public interest (Downs, 1972) |

**Figure 5.5: Science-issue story type cycle from previous research**

This figure is a representation of the science-issue-related issue-cycle and time-related frames identified from previous research. The previous research literature used in compiling this figure is detailed in Table 5.29 and is represented on the figure by the first letters of the author(s) surname and last two digits of the year the article was published. Unlike previous research that has tended to consider only one part of the DRR cycle this compilation represents observations about media stories published before, during and after events (across all four phases of the DRR cycle, reduction, readiness, response and recovery).

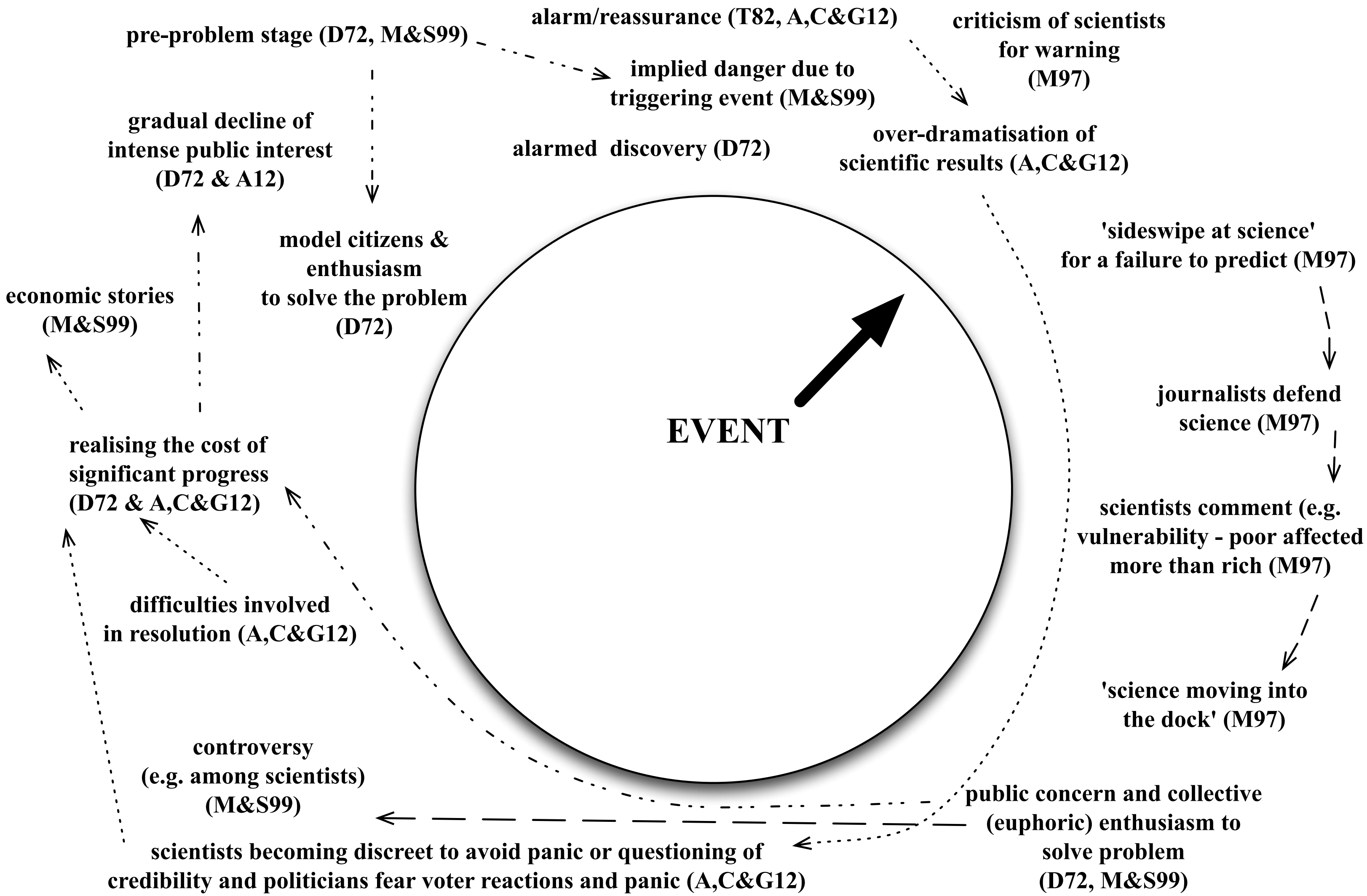
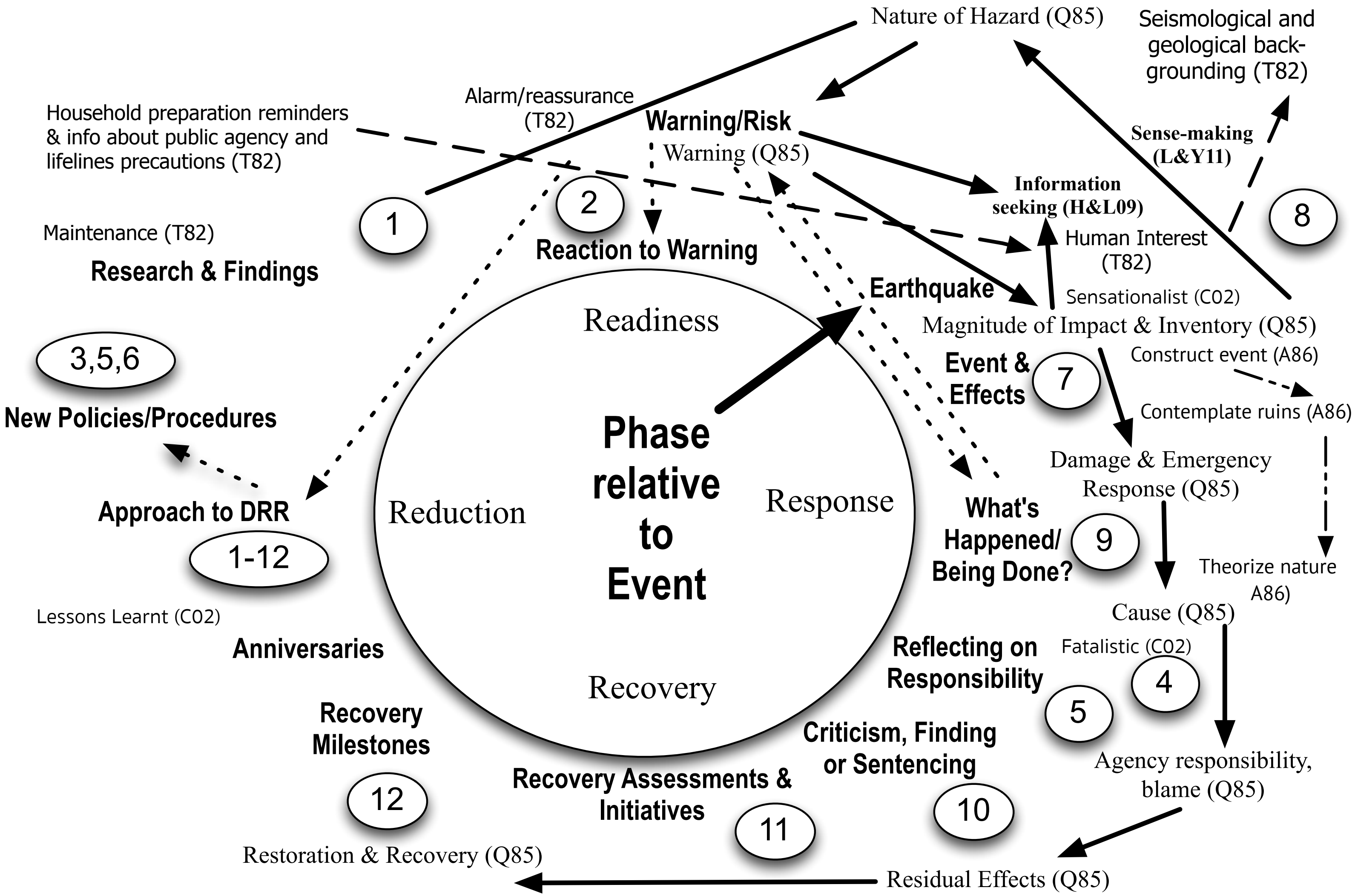

pre-problem stage (D72, M&S99)
alarm/reassurance (T82, A,C&G12)
criticism of scientists for warning (M97)
implied danger due to triggering event (M&S99)
gradual decline of intense public interest (D72 & A12)
alarmed discovery (D72)
over-dramatisation of scientific results (A,C&G12)
'sideswipe at science' for a failure to predict (M97)
model citizens & enthusiasm to solve the problem (D72)
economic stories (M&S99)
EVENT
journalists defend science (M97)
realising the cost of significant progress (D72 & A,C&G12)
scientists comment (e.g. vulnerability - poor affected more than rich (M97)
difficulties involved in resolution (A,C&G12)
'science moving into the dock' (M97)
controversy (e.g. among scientists) (M&S99)
public concern and collective (euphoric) enthusiasm to solve problem (D72, M&S99)
scientists becoming discreet to avoid panic or questioning of credibility and politicians fear voter reactions and panic (A,C&G12)

**Figure 5.6: Compilation of risk- and disaster-related media-story-, issue-cycle- and time-frames from previous research**

This figure shows the relationship of previous researchers' comment about risk- and disaster-media story cycles, disaster- and risk-issue frames to the four phases of the DRR cycle. The previous research is as listed in Table 5.29. The literature is referenced on the figure by the first letters of the author(s) surname and last two digits of the year the article was published. Numbers in circles represent the twelve DRR topic codes developed in this research (Figure 3.4) to show the relationship of the DRR topics to the story cycle. Story categories and groups developed in this research (Tables 5.12-5.16) have also been overlain. The arrows show the typical flow of stories indicated by previous researchers.



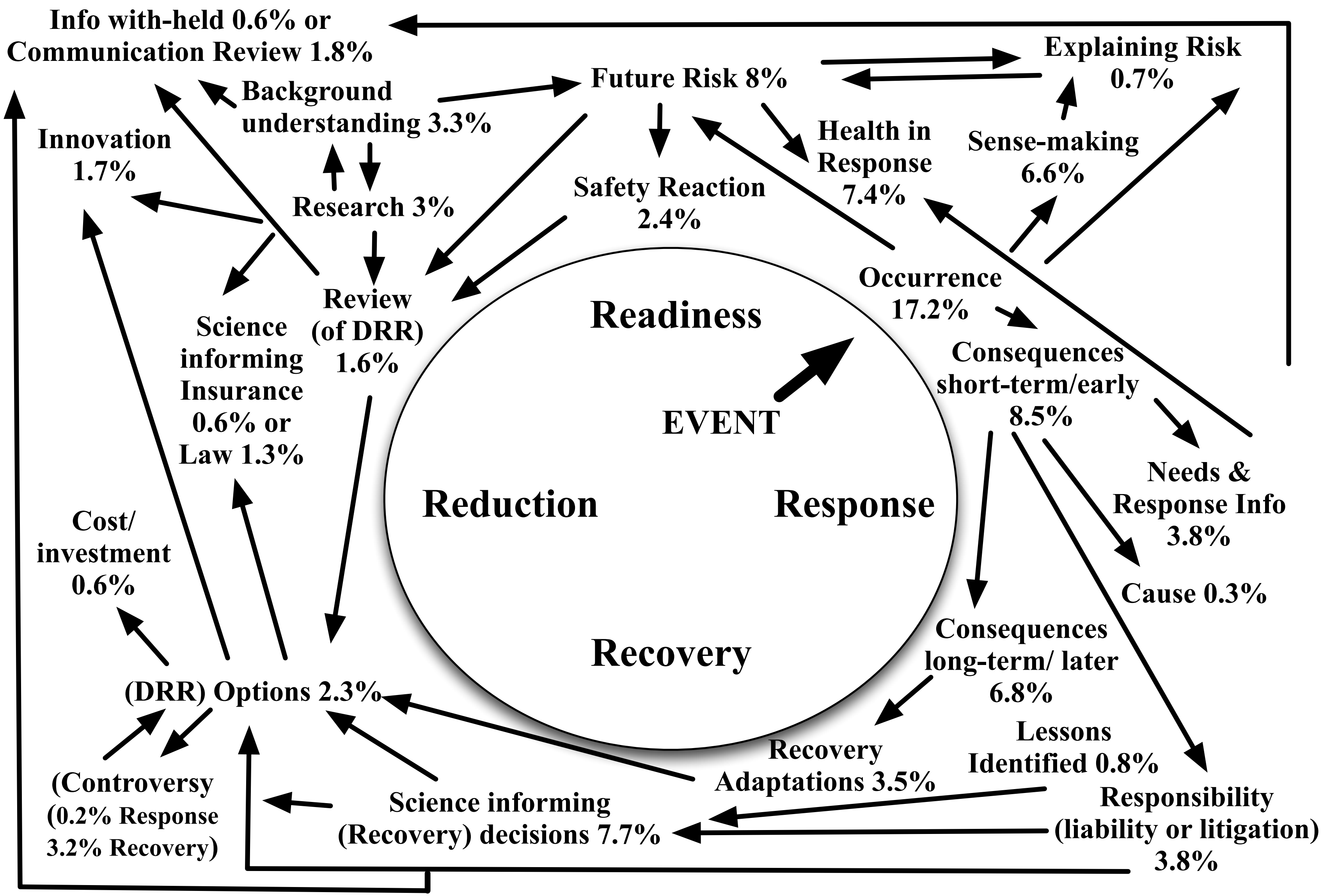
Nature of Hazard (Q85)
Seismological and geological back-grounding (T82)
Alarm/reassurance (T82)
Household preparation reminders & info about public agency and lifelines precautions (T82)
Warning/Risk
Warning (Q85)
Sense-making (L&Y11)
Information seeking (H&L09)
Human Interest (T82)
1
2
8
Maintenance (T82)
Reaction to Warning
Research & Findings
Earthquake
Sensationalist (C02)
Magnitude of Impact & Inventory (Q85)
Readiness
Construct event (A86)
3,5,6
Event & Effects
7
Contemplate ruins (A86)
New Policies/Procedures
Phase relative to Event
Damage & Emergency Response (Q85)
Approach to DRR
Reduction
Response
What's Happened/ Being Done?
9
1-12
Theorize nature A86)
Lessons Learnt (C02)
Cause (Q85)
Anniversaries
Reflecting on Responsibility
Fatalistic (C02)
4
Recovery
5
Recovery Milestones
Criticism, Finding or Sentencing
Agency responsibility, blame (Q85)
Recovery Assessments & Initiatives
12
10
11
Restoration & Recovery (Q85)
Residual Effects (Q85)

**Figure 5.7: New Zealand DRR-science-issue story type cycle and results**

This figure is an example of a science-issue cycle where the topic is DRR. The cycle was identified from television and print media coverage before and after the Canterbury earthquakes of 2010 and 2011. The DRR-science issue codes relate to the DRR-related media story type codes developed in this research. These DRR science-issue codes were developed taking into consideration previous literature relating to science issues (as depicted in Figure 5.5 and 5.6 and listed in Table 5.29).

The arrows show the typical flow of stories relating to earthquake-related New Zeland media articles over time. Percentages shown are prevalence of these science-issue story types in the 1000-post-Darfield-Stuff articles.

'Explaining risk' science story types included explaining probability and inability to predict. Future risk includes social or building vulnerability, risk of secondary and/or health hazards. Risk (in)action included discounting risk or evacuation. 'Reviewing mitigation' was scientists' reaction to inaction and reasons supporting action. 'Science informing recovery' decisions included articles framed as 'science takes time'. 'Safety Reaction' includes all reactions to risk whether considered irrational or rational. Cause stories don't show on the figure as leading directly anywhere, however as they frame potential options a link to 'Review (of DRR) could be shown.


Info with-held 0.6% or
Communication Review 1.8%
Background
understanding 3.3%
Future Risk 8%
Explaining Risk
0.7%
Innovation
1.7%
Research 3%
Safety Reaction
2.4%
Health in
Response
7.4%
Sense-making
6.6%
Review
(of DRR)
1.6%
Science
informing
Insurance
0.6% or
Law 1.3%
Occurrence
17.2%
Readiness
Consequences
short-term/early
8.5%
EVENT
Needs &
Response Info
3.8%
Reduction
Response
Cost/
investment
0.6%
Cause 0.3%
Consequences
long-term/ later
6.8%
Recovery
(DRR) Options 2.3%
Lessons
Identified 0.8%
Recovery
Adaptations 3.5%
Responsibility
(liability or litigation)
3.8%
(Controversy
(0.2% Response
3.2% Recovery)
Science informing
(Recovery) decisions 7.7%

## Figure 5.8: Code examples - New Zealand DRR-science-issue story types

This figure provides examples of media articles of each of the DRR-science issue codes. The example articles are from the 1000-Stuff dataset. Note that these codes are quite distinct from media story types

**'Future risk'** could potentially be about social or building vulnerability or risk of secondary land or health hazards, not only earthquake risk. In the New Zealand media analysed there were some of the latter stories relating to nuclear issues associated with the Japanese, Tohoku earthquake event (e.g. "NZ safe from nuclear fall-out" by Easton, 2011), otherwise they were most related to future earthquake risk.

'**Explaining Risk'** stories could potentially be from any discipline. In this study 'Explaining Risk' science stories were primarily about prediction (or pseudo-scientific prediction) and earthquake precursors in Canterbury, in relation to international events, and generally (e.g. "Reading signs before a quake" (Vicki Anderson, 2011c) and "PM's science advisor rubbishes Christchurch quake claim" (K. Johnson, 2011a)).

'Safety Reaction' stories were about discounting risk (e.g. "New faults fail to dull optimism" (Gorman, 2011h) or "Homeowners ignore safety notices" (Fairfax NZ News, 2011k)), evacuations or closures (e.g. "Earthquake Risk closes Canterbury Hospital" by Carville, 2011c), scientist reaction to inaction (e.g. "'Unrealistic optimism' bounces back" by Sharpe, 2010), reasons supporting action (e.g. "Canterbury more prepared than ever" by Napier, 2011).

**'Research' and 'Background Understanding'** story framing was typically in relation to earth science, for example "In-depth fault line research gets backing" (Ash, 2010) or "Fracking – yes or no?" (Vicki Anderson, 2011b).

An example of a '**Health in Response'** story was "Residents say silt dust a health risk" (Heather, 2011c). A **'Review of DRR'** story was "Standards process robust" (Chin, 2010).

**'Sense-making'** frames in media stories could potentially be from any discipline but were typically about Earth science in the media analysed (e.g. "The science behind the shakes" by Gorman, 2010).

Most articles of the **'Recovery Adaptation'** issue frame related to mental health (e.g. "'Quaking' is not a condition we must live with'" by Vallance, 2011).

The three **'Science Informing...'** DRR-science issue media story frames included the recovery stories "Some areas 'simply not feasible to rebuild'"(Heather, 2011e) or "Flooded Christchurch area can't be fixed – expert" (Heather, 2011l). An example of '... Informing Insurance' was "Christchurch aftershock worries insurers" (Heather, 2011g). An '...Informing Law' example was "Ecan rewrites regional planning policy" (Gorman, 2011j).

**'Liability and litigation'** framing was mostly procedural matters relating to the Royal Commission of inquiry (e.g. "Royal commission hearings start in October" by Carville, 2011a), some articles about evidence presented at the inquiry (e.g. "Earthquake-Strengthening Rods failed in Christchurch" by Gates & Carville, 2011), and media articles relating to the L'Aquila earthquake (e.g. "Scientists on trial over earthquake deaths" by Winfield, 2011).

**'Recovery Controversy'** in the New Zealand media was typically about land or demolitions decisions; citizens questioning the reasoning (e.g. "Owners fight red-zone buy-out" (Greenhill & Wright, 2011) or "Building could have been saved/engineer" (Conway, 2010)) or the timing of decisions (e.g. "Quake decisions coming too slowly" by Hartevelt, 2011b). Most times it was unclear whether the controversy was scientific (about the data alone) or what might be done on the basis of data (more politically driven). 'Info with-held' framed headlines included "Kairaki residents seek data under act" (M. Wright, 2011b).

**'Communication Review'** included "Rating the quake coverage" (Mace, 2010) although this was an analysis an opinion story by a reporter written a few days after the Darfield earthquake, not a summary of The Press's research such as from a reader survey commissioned by The Press (Futurescape-Global-Ltd, 2012). **'Review of DRR'** framed stories typically told of authorities' review or even leader opinion about DRR (e.g. former New Zealand Prime Minister in "World should emulate NZ – Helen Clark" by Backhouse & NZPA, 2010) rather than independent scientific review.

**'Innovation'** DRR-science issue media story types included "Leading the world in quake engineering" (Buchanan, 2010) and "Floating design allows building on fault-lines" (Mussen, 2011).

**'Lessons identified'** typically have the word 'lessons' or 'learned in the title – (e.g. "Many lessons learnt, says post-quake boss" by Heather, 2011b)

**'Cause'** DRR-science-issue types included 'earthquake cause' (NZPA, 2010e), and 'disaster cause', whether that was fatalistic (e.g. "NZ 'blessed' no one died" by NZPA, 2010f), or relating to building construction (e.g. "Questions over CTV Building Construction" by M. Wright, 2011c).

## 5.5 The role of science and scientists in DRR-related media

*Science is at the heart of deciding what to do next in Canterbury – for instance, one of the reasons it has taken so long to decide which suburbs will be condemned is the complexity of predicting future vulnerability to liquefaction.*

'The year the earth shook' (Dudding, 2011)

### 5.5.1 This section discusses how the NZ media portrayed science in relation to DRR

In the following sub-sections the body text of the 20-earthquake-research-database and audio (speech acts) in television news items were examined for scientist sources and science-related content that has impact on DRR. The body text has also been considered for qualitative comment. The following subsections discuss what this research has revealed about the scientists, disciplines and institutions that were the sources providing information about earthquake-related DRR topics in the New Zealand media. The comments from non-scientist sources in the media, about science and possibilities in DRR are also revealing, in terms of attitudes to science, and whether people agree with and understand the relevance and use of science for DRR. This is discussed briefly in section 0. Recall from chapter 3 that the interest in this research was not only on academic scientists but also on all scientists including professionals and practitioners applying evidence-based information at the science-society interface, and how they did or did not communicate this.

The following chapter (6) focuses on the disciplinary background of scientist sources in the media.

### 5.5.2 More articles mentioned science briefly than were focused on science

To code an article or television item as having a 'science focus' the title/headline needed to refer to science or a scientist *and* have multiple paragraphs in the body text (spoken content for television) that discussed the evidence-basis of an issue, and/or were comments by a scientist or other source about science. Articles coded as containing a science 'section' typically contained only one or two paragraphs (statements in television items) that gave some detail about science, a scientific institution or scientist. There may occasionally have been more paragraphs when the article item was a long one. The difference between an article coded as having a 'science focus' and those coded 'section' is that for the latter there are significant parts of the article or item that did not relate to science.

For a comparison of whether news and current affairs items on New Zealand television relating to earthquakes focused on science, only contained a section relating to science or only mentioned science briefly, see Figure 5.9.

Figure 5.9 shows that, with one exception, whatever the scientific disciplinary group, the proportions of emphasis on science were relatively similar. For example, regardless of disciplinary type, 20-35% of television items were focused on a science topic. The exception is that where the item headlines suggested topics that were inter-disciplinary or multi-disciplinary in nature, there was a predominance of brief mentions of science rather than a focus on science. Only 10% of items whose headlines were inter-disciplinary or multi-disciplinary in nature focused on the evidence-basis.

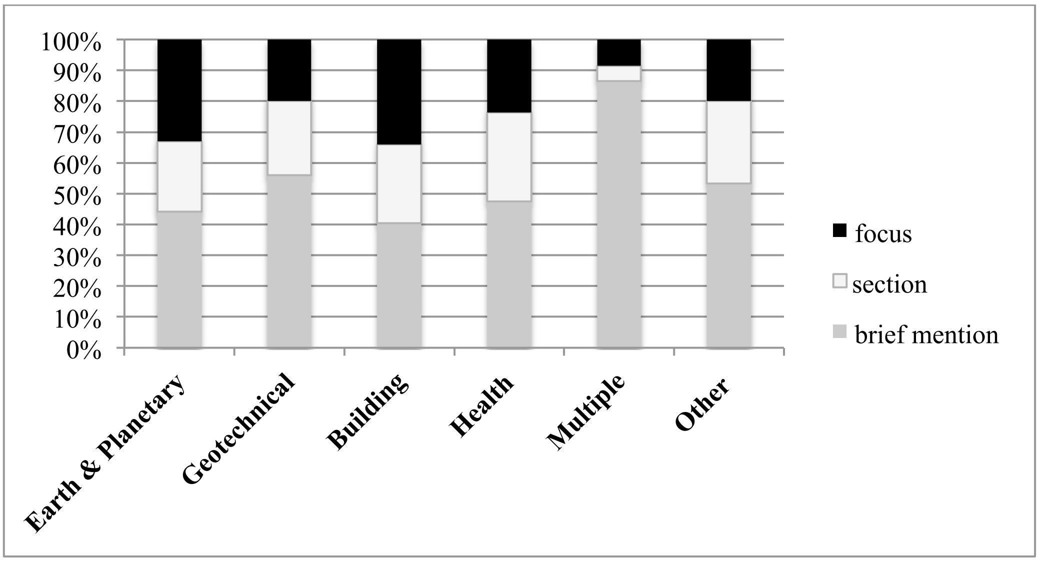



**Figure 5.9: Proportions of science brief mentions, sections and science-focused television items**

Proportions of news and current affairs items from the TV1 dataset (04 September 2010-03 December 2011) briefly mentioning a particular science discipline, containing only a section relating to science, or focusing on science. In this graph 'Other' relates to all science discipline groups that are not mentioned on the figure. See section 3.6.4 for discipline descriptions. This figure shows that in most cases television items were not dedicated to a science topic or scientist commentary. The table also shows that articles that contain only brief mentions of earthquake impart science knowledge.

Figure 5.9 also shows there were a greater number of media articles that contained only brief mentions of earthquake-related science than there were articles focused on earthquake-related science. This means that science knowledge can be constructed from articles not only focused on science. Consequently it is important to analyse these articles also, leading to the following recommendation.

**Recommendation 7 (information, decision & management science):** Researchers - Media content analyses should assess articles where there are only brief mentions of a topic, as well as articles that are focused on the topic as the knowledge imparted may be very different (cf. section 5.3.4).

### 5.5.3 The most obviously DRR science-related media story types were either about researchers, their plans and findings

The media headline story types most clearly related to science were often of the *Research Plans, Research Findings* and *Researcher/Researching* story types. *Background Expectations* headline story type articles are part of the set of articles intuitively referred to as 'science communication'. So too are all story types in the ‘Warnings/Risk’ group and, for the topic of earthquakes, *Understanding Earthquakes* and *Associated Natural Phenomena*. Television contained a comparatively high proportion of ‘Research & Findings’ story group stories. Women’s magazines contained none. Next magazine published one and NZWW published four other *Background/Expectations* stories, but otherwise none of the story types most typically associated with science (e.g. Table 5.28).

All of the aforementioned story types in the ODT on Stuff and on television related mostly to earth sciences. This might intuitively be expected unless one asks why it is any more important for DRR and resilience to earthquakes to know and understand about the work, life and findings of someone who studies an uncontrollable process like seismicity, over the work, life and findings of, say, a building scientist (see chapter 6 for further discussion).

### 5.5.4 Science and scientists or scientific institutions were mentioned in over 80% of the Stuff dataset but hardly mentioned in women’s magazines

Of the 1000-Stuff articles that were selected as potentially being stories that referred to science topics only five of the 1000 Stuff articles were from the ‘Science’ section of the Stuff website, four were from ‘Technology’ and one was from the ‘Environment’ section. Most articles on that dataset were general news from The Press (Christchurch).

There was no scientist source, scientific institution mentioned, or mention of science in 16.8% of the 1000 Stuff articles. The proportion of science-related mentions and appearances on television and in Stuff articles is shown in Table 5.30. Most often a named scientist was used rather than a generic reference to information from an institution or research results in general. The 1000-Stuff data set included opinion pieces by scientists, for example media articles by Buchanan (2011) and P. Wood (2010).

**Table 5.30: Type of science mention (scientist, institution or other)**

| Science mention type | Stuff % | TV % | NZWW % | Next % |
|---|---|---|---|---|
| Scientist (academic, professional or govt research) | 61.9 | 54.4 | 10 | 33.3 |
| Institution - named | 11.1 | 7.5 | 10 | 0 |
| Experts who were officials (research not primary function) | 8.1 | 10.5 | 0 | 0 |
| Scientist(s) un-named | 13.8 | 18.4 | 50 | 50 |
| Other – e.g., mention of survey, poll report, analysis, method, victim who was scientist, website | 5.1 | 9.2 | 30 | 16.6 |

Proportions of scientists mention types where scientists were mentioned. Percentages of individuals named as scientists, named scientific institutions, organisation or groups who conduct or represent science, named mention of experts who were officials, generic mention of scientists (un-named), or other mentions of science on television (n=569 appearances) in 1000 Stuff articles (n=239 mentions), or in women's magazines NZWW (n=10) or Next (n=6). The small number of magazine articles published in the period mean comparison of proportions is not useful.

Of the television (TV1) news and current affairs items (in the 15-month period 4 September 2015 to 4 December 2011) 6% only focus on science. A further 6% contain a section on science. Another 15% of articles contain a brief mention of science. Thus, just over 27% of television items can be said to potentially convey to the viewer evidence-based information, or knowledge of how science works.

In women's magazines there were only brief mentions of 'scientific fact'. Most mentions of science in women's magazines were in human-interest stories. Only ten out of sixty-eight NZWW articles, but six out of eighteen (one third) of Next magazine articles made specific mention of science, scientific institutions or scientists. In both magazines most mentions were of unnamed health professionals. An exception was one Next article on post-traumatic stress referred to multiple PTSD experts including international experts. Most mentions in the NZWW were generic ones of emergency medical or public health professionals; the institution mentioned was the Canterbury District Health Board.

Mentions of earth science were mostly in introductory statements made by journalists or in unattributed 'fact files' or other inserts onto pages that otherwise featured the personal interest stories. There was a significantly higher proportion of references to the paranormal – animal instincts, 'premonition', electromagnetic energy related to earthquakes causing hauntings in the women's magazines than on television items or print media articles about earthquake. For example article "City's Spirit Lives On" (V. Tyler, 2011) included an image of what might have appeared to be 'scientific equipment' and quoted *"Christchurch Paranormal Investigators New Zealand director Anton Heyrick"* as saying *"We stop and look at the scientific side where we can"*.

There was one article in Next on post-traumatic stress disorder that gave websites for further information written by a scientist referring to other scientists.

### 5.5.5 There was a mix of science- or expert-related institutions, organisations, consultants and groups in the media

A mix of academic and Crown-research, government authorities and small- and large - consulting scientists and professional groups were mentioned or used as sources in the post-Darfield-earthquake media (Table 5.31 and Appendix 9).

Some DRR-science-related groups or institutions were rarely mentioned in the media, other, namely hazard- research and health-related institutions or the individuals they employed dominated the coverage.

Most scientists were based in New Zealand. On television GNS was the institution mentioned more than any other. The University of Canterbury, Canterbury District Health Board and Christchurch Hospital were the institutions featured next most often. Other New Zealand universities being further away from the earthquakes were mentioned in fewer television items. The University of Otago and Victoria University were mentioned in twice as many items as the other universities. All other institutions or groups were mentioned in only one or two items of the television coverage analysed. In post-Darfield Stuff articles 25 institutions were mentioned in three or more articles. GNS, the University of Canterbury, the Canterbury District Health Board and Environment Canterbury (the regional council) were the institutions that featured the most (Table 5.32).

**Table 5.31: Type of institution mentioned or institution scientist employed by**
Whether New Zealand, international institutions or no institution (or no individual whose institution was known) were mentioned on television (TV1 n=569 appearances) and in the 1000 Stuff articles (n=239 mentions). Further subtypes were shown if the institution was a New Zealand.

| Institutional type | Stuff % | TV % |
|---|---|---|
| New Zealand | | |
| Academic | 17.0 | 16.3 |
| Government – research (CRI) | 13.0 | 13.4 |
| Government – regulatory authorities | 13.0 | 11.3 |
| Professional - large business (not health provider) | 7.4 | 6.7 |
| Professional - health provider | 4.9 | 5.9 |
| Consultant/small private business | 4.4 | 7.5 |
| NGO/professional group | 7.0 | 7.5 |
| International | 16.2 | 5.4 |
| Not given or not individual or institution | 17.0 | 25.9 |

**Table 5.32: Most frequently mentioned institutions in science/expert related coverage**
The 25 institutions that were mentioned in the greatest numbers in the 1000 post-Darfield Stuff articles analysed are listed below. The right hand column gives the percentage of the total number of articles that these institutions were mentioned in. Note that the proportions of mention of these institutions in overall coverage (as opposed to this science-focused dataset) would have been quite different.

| Institution | % of mentions |
|---|---|
| Geological and Nuclear Sciences | 22.3 |
| University of Canterbury | 18.0 |
| Canterbury District Health Board | 6.2 |
| Environment Canterbury (Regional Council) | 4.7 |
| University of Otago | 4.3 |
| Victoria University | 3.8 |
| Christchurch City Council | 3.3 |
| National Institute of Water and Atmospheric Sciences | 2.8 |
| Opus Group | 2.8 |
| Christchurch Hospital | 2.4 |
| Lincoln University (Canterbury) | 2.4 |
| United States Geological Survey | 2.4 |
| University of Auckland | 2.4 |
| Tonkin & Taylor (geotechnical consultants) | 2.4 |
| Department of Building and Housing | 1.9 |
| Department of Conservation | 1.9 |
| Christchurch Hospital | 1.9 |
| Massey University | 1.9 |
| New Zealand Society for Earthquake Engineering | 1.9 |
| New Zealand Historic Places Trust | 1.9 |
| ANZ bank | 1.4 |
| BNZ bank | 1.4 |
| Geotech (Consulting Limited) | 1.4 |
| Harvard University | 1.4 |
| Joint Centre for Disaster Research | 1.4 |
| Statistics New Zealand | 1.4 |

Certain groups were rarely mentioned in media coverage; for example Resilient Organisations (Resorgs) and Sustainable Buildings of the Future. Individual affiliations with such groups were also rare. For example Dr Seville's association with Resilient Organisations was not mentioned in the articles analysed. While Dr Potangaroa's experience with many international disasters was mentioned, his association with Resorgs was not. These are lost opportunities to frame the concept that businesses and organisations can be resilient. Even the Joint Centre for Disaster Research (JCDR) does not feature high up the list. This is considered a lost opportunity for DRR.

Neither the Department of Building, and Housing or the Earthquake Commission (EQC) or sources from them took the time to succinctly express the value of their organisations to New Zealand. It was an international source who made the only comment in the print articles analysed regarding EQC's activities rather than insurance assessments;

> *One of the great things New Zealand has going for it is the Earthquake Commission (EQC & CAENZ). They are great. They invest money into earthquake studies. They're ahead of everyone. ... it is likely that New Zealand will undertake a shakeout drill too, perhaps on a national scale.*
>
> Prof. Robert Yeats in "The next one" (The Press, 2010)

Alongside television presenters, four other individual authority figures were found to frequently make comments about science, present data, or otherwise represent scientific expertise. They were Earthquake Recovery Minister Gerry Brownlee (geotechnical aspects, land remediation, and occasionally other topics such as economic indicators), Christchurch Mayor Bob Parker (on a range of topics from public health warnings and chemical toilet function, through to future seismicity), Prime Minister John Key (primarily on economic costs of the earthquakes), and Roger Sutton CEO of electricity provider Orion, and later head of the Canterbury Earthquake Recovery Authority (CERA). Sutton's comments and appearances were initially in his capacity as infrastructure engineer and later reiterating Minister Brownlee's 'science takes time' messages, in terms of geotechnical assessments. Minister Brownlee might be said to be the "information czar" on the topic of geotechnical matters relating to liquefaction (e.g. "Quake land report released" (Cowlishaw, 2010)) and the Christchurch rebuild (e.g. "My hometown can be rebuilt – Brownlee" (Chapman, 2011)).

### 5.5.6 Scientist media source prevalence broadly matched New Zealand research areas

As noted in chapter 2 much research has focused on the media as 'agenda-setter'. Few researchers acknowledge, address or begin to quantify the influence of sources approached by the media, or who enter the media of their own accord.

In New Zealand the major DRR-research groups relate to hazard-research, (geophysical monitoring and active tectonics research through most of the universities and through GNS), engineering design and construction (primarily at the Universities of Canterbury and Auckland, and associated with the New Zealand Society for Earthquake Engineering), psychosocial aspects of disaster and risk perception (Joint Centre for Disaster Research affiliates primarily from Massey and Victoria Universities and the University of Canterbury), Resilient Organisations, and to a lesser degree lifelines engineering (OPUS and regional and local councils). Prior to the earthquake these organisations were also associated with the Joint Centre for Disaster Research and Natural Hazards Platform (see Appendix 4). Increasingly interdisciplinary teams have worked on projects together (e.g. the 'Wellington it's our Fault' team involves tens of researchers, across a range of disciplines, albeit quite heavily hazard-focused.

The two areas of scientific research most frequently mentioned in the New Zealand media, seismology and psychology, match the two strongest research groups in New Zealand. The range of psychologists used as sources range from industrial to clinical psychologists, through to those specifically involved in disaster research at Massey University.

However, whilst engineering research and practice in New Zealand is the subject of much attention (Appendix 4) there were relatively few engineering sources in the media. This might be in part a function of the fact that many engineers are in private business and concerned about issues of liability. However this does not account for why little is heard from academic engineers. Why academic geoscientists consider the importance of hazard warning for DRR, but academic engineers do not similarly see the importance in their communicating about solutions is an aspect that could do with further research.

The reasons for the relative absence of comment from researchers from Victoria Universities' architecture and building science department would also be interesting to understand. It may be that the media's use of local engineering academics from Canterbury's engineering school was deliberate.

Overall many aspects of the coverage of science and scientists discussed in this section were remarkably similar in both television and print news (Tables 5.32-5.35). This is even though the television items were most often only a few minutes long (Figure 3.6) and therefore could not have been expected to show many sources.

### 5.5.7 Most scientists/expert sources in the media were New Zealand residents

It is worth noting that science/expertise sources were mostly New Zealand residents. This holds whether one considers either the complete list of (Appendix 9), or most mentioned scientists/experts (Table 5.36). This is most likely a function of source availability/ease of interview of locals. Television appearances of internationals would be almost nil, were it not for visiting seismologist Professor Kevin Furlong, a group of geotechnical experts, and architect Shigeru Ban who designed the cardboard Cathedral. Television presenter comments, and perusal of citizen comments to articles suggest a tendency to respect international expertise more than that of locals. For example in "Engineers dispute estimate" an unattributed journalist (News, 2011) wrote *"The [CCC] has declared almost 600 houses on the Port Hills off limits while engineering consultants, including two international experts, assess the rockfall danger"*. There were few instances of international experts in disagreement with local experts in the media. Two examples were Vicky Anderson and Kozanic (2011) and (Gorman, 2011a). In the latter Gorman wrote *"an outsider, visiting Pennsylvania State University geologist Professor Kevin Furlong believes the best science does not come from such consensus"*.

The importance of local expertise was argued in "Quake jolt for Canterbury University jobs" (Gorman, 2011m);

> *[Tertiary Education Union national president Sandra Grey said] "We need to say to Cabinet, 'This isn't like every other business; this is a critical part of the infrastructure'. There's lots of research and community work going on thanks to their expertise. "Clearly you don't want to lose that expertise, not just in the geological sciences and engineering, but the social sciences too. Canterbury needs them."*

### 5.5.8 Nearly 400 scientists were mentioned or appeared in earthquake-related media

There were 160 named individuals who were scientists or institutional experts who appeared or were mentioned on New Zealand's television channel TV1. Most appeared or were mentioned once or twice only (88%). Similarly, of the 397 individuals named in the 1000 Stuff online articles analysed 80% were mentioned once or twice only on Table 5.33.

**Table 5.33: Scientist/expert mentions or appearances**
Number of separate online print media articles published or television items broadcast after the Darfield earthquake that individual scientists or experts appeared on or were mentioned in (from analysis of the TV1 and 1000-Stuff datasets).

| Number of mentions or appearances | TV and Stuff Numbers | TV1 Appearances | Stuff Mentions |
|---|---|---|---|
| 1 | 116 of 160, 269 of 397 | 72.50% | 67.80% |
| 2 | 25 of 160, 53 of 397 | 15.60% | 13.30% |
| 3 | 5 of 160, 23 of 397 | 3.10% | 5.80% |
| 4, 5 or 6 | 11 of 160, 28 of 397 | 6.90% | 7.10% |
| 7 or more | 3 of 160, 24 of 397 | 1.90% | 6.00% |

Sixty-six of the named individual scientists/experts appeared or were mentioned on both the Stuff website and television. In addition to the individuals listed in Appendix 11 there were also 16 unidentified scientists (mostly structural engineers engaged in assessments and a few laboratory scientists) shown on television.

Only 16.9% and 21% of the individual science sources were female (on television and Stuff respectively - Table 5.34). These results are notably similar to Voorhees et al. (2007) finding that males were shown in positions of authority 86.1% of the time, compared to 13.8% for females (in relation to media coverage of Hurricane Katrina in the US). This is however likely to be more a function of who hold particular science roles (or in the US example who holds authority) than a media bias.

**Table 5.34: Scientist's gender**
Percentage of individual scientists named on television (n=397 individuals) and in 1000 Stuff articles (n=178 individuals) who were either gender.

| Scientist Gender | Stuff % | TV % |
|---|---|---|
| Female | 16.9 | 20.7 |
| Male | 83.1 | 79.3 |

As discussed in Chapter 3, in this research the scientist sources identified included academics, government or research scientists and practicing professionals (e.g. engineers or psychologists). Those who were likely to have science qualifications, but whose positions as reported in the media did not identify their qualifications are referred to as 'institutional experts' in this research (e.g. CEO Debbie Chinn from Standards New Zealand, a CDHB spokeswoman, the chair of the Energy Efficiency Conservation Authority (EECA) or Mark Christison from Christchurch City Council (CCC) water and waste unit).

The twenty-seven individuals who appeared or were mentioned the most frequently are shown in Table 5.35. Two aspects of Table 5.35 are most striking. Firstly these representatives of science expertise are, without exception male (though as noted above it is not suggested that this is a deliberate bias on the part of the media). Secondly, the disciplines represented are heavily weighted to earth science, and would be more so, were the five individuals selected on the basis of having appeared on television three times not included. This would also remove the one listed representative of social science. There was no single individual who dominated the discussion of economics, building science, or cognitive and behavioural science topics. However, unlike the seven structural engineers, no economists or psychologists appear in Table 5.35. This serves to exemplify and reinforce the disciplinary bias that will be further discussed in chapter 6.

**Table 5.35: Individual scientists/experts mentions and appearances**

This table shows the 27 individuals representing the disciplines listed (in the left-hand column) who were mentioned in 8 or more of the 1000 articles downloaded from the Stuff website, and/or appeared 3 or more times in the 1316 television (TV1) items analysed (covering the period 04 September 2010 – 04 December 2011). Those in italics were spokespeople represented as experts from authorities than academic or Crown research scientists. The last named is pseudo-scientist Ken Ring. (It is acknowledged that some individuals would have been seen by more viewers during disaster coverage than others appearing late in 2011, e.g. Adam Thornton, whose appearances were related to the Royal Commission of Inquiry). Note that this list does not represent the volume of source comment or duration of appearance, only the number of articles or items in which the individuals are sources, or mentioned.

| Name | Stuff Mentions | TV Appearances | Discipline |
|---|---|---|---|
| Berryman, Kelvin | 39 | 4 | Earth science - seismology |
| Quigley, Mark | 16 | 12 | Earth science - general |
| Furlong, Kevin | 19 | 6 | Earth science - seismology |
| Ristau, John | 20 | 4 | Earth science - seismology |
| Pettinga, Jarg | 17 | 4 | Earth science - general |
| Fry, Bill | 18 | 2 | Earth science - seismology |
| Ferris, Brian | 17 | 0 | Earth science - seismology |
| Gerstenberger, Mark | 15 | 2 | Earth science - seismology |
| Callan, John | 10 | 0 | Earth science - general |
| Smith, Euan | 7 | 3 | Earth science - seismology |
| Barnes, Philip | 8 | 1 | Earth science - seismology |
| Gledhill, Ken | 7 | 2 | Earth science - seismology |
| Yetton, Mark | 12 | 1 | Geotechnical |
| Ban, Shigeru | 2 | 3 | Engineering - architecture |
| Hare, John | 15 | 0 | Engineering - structural |
| Ingham, Jason | 6 | 4 | Engineering - structural |
| Buchanan, Andrew | 8 | 0 | Engineering - structural |
| Scarry, John | 1 | 5 | Engineering - structural |
| Restrepo, Jose | 1 | 4 | Engineering - structural |
| Thornton, Adam | 1 | 3 | Engineering - structural |
| *Christison, Mark* | *21* | *2* | *Engineering/Env/Health* |
| Humphrey, Alistair | 27 | 6 | Health – Public Health |
| *Matenga, Gordon* | *19* | *5* | *Health – Coroner* |
| *Meates, David* | *9* | *7* | *Health - CEO CDHB* |
| *MacLean, Neil* | *8* | *5 (+3 mentions)* | *Health – Chief Coroner* |
| Johannson, Jon | 0 | 3 | Political Science |
| *Ring, Ken* | *14* | *2 (+5 mentions)* | *Other* |

### 5.5.9 Some scientists became celebrities or ‘media czars’

In relation to the Canterbury earthquakes the media primarily used local specialists and made celebrities of some. There was no clear evidence of the media preferring celebrity scientists as was suggested by (Shepherd, 1981). Except perhaps in as much as the events made celebrities of some scientists.

One could say that the event created two celebrity scientists. Visiting US professor Kevin Furlong became one of two earth science ‘media czars’. Science-information-czars or disaster-‘media-czar’s are the media’s preferred choice for a single credible, and authoritative source of information (Sood et al., 1987). However this choice of who appeared in the news immediately after the Darfield earthquake and was then used again was more a case of who was available in the Canterbury University geology department on the day of the Darfield earthquake than a deliberate effort to use an international expert (pers. comm I028).

Dr Mark Quigley was the main earth science information czar appearing in almost twice as many television items as any other DRR-science source. Dr Quigley was later to be awarded the New Zealand Prime Minister’s Science communication prize in 2011. Canterbury’s Chief Medical Officer of Health Dr Alistair Humphrey was the public-health-related media czar. Mark Christison of the CCC was recognised in the media as a key figure in Christchurch’s recovery. The article “Christison’s dedicated to Christchurch” (Sachdeva, 2011c) was not one in the 1000-Stuff dataset. Mark Yetton was the geotechnical czar, most particularly in terms of rock-fall.

While Dr Kelvin Berryman of GNS was quoted in far more Stuff articles than Dr Quigley his celebrity status was not the same as Quigley’s. This may suggest that being a media-czar relates most to television appearances, perhaps to being a source early in the response period, or it may be related to on-screen delivery and personality.

‘The Moon Man’ Ken Ring, who was described as a ‘pseudo-scientist’ in the media and by, was also one of the most mentioned individuals in relation to earth science. Ken Ring reached celebrity status for his earthquake predictions (see section 7.7.3.)

There is little value to DRR in identifying who won the ‘popularity contest’ as most quoted scientist or most frequently mentioned institution. This does not identify whether a holistic understanding of DRR is being communicated. Hazard understanding, and modelling of probability are only part of DRR. Since the most commonly cited sources were earth scientists discussing hazard topics DRR science and scientists have clearly been represented in an unbalanced way.

### 5.5.10 Scientific expertise was primarily framed in the NZ media as observations, risk commentary, findings and informed opinion

Headlines of earthquake-related articles in Stuff suggest that expertise is about the provision of observations, risk commentary, informed opinion and findings (including some revisions of findings) as shown in Table 5.36. Expertise was portrayed through earthquake-related headings as involving calculations and controversy in 4% of the articles. Expertise was shown as relating to research studies (beginning) and having legislative or political implications in 3% of headlines each. It was the application of expertise particularly as communicated by officials and politicians that was controversial.

Looking in detail at the way science and science practice was portrayed in the 29 articles that had a heading that emphasised expertise, the most common portrayal was about science having achieved an outcome, scientists going above and beyond, 'discovering' and requiring funding (each in 13% of articles). One each of these science/scientific practice headlines suggested science was wonderful, pioneering, a puzzle, involving thought, or the release of a report, and experts would provide support (health) or reassurance (geoscientists). Concern with information availability and other controversy were also in one headline each.

Looking at all 1000 articles, expert involvement in risk commentary was variously about safety and fear of threat, forecasting, provision of advice and recommendations and warnings. Decisions were announced in 1.4% of the headlines. Controversy about decisions was reported in 4% of the headlines. Controversy was mainly about demolition decisions, the time taken to provide information about land decisions where there had been liquefaction, and provision of risk information (predictions, forecasts or warnings) both in New Zealand and in relation to the L'Aquila earthquake, and between New Zealand scientists and visiting Prof Furlong of the US regarding fault location. There were also articles about rushed building assessments, and whether it was safe to rebuild the CBD of Christchurch. Prime Minister John Key's comments regarding the length of time taken to achieve release of victim's names (denied on television on 07 March 2011) were taken as a slur on forensic scientists, spawning interviews with the scientists in the disaster victim

**Table 5.36: Expertise as portrayed in print media after the Darfield earthquake**

Headlines from the 1000-Stuff-dataset were coded into one of 20 framings as to the basis on which expertise was established. Note that given the selection of articles (science-related), levels of 'citizen expertise' are unlikley to be representative.

| Type of expertise | All articles | Expertise including implied and possible, but not authorities | Authorities (officials) not politicians | Politician | Self-credentialed 'pseudo-expertise' | Citizen s | None |
|---|---|---|---|---|---|---|---|
| Total | 1000 | 747 | 196 | 11 | 8 | 10 | 8 |
| observation | 321 | 253 | 38 | | 2 | 6 | 2 |
| risk comment | 210 | 121 | 80 | 2 | 4 | 1 | 2 |
| findings presented | 100 | 94 | 5 | 1 | | | |
| informed opinion | 73 | 63 | 10 | | | | |
| calculation | 43 | 42 | 1 | | | | |
| controversy | 40 | 23 | 16 | 1 | | | |
| research/study beginning | 30 | 30 | | | | | |
| legislative/political implications | 29 | 1 | 22 | 6 | | | |
| science/scientist practice | 29 | 26 | 1 | 1 | 1 | | |
| background (mostly hazard) | 20 | 19 | | | 1 | | |
| decision announced | 14 | 3 | 11 | | | | |
| information provided | 13 | 10 | 3 | | | | |
| lessons, talk or teach | 12 | 10 | 2 | | | | |
| uncertain/challenging | 11 | 9 | 1 | | | | 1 |
| proposal or plan | 9 | 3 | 6 | | | | |
| ask an expert | 8 | 8 | | | | | |
| award/commendation | 8 | 8 | | | | | |
| about scientist | 7 | 6 | | | | | 1 |
| technology | 7 | 7 | | | | | |
| innovation | 6 | 6 | | | | | |
| none | 10 | 5 | | | | 3 | 2 |

identification (DVI) team who explained the lengthy process to identification. At the end of November Stuff followed this up with a story "Earthquake ID Process Should be Streamlined" (Fairfax NZ News, 2011n).

Uncertainty or challenge was only mentioned or implied in 1% of the headlines. When mentioned it related to forecasting of earthquakes and aftershocks, understanding of earthquake clustering, demolition decisions, victim identification and making land decisions. Retrofitting buildings was framed as 'tricky' (L. McDonald, 2011) and costly.

In summary the results presented in Table 5.36 suggest that experts involved in earthquake-related science, 'did science', they observed, presented findings and provided opinions. Decisions were made (by authorities) on the basis of their findings. The application of the research findings was sometimes controversial (as is further discussed in section 5.5.11).

### 5.5.11 Media headlines focused on results, issues and decisions

Table 5.37 shows that while references to science and scientists themselves accounted for a tenth of the headline-science emphasis, there were two other areas that headlines focussed on twice as much; results (24.2%) and issues (22.7%). Decisions accounted for 14.2% of the headline emphasis, information only 6.6%. However while decisions feature as headline emphasis the body text rarely explained the basis for the decisions see section 6.7.

### 5.5.12 Science takes time was the overwhelming portrayal of science and scientists in comments in New Zealand earthquake-related television items

This section provides a window to the portrayal of science and scientists another way – this time through 240 statements made on television (TV1) after the Canterbury earthquakes. The statements are summarised in Table 5.38. Examples of the statements are given in Table 5.39.

The framing of science as providing results and decisions as opposed to say, assessments and options is particularly important in the light of participatory process. Table 5.38 shows that earthquake-related science is not yet framed in media in a way that it suggests that data and information is being provided for citizens to understand any assessments or 'decisions being made on their behalf', or 'information on which to base their own judgments and decisions'. This has particular ramifications for the understanding of DRR topics 2, 18, 0, 11 as will be further discussed in Chapter 7.

**Table 5.37: Role of science identified from headline keyword searching**

| Role of Science | No. articles |
|---|---|
| The first science-related keyword in each headline of the 1000-Stuff datasetwas coded according to what it emphasised of a) science/scientists themselves b) results, c) research and questions d) issues e) responsibility f) advice g) information h) decisions/opinion i) political/legislation | |
| a –science/scientists themselves | 142 |
| discipline | 63 |
| expert | 24 |
| pioneer/history & technology | 4 |
| science | 7 |
| scientist(s) | 32 |
| technology | 12 |
| b- results | 242 |
| data/fact | 9 |
| discipline | 1 |
| identified | 12 |
| qualify | 38 |
| qualify-comparative | 27 |
| qualify-superlative | 10 |
| quality | 5 |
| quantify | 107 |
| quantify-time | 3 |
| record/report/rate | 21 |
| relationship | 4 |
| report/results | 1 |
| teach/lecture | 4 |
| c – research & questions | 57 |
| event | 1 |
| identify | 7 |
| mystery | 4 |
| question | 14 |
| research | 30 |
| results | 1 |
| d - issues | 227 |
| issue-awaiting decision | 7 |
| issue-Health & Safety | 18 |
| issue-problem (other) | 62 |
| issue-problem-occurrence | 80 |
| issue-risk | 55 |
| problem-awaiting decision | 5 |
| e - responsibility | 45 |
| blame | 9 |
| event | 17 |
| event-inquiry | 2 |
| lesson/learn | 6 |

**Table 5.37 cont/-**

| Role of Science | No. articles |
|---|---|
| results of review | 8 |
| review | 3 |
| f – decisions/opinions | 123 |
| decision | 23 |
| decision-risk | 7 |
| forecasting | 1 |
| opinion | 86 |
| should never | 1 |
| solution | 5 |
| g - information | 66 |
| information | 66 |
| h - advice | 44 |
| advice | 26 |
| warning | 18 |
| i) – legislation/political | 54 |
| citizens | 2 |
| code | 1 |
| legislation | 13 |
| planning | 13 |
| political | 25 |
| Total | 1000 |

Policy or decision-makers (officials or elected representatives) who mentioned science or scientists were typically interviewed in an office or visiting a badly affected area. The scientists were interviewed in their offices, laboratories, or in the field.

Scientists spoke of being excited, enjoying their work and the related discovery, but tempered this by stating that they were aware of loss and sadness associated with the natural hazard event(s). They also emphasized their hard work, collaboration and teamwork. Television newsreaders presented scientists in response and early recovery as expert, specialist and or highly trained and hard-working, heroes even. Some scientists were also heroes in the eyes of their fellows.

Perhaps true to New Zealand's relaxed culture, academic titles were not always used either in online print media or on television (see Appendix 11).

Survey respondent and media-website on-line commentary that earth scientists were over-excited about the research potential of the Darfield earthquake suggests that they might

**Table 5.38: Portrayal of science and scientists in earthquake-related media**

Statements about science and scientists within 100 randomly chosen Canterbury earthquake-related TV1 items were analysed and thematically grouped. Some statements fitted within more than one theme. Fifty of the statements were by scientists about science. Three-quarters of the total statements were made either by television presenters or policy- decision-makers or other officials. The results of analysis are presented from most to least common theme.

| Science or Scientists | % of comments | Comments by scientists / non-scientist |
|---|---|---|
| Takes time (to know/find-out) | 36.7 | 7/81 |
| (relates to) Technology | 11.3 | 0/27 |
| Expert/specialist/highly trained | 10.0 | 2/22 |
| Excited; interested, fascinated, discovery | 5.8 | 6/8 |
| Hard-working/ big effort | 4.6 | 3/8 |
| Involves proof, debate, may be inexact, radical | 4.2 | 1/6 |
| Collaboration-team | 2.9 | 2/7 |
| Disagreement amongst scientists | 2.9 | 6/1 |
| Learn a lot/interesting | 2.5 | 3/3 |
| Ego – scientists know/citizens don't | 2.1 | 4/1 |
| Release of information/ communication issues | 2.1 | 0/5 |
| Useful to society | 2.1 | 2/3 |
| Heroes/extraordinary | 1.7 | 2/2 |
| Laboratory/testing/ in field | 1.7 | /3 |
| Complex/mysterious | 1.3 | 1/2 |
| Use of numbers | 1.3 | 0/3 |
| Expectation that scientists know – disappointment when don't | 0.8 | 0/2 |
| Pseudoscientists | 0.8 | 1/1 |
| Peer review | 0.8 | 1/1 |
| Unusual/rare and interesting | 0.8 | 0/2 |
| More research needed | 0.8 | 1/1 |
| Trustworthy | 0.4 | 0/1 |
| Blamed | 0.4 | 0/1 |
| Fatalism by a scientist | 0.4 | 1/0 |
| Leader 'thinks' scientist is right | 0.4 | 0/1 |
| Involves report | 0.4 | 0/1 |
| Lack of funding/facilities | 0.4 | 1/0 |
| Citizen science | 0.4 | 0/1 |

temper this enthusiasm when used as sources in the media and focus on responding to citizen needs for event sense-making.

Technology, either specialist equipment for response or recovery, or retrofitting or mitigation was discussed in 17% of the randomly chosen earthquake-related television items and was the second-most prevalent form of portrayal of science.

The most repeated message by far though (at 57%) was that ‘science takes time’. This was sometimes associated with a decision not to release information until ‘everything is known’ (a further 6% of items) or that more research was needed (1%). The statements were predominantly made by authorities, and in particular Earthquake Recovery Minister Gerry Brownlee, and Prime Minister John Key. The ‘science takes time’ message was repeated by newsreaders who mentioned the frustration that the lack of information, certainty and, or transparency was causing to citizens.

The quote *“So first must come the science. A research effort of a scale probably unique in New Zealand’s history”* from “Can we fix it?” (McCrone, 2011) is an example of two other repeated framings observed in the on-line print media associated with the ‘science takes time’ framing; 1) that ‘science comes first’ and 2) that the post-Canterbury research effort was very large.

#### 5.5.13 Expectations regarding forecasting and transparency appear to be different for different disciplines

As shown in the previous sections scientists were reported as providing data and facts to support comments, advice, opinions and warnings.

Seismologists were at times almost ridiculed in the on-line comment on these articles - for being part of an inexact science – for the inability to predict earthquakes or aftershocks. That same inability to accurately forecast was, however, accepted in relation to the variability in views relating to likely economic costs, and psychological effects.

Earth scientists were also variously criticised in the body text and on-line comments to articles for alarming or reassuring with their earthquake hazard forecasts. Dr Kelvin Berryman apologised in the media and suggested earth scientists would do better at communicating their science in future. In contrast no media article questioned or clarified why geotechnical experts did not themselves release information that Minister Brownlee, the Earthquake Commission or even Canterbury Earthquake Recovery Authority were

### Table 5.39: Example statements re portrayal of science and scientists

Statements illustrative of over 240 statements about science and scientists as described in Table 5.38 are presented in alphabetic order of theme.

| |
|---|
| **Blamed** - "Why collapsed the building Mr Engineer, if you believe it, that [it] was ok?" - Gerardo Torres, lost wife in the 22 February 2011 earthquake (TV1, 2009-01-29) |
| **Citizen science** – "A man who lives in this street and has lived here for some time tells me he uses GPS all the time, he says he looked at that GPS back in 2008 and it put this area at 1m above sea-level, now he checked the GPS again just this week, it says it's 90cm below sea-level. We obviously can't verify those figures but if that is indeed right that means the land here has dropped away almost two metres" - Minister Brownlee (TV1, 2011-06-19) |
| **Collaboration-team** – "Teams from GNS Science, NIWA and three universities made the discovery" - Greg Boyed, presenter (TV1, 2011-06-03) |
| **Complex/mysterious** – "Science is limited by knowledge and the earth system that we are trying to understand is actually very very very complicated." - Kelvin Berryman, seismologist, GNS, (TV1, 2011-07-13) "they'll take them back to the university and they'll test them for tensile strength or whatever they test them for to see if it's shit concrete or good concrete"- Richard Owen (TV1, 2010-10-29) |
| **Disagreement amongst scientists** – "Yes I think Prof Restrepo was wrong when he said it complied with the building code in 1986, the R6 spiral at 250 centres in the columns could never have complied." - John Scarry, engineer (TV1, 2011-08-22) |
| **Ego – we know/citizens don't** – "... because of their own failures in prediction they've in recent years said 'earthquakes cannot be predicted' and that's because their own ego doesn't allow them to admit failure - Jim Berkland, former USGS geoscientist (TV1, 2011-03-17). "Engineers say the impact on residents was minor, the testing essential - the impact would be very minor - the nearest residence is 270m away" - Alison Pugh, presenter (TV1, 2011-11-01) |
| **Excited; interested, fascinated, discovery** "It's wonderful! It's really rewarding, it's why I'm here … once you've actually found a match it's really exciting ... 'we've found him we've found him - it is wonderful. It is exciting, it's very sad." - Viv Levy, forensic scientist (TV1, 2011-03-29). "Exactly what's happened to the land and how stable it is has fascinated geologists" - Lisa Wilkinson-Baker-presenter (TV1, 2010-09-24b) |
| **Expectation that scientists know – disappointment when don't** - "area they don't know much about" – Vicky Wilkinson-Baker in "NIWA's looking at Canterbury quakes" (TV1, 2011-03-19a) "But you guys didn't know either - it was hidden from science" (TV1, 2010-09-06) |
| **Expert/specialist/highly-trained** – "The country's top seismologist briefed the emergency response team" (TV1, 2010-09-08a) "a panel of experts" - Joy Reid and "has to be assessed by people who know what the technical data is telling them" Minister Brownlee, both in "Urgent warnings for building owners" (TV1, 2011-09-30) |
| **Fatalism by scientist** - "We keep our fingers crossed that we don't have any more large earthquakes" - Kelvin Berryman, seismologist GNS Science (TV1, 2011-07-13). |
| **Hard-working** - "Scientists, surveyors, pilots and plumbers working hard to repair the city have all seen different views in their work, and this morning we've collected their images" - Alison Pugh TV presenter (TV1, 2011-05-03). "We're working very hard and we already have a whole lot more information than we had yesterday about this aftershock". Bill Fry, earth scientist (TV1, 2011-02-23a). "Mark Quigley has dedicated his life to studying earthquakes" (TV1, 2011-02-22) |
| **Heroes/extraordinary effort/proud** - "So this kind of makes these kind of people (Profs Parking and Caulay from Civil Engineering Department, University of Canterbury) heroes in a way does it?" - Ian Sinclair TV presenter (TV1, 2010-09-12) "We don't recognise these people until we have an event like this, which shows their good work" - Seismologist Euan Smith) (TV1, 2010-09-12) "I think they are doing an extraordinary job of trying to find out exactly what the condition below us is at the moment" – Minister Brownlee (AAP, 2010). "I think the engineers responsible for those projects [museum, Christ's College, Arts Centre] can be very proud of their work" – Jason Ingham (TV1, 2011-02-26) |

## Table 5.39 cont/- Example statements re portrayal of science and scientists

| |
|---|
| **Involves proof, debate, may be inexact, radical** – "So they've got to be put out there and tested with scientific evidence that has proven things in the past" - Corin Dann, presenter (TV1, 2011-03-07). "Most of the processing is complete and we are analysing the different datasets and in the next couple of weeks we will be seeing more and mo.re data coming out of the projects." - John Beavan, seismologist (TV1, 2011-05-03). 'Inexact science' - Department of Building and Housing Minister (TV1, 2011-03-02). "Part of the scientific community is around debate, it's debating scientific facts, and that's trying to come up with evidence and proof, so, putting these theories out there is generally accepted, and will be debated but they've got to have the proof to back them up" - Colin James of Stardome observatory (TV1, 2011-03-07) "She's also going to give advice as to where you can get help to deal with that but first the science" (Mark Sainsbury – TV presenter -TV10900. "He said he would like to work with people like yourself.. That traditional science doesn't have the monopoly on understanding things… does he have a point there?... But has science always been right - there's been times when science has been limited just by it's lack of knowledge of something" (TV1, 2011-07-13) |
| **Involves a report** – "To make that call (whether to rebuild) the government needs a series of reports on land conditions." - Jack Tame, presenter (TV1, 2011-03-08) |
| **Laboratory/testing, in field** – "We'll get those tested in a lab at the University" - Rhys Smith, structural engineer (TV1, 2010-10-29). |
| **Lack of funding/facilities** – "That's one of the issues, we don't have a 24/7 facility the same as the Americans or the same as the Japanese" - Willem de Lange, academic, University of Waikato (TV1, 2011-03-28) |
| **Leader 'thinks' scientist is right** - "I think your professor is dead right" (Building and Housing Minister Maurice Williamson (TV1, 2011-03-02) |
| **Learn a lot/interesting** – "...interesting to marine scientists, to earthquake geologists on land and engineers… things to learn" - Philip Barnes, NIWA (TV1, 2011-03-19a). "We learn from them they learn from us" - Andrew King (TV1, 2010-11-07). |
| **More-research needed** – " as a result he (Jarg Pettinga) says that more research is necessary" – Alison Pugh, TV presenter (TV1, 2011-06-23a). "Today's announcements represent the next step in the governments on-going work to give residents accurate information as quickly as possible" - Prime Minister John Key (TV1, 2011-06-23d) |
| **Peer-review** - "EQC engineers have filed their report but it's now out for peer review" (TV presenter Lorelie Mason – (TV1, 2011-06-13)). |
| **Pseudo-scientists** – "He can't win though - if he predicts a quake he gets pilloried, if he says there's not going to be one he gets pilloried…is the problem just with the fact he's predicting things? "– Mark Sainsbury presenter (TV1, 2011-07-13)). |
| **Release of information/communication issues** – "Gerry Brownlee wants to wait until he knows everything before releasing information (Greg Boyed, presenter (TV1, 2011-06-15)). "He said GNS Science should be more careful in the way it releases quake data. "If they're going to put the information out, it needs to be put out in complete context." (Bob Parker, Mayor (TV1, 2011-05-31a)). |
| **Technology** – "Thermal imaging teams are out making sure power is getting to the people..." (TV1, 2010-09-07). "This is a seismograph my Dad and I built (Lego) (TV1, 2010-09-09). "GNS Science had 77 devices across Canterbury measuring data." - Peter Williams, TV presenter (TV1, 2011-03-19b). "... highly specialised equipment used to map faults under the sea" - Vicky Wilkinson-Baker - presenter (TV1, 2011-03-19b). "This retrofitting technology may be the alternative to demolition" Joy Reid, presenter (TV1, 2011-09-02). |

**Table 5.39 cont/- Example statements re portrayal of science and scientists**

| | |
|---|---|
| **Takes time (to know/find out) -** "Well at the moment the seismologists at GNS are working on locating the earthquake, sometimes these things can be messy affairs with lots of waves arriving at different times, and things like that, so this will be something that gets pinpointed over the next hours..." - Mark Quigley (Cairns, 2011b). "Now obviously it takes expert engineers, structural engineers to tell whether that's the case or not, so obviously all of this is going to take time. There's been talk by some that all of this is going to take a year before things are returned to normal, it could be a lot longer than that though couldn't it?" - television presenter Paul Henry in (TV1, 2010-09-08b), or "Around historic buildings there are, quite rightly, a process, a lot of tests... it can end up in the environment court." - Mayor Bob Parker (TV1, 2010-10-04). "We want right answers, we don't want rushed answers." - Mayor Bob Parker (TV1, 2010-10-03) "...if you look at the scale of the work that's been done both in terms of assessing the twenty-two and a half thousand properties that went into the report and also the scale of the work that's ahead and the complexity of that work; I think the engineers are moving forward very quickly." - Ian Simpson, CEO EQC (TV1, 2010-12-01). "You've got to remember that we know a whole lot more about the Geology under Christchurch than we did 12 months ago... " (Earthquake Recovery Minister Gerry Brownlee, (TV1, 2011-06-13). |
| **Trustworthy** – "And I know people have said that before, and I'm not a geologist but I do trust the scientists." – Minister Brownlee (TV1, 2011-06-13). |
| **Unusual/rare and interesting** – "They [GNS] say one of the factors contributing to the tremor's intensity was the recently discovered "trampoline effect" Peter Williams, TV Presenter (TV1, 2011-03-19b). "GNS Science said it's rare to obtain such data and it will be analysed by seismologists around the world." (TV1, 2011-02-22) |
| **Use of numbers** - "These figures were discussed in a recent CERA meeting" (TV1, 2011-05-31b). Visual image of building with numbers chalked on it (TV1, 2010-10-04). |
| **Useful to society** – ".., so it's to the common good that we find unique characteristics" Andrew King - (TV1, 2010-11-07). "It's a job that means so much to the families" - Mark Sainsbury, (TV1, 2011-03-29). "team at Tonkin and Taylor who continue to work through the night to get information we need for the people of greater Christchurch" - (TV1, 2011-06-23d) |

criticised for with-holding. It seemed to be implicitly understood that their terms of engagement would have been with the government. Structural engineers' reticence to speak in the media also seemed to be accepted without question because of liability implications (noted by both I018 and I019 who acknowledged that many engineers were practicing industry professionals).

Meanwhile health scientists seem to be very comfortable with providing advice without the need to communicate the evidence basis (see section 6.9.1).

### 5.5.14 While there was some suggestion of research not being utilised, scientists were portrayed as hard-working and research as on-going

Wellington (1999) suggested that science in media is often presented as 'whizz-bang' or dramatic, a "disconnected rag-bag of work and discovery", certain, individual, sudden (not based on earlier work) or crackpot discoveries at the periphery of science. In this research there was some portrayal of so-called peripheral science, as to the cause of earthquakes (discussed in Chapter 7). However there was not much about earthquake-related science in the years of coverage analysed that could be said to be ‘whizz-bang’ or overly dramatic. Instead the portrayal as shown in the preceding sections was of scientists who were both fascinated in their areas of research and hard-working in the pursuit of answers, and research was portrayed as on-going. Uncertainty was recognised.

It has been said that the media use strong angles such as conflict, controversy, or *“opposing views of scientists when uncertainty is evident”* (Tully, 2007b, p. 5).

In this research there was not so much controversy expressed in media headlines (Sections 5.3.6, 5.7.1 and 6.4.11 discuss aspects of controversy, and Figures 5.7, 5.8 and Table 5.35 depict aspects of controversy in the New Zealand earthquake-related media. One body text example of controversy is where US Prof Furlong questioned GNS Science’s scientists’ views on the extension of the Greendale Fault (see second quote in Table 7.22)).

Scientific data not being released, taking time, and scientific expertise not having been utilised to inform recovery were the main topics in which ‘conflict’ was evident.

One body text example of controversy is where US Prof Furlong questioned GNS Science’s scientists’ views on the extension of the Greendale Fault (see second quote in Table 7.22).

Three examples of local researchers who felt that research and knowledge was not sufficiently utilized after the quake are given below. Whether these and other examples were situations where officials had not consulted certain experts, or not consulted academic experts outside of Crown research entities, was not explored in the media.

> *He (Ian Athfield] wrote in Architecture New Zealand magazine that after the February quake, "the architectural voice was not encouraged, understood or respected". He said the Christchurch City Council had failed to include local architects in the central-city plan drafting. ... Council strategy and planning general manager Mike Theelen said the council had talked with architects. “Council engaged and consulted with a number of architectural groups and has been encouraged with the degree of synergy between the council's work and the directions signalled by some of the city's premier architects.”*
>
> “Architects 'ignored' by council” (Gates, 2011c)

> *As perhaps the country's top expert, hadn't the Government asked Glavovic what it should do [re recovery]? Bemused, Glavovic says certainly no-one sought his opinion. Or anyone else's that he knows.*
>
> “Over the top?” (Unattributed, 2011c)

*Dr McClure urged public bodies to use more research findings. Civil Defence was one body in particular that engaged in "insufficient dialogue" with the research community.*

"Post quake fear 'a missed opportunity'" (Fea, 2011)

The official message echoed by some scientists was that:

*"Science, engineering, enforced regulation and preparation and disaster planning will keep Christchurch residents safe"* (in "Scientists see no reason not to rebuild city" by Gorman, 2011d).

### 5.5.15 Vested interest in science or mandate for DRR? Only 40% of scientist survey respondents self-reported being involved in DRR

*When we go to a conference it is about preaching to the converted. Scientists need to communicate outside to 'real' people.*

Dr Stefano Pampanin, interviewee I009

Gascoigne (2008) suggested that more scientists should recognize themselves as issue advocates.

Four of the five geotechnical experts who responded to the survey in this research were involved in DRR through their work and in the community. Scientists from all other disciplinary groups reported a lesser involvement in DRR directly in the community than through their work. Less than 20% of both health scientists and building scientists surveyed indicated that they were DRR-advocates both through their work and in the community (Table 5.40). Only 36% of earth scientists consider themselves DRR-advocates.

**Table 5.40: Whether scientists consider themselves DRR advocates**

Responses to Question 4 of the survey arranged by science qualification type. The percentages of those who reported being involved in DRR through their work are shown in the second column. Those who considered themselves to be involved in DRR in the community are shown in the column to the right. The fourth column shows the percentage of science respondents who indicated they were involved in DRR both through their work and in the community.

| | Percentage of scientist respondents who self-reported being involved in DRR | | |
|---|---|---|---|
| **Scientist type** | **through their work** | **in the community** | **both** |
| Building | 30.0 | 10.0 | 10.0 |
| Earth and Planetary | 50.0 | 31.3 | 31.3 |
| Geotechnical | 80.0 | 60.0 | 60.0 |
| Environmental | 33.3 | 25.0 | 41.7 |
| Health | 25.9 | 11.1 | 11.1 |
| Planning | 55.6 | 22.2 | 22.2 |
| Social Scientists | 66.7 | 43.3 | 43.3 |
| Other | 20.0 | 14.3 | 11.4 |
| Overall | 40.3 | 24.3 | 25.7 |

Turner (1982) seemed to cautiously suggest that earth scientist sources he had studied had promoted vested interests that were not always DRR-focused. Examples of this might be the ‘research’ story types that describe the research and the researchers and include a sentence at the end that the hazard research is important.

Further, science is often required to legitimize its usefulness to society (Schäfer 2009). This research identified that many of the abstracts of the 20-earthquake-dataset that made claims about the value of the studies to DRR were less than compelling. If the authors are unclear about the value of their research to DRR in research papers they are unlikely to be so if discussing their research in the media. Some academic research papers of the geotechnical type appear to be more focused on achieving funding, or sales of technology rather than a DRR aim. For example remote sensing conference presentations and articles in remote sensing journals relating to the application of geo-observation technology to aspects of DRR. This is in contrast to the rare reviews of the application of those technologies to emergency management and disasters (e.g. Thompson 2010, Wang 2010, Wang et al. 2010).

Turner also wrote of the need for agencies with a mandate for making household and individuals safe against earthquakes, to communicate about these matters. In New Zealand this would be the Ministry of Civil Defence and Emergency Management, the Department of Building and Housing, and Regional and District Councils. Somewhat surprisingly (as discussed in the previous section sources from these institutions rarely appeared in any other than *Authorities advice in response* stories. Two of the interviewees (one who wished to remain anonymous on this topic, and I019) suggested that this was a matter of wanting to avoid liability. Another interviewee (I018) referred to the communications departments of government agencies being risk averse.

### 5.5.16 Many articles with headings that did not suggest science contained science

Articles did not always have headings that were strongly suggestive of science in order to contain science. For example “Businesses unite to keep Christchurch alive” is a business human-interest article (Tamlyn, 2011) where the effects of liquefaction on business, and in terms of a structural engineer’s work were described.

Similarly, evidence-based details regarding consequences were also evident in article types where they might have been least expected, communicated by non-scientist/non-expert authorities (see the first half of the quote below). Having reassured first that there was no immediate health risk there was no advice was given regarding mitigating the irritating aspects of the silt. Nor was there any mention of long-term health effects from the silt. The second half of the quote (after the reference to weather prediction) shows what is a relatively typical segue in many media articles to advice about household preparedness whether by scientists or citizens without relevant expertise. This focus on survival actions at the expense of references to other forms of DRR is the basis of a recommendation discussed further in section 6.6.6.

> *Christchurch residents have been warned to take care today with strong winds forecast. Mayor Bob Parker said there was 180,000 tonnes of dust and debris from Tuesday's quake - compared with 30,000 tonnes following the September quake. ... Parker said the dust was not an "immediate health risk, but itself it is an irritant". He said at a press conference late this afternoon that the winds were not as high as initially predicted, which came as a relief. Parker this morning urged all New Zealanders to plan for when a big quake may strike, ... The quake had shown that everyone in New Zealand needed to be prepared. He said his mind turned to Wellington, which sat on the country's most well-known faultline. Parker urged people to put aside emergency supplies and have a plan in place for what they'd do if such a disaster struck again.*
>
> "Christchurch earthquake impact 'bigger than Katrina'" (AAP, 2011)

### 5.5.17 There is potential value of combining science and arts coverage

Ibrahim et al. (2012) wrote of the differences between science and arts coverage of environmental and health issues in Malaysian media. The value of each mode of story coverage is recognised in a unique way. It is the author's observation that much science communication research still appears premised in the superiority of science. Conversely there is also a perception that science is 'incapable' of capturing human considerations. An example of this was the statement:

> *Art will always be better than science at explaining how everyday life goes on even in times of great loss.*
>
> "The earthquake blame game" (Boniface, 2010)

Like other media coverage disaster coverage focused heavily on human anecdotes (Moeller, 2006). Disaster media research has noted the 'over-abundance' of human-interest stories. Why this over-abundance of human-interest stories is not beneficial to science or DRR is not explained. References to the human-interest frame as 'hysterical journalism' (Cho & Gower, 2006) are concerning in that they may cause caution about use of human-interest stories.

The value of storied approaches to science- and risk communication was discussed in section 4.2.6. Furthermore relevance or salience may be achieved through a more emotive, rather than dispassionate (scientific) framing. Choi and Lin (2008) gave the example of regional monetary looses not being a personalized risk whereas damage to ones home is, gives a clearer and more direct idea of the potential outcome and links to the idea of needing to do something to remedy it.

It is suggested here that the human-interest story rather than being criticized, should be recognized as a mechanism for achieving engagement in DRR (cf. section 4.2.5). Human-interest stories personalize risk and risk reduction. It is the framing, or otherwise, within those and other stories, of DRR as being valuable and achievable, something that all citizens can and should be contributing to, that is most important. Stories may contain elements of the arts and science without detracting from either of these two perspectives.

Analysis showed that many stories contained science when their headings did not suggest this. One of the most compelling examples of such a story is "Christchurch three months on" by Canterbury resident and former editor of the Sunday Star Times, Cate Brett (Brett, 2011). The article may be found in full in Appendix 17. A summary follows.

Mara Apse a Port Hills resident was concerned about cracks in the hillside (there had been cliff collapse and many houses had been abandoned). She spoke with "*scientists scouring the Port Hills and the residents whose fate these experts would determine"* and asked what locals could do to help. Three experts *"advising Civil Defence and EQC on land stability and remediation issues"*, Mark Yetton (consultant geologist), James Molloy (principal geotechnical engineer GHD) and Dave Bell (University of Canterbury's Natural Hazards Research Centre) *"believed there was an immediate temporary solution available for this neighbourhood's hillside crack: bentonite"*. Other Port Hills residents, concerned about hillside cracks and *"prepared to do what it takes"* to stay in the neighbourhood wheel-barrowed 7 tonnes of bentonite and 23 tonnes of gravel up through 40 properties to fill cracks.

> *For Mara and her community, the project restored a sense of purposefulness and some small measure of control, countering the sometimes overwhelming sense of powerlessness that most have experienced in the wake of the quake.*
>
> "Christchurch three months on" (Brett, 2011)

This human-interest story told of:

- successful dialogical communication between earth science and geotechnical experts and the public
- more than the definition of a problem

- a scientifically robust solution
- scientists working with the community to find solutions
- more than household preparedness and survival actions
- citizens’ control and self-efficacy; and
- an empowered community – involved in disaster risk reduction.

## 5.6 Summarising chapter 5: research about multiple earthquakes is needed to support sources preparing comment in advance of earthquake events and as the DRR-science issue cycle evolves

This chapter has shown that New Zealand journalists wrote, and television broadcast a wide range of earthquake stories both before, and many more after the Canterbury earthquakes.

Over 155 existing earthquake-story types were identified that could potentially carry DRR messages. Any of these stories could potentially include a scientific evidence-basis, some insight about science in general or the value of science to DRR and thus to all of society.

Combining the observation in section 5.1.2 that there is typically only a short window in which earthquake events remain in the news, the DRR-science issue types and cycle (section 5.3), and the 155 earthquake story types identified results in the following recommendation.

**Recommendation 8 (any aspect of DRR):** All - Be prepared with story templates before an event occurs, as otherwise it will be difficult to produce material when the DRR-issue cycle evolves rapidly (e.g. in the 3-4 week response window).

Six other general recommendations relating to the communication of DRR-related sciences have been presented after reflecting on the collective results of the various parts of this research (described in Chapter 3).

The finding that Canterbury was the most prevalent event in the news for many years is not at all unusual. The value to DRR is in the salience of observations and learnings from the event to New Zealanders, though knowledge drawn from a wide range of events would also be helpful.

As was discussed in section 5.2.14 it is not only media content, but also earthquake-related research that are single-event based. This means that there is no summation of knowledge drawn from multiple events readily available to DRR advocates or for an institution such as the Science Media Centre to distil ready for communication, let alone for individual scientist sources whose primary role is not DRR advocacy, to use. It is unsurprising then that the media do not provide wider context to earthquake-knowledge portrayed in the media.

Scientists commented in stories where neither science nor DRR are necessarily the focus, however all earthquake-related story types provide an opportunity to discuss DRR topics (section 5.3.2, 5.7.1 and 5.7.7).

The key risk and DRR-media communication related learnings from the research presented in this chapter have been summarised as recommendations 1-7 (Appendix 17). Most particularly, learnings from multiple events should be summarised and repeated in as many story types as possible since different story types are read or viewed by different sections of the population.

# 6 Representation of specific disciplines in DRR and the media

*The data and information required for recovery and rebuilding is not limited to geoscience and geotechnical information and seismic engineering. It covers data and information relating to business, tourism, car parking, infrastructure, as well as ways of measuring, recording and resolving social views and needs. ... "We need to review the information that comes out of Christchurch for all disciplines, including seismology, geotechnical, structural, energy management and social."*

"Resilience puts city on a fast track back to solid ground" Peter Wood, then President of the New Zealand Society of Earthquake Engineers (P. Wood, 2010)

## 6.1 The first study of representation of disciplines in DRR and the media

### 6.1.1 Representation of DRR-related science in the media has not been studied before

In the previous chapter (section 5.5) there was discussion about the scientists, the institutions they represented and media portrayal (framing) of the role of expertise and science in society. This chapter focuses on the disciplinary background of scientist sources in the media and shows that many disciplinary voices and topics were absent from the New Zealand media. This chapter explores a) the aspects of their discipline scientists communicated, and where scientists of a particular discipline were not prevalent in the media whether there were, b) other media story type opportunities for scientists to be sources or, c) other reasons the topics and sources might not be part of New Zealand's earthquake-related media landscape.

If knowledge from a range of disciplines is vital to DRR, and communication of knowledge in the public sphere is a key part of DRR (Chapters 1 and 2) then it follows that communication should represent the full range of scientific disciplines (section 3.6.4).

The importance of inclusion of a wide range of disciplinary approaches and voices in media stories of disaster is however, not yet recognized by the general population or even by researchers outside or at the fringes of DRR (such as those who have researched related media content). Little has been written about the disciplinary contribution of a range of sciences in DRR itself, or in the media in general - let alone in relation to DRR, natural hazards, disasters or earthquakes.

There is no other known study where the representation of all DRR-related disciplines in the media has been analysed.

Nor has a previous study been identified in the academic literature where earthquake-related media content has been compared against a proxy for DRR knowledge. Such a comparison is valuable if responsibility is being attributed for observed imbalances (biases) in the media. The representation of particular scientific discipline groups (Table 3.14) in both global earthquake-related academic articles and New Zealand earthquake-related media articles are compared and discussed in this section.

In the following sections the body text of the 20-earthquake-research-database and audio (speech acts) in television news items were examined for scientist sources and science-related content that has impact on DRR. Scientists were identified on television in one or both of audio and on-screen text. The body text has also been considered for qualitative comment.

Recommendations made in this chapter are based on observations, conclusions and recommendations as described in chapter 5. The same caveats on the relative evidence behind each recommendation as discussed in chapter 5 apply.

The following section (6.2) discusses the overall representation of disciplines, and the implications of this. Then subsections 6.3 to 6.14 discuss what each disciplinary group of scientists published academically about earthquakes and what was communicated in the New Zealand media about that science and earthquakes between April 2008 and the end of December 2011; that is before, during and some way into the recovery from the Canterbury earthquakes of 2010-2011.

### 6.1.2 Most previous media analyses of disasters or earthquakes focused on earth science, earthquake risk, or sociology of disaster

There has been comparatively little written about social science reporting in media in general let alone in relation to natural-hazards disasters or DRR. Some exceptions are Cassidy (2008); Weichselgartner and Kasperson (2010); Weiss, Singer, and Endreny (1988). Research has shown that social science is, paradoxically, immensely popular in the public sphere, but also marginalized in the media (Cassidy, 2008). It is surmised that the marginalization has occurred because journalists assess what is 'scientific' based on methodology, and thus certain social sciences are seen as 'scientific' (e.g. psychology) whereas others that employ qualitative research methods are seen to be of lower status and are consequently not reported on in the media as frequently (Cassidy, 2008; Schmierbach, 2005). Reporting of social science has tended to be by non-specialists. This has also been attributed in part to social scientists not having been as proactive about communicating their research as natural scientists have become (Cassidy, 2008).

There have been many articles written relating to communication of physical- and health science reporting in the media, but few related specifically to natural hazards and disaster. Literature analysis revealed that most previous media analyses of disasters or earthquakes focused on earth science, earthquake risk or sociology of disaster. Engineering, building science and geotechnical aspects, planning, economics, environmental and political science have been largely ignored in media analyses of disasters and earthquakes, as they also have been in studies of science communication. In particular there has been little written in terms of disciplinary background of scientist sources in relation to science, risk or disasters.

The only research identified correlating any aspect of media portrayal of engineering and/or the built environment and disasters was J. Cowan et al. (2002). Few science-, risk-, disaster or disaster media researchers mention the influence of sources in the media. There are previous studies of sources (both scientists and non-scientists) in relation to disasters (e.g. Lamontagne, DuBerger, & Stevens, 1992; Masel-Walters & Hornig, 1993; Rasmussen, 2005; Shipman, Fowler, & Russ, 1993; Vasterman & Ruigrok, 2013; Wilkins, 1985, 1986). However of these only Vasterman and Ruigrok discussed sources in any depth. Their research related to media coverage of pandemics not natural hazards.

Attributing information to different sources has an effect on the perceived qualities and relevance of information, as well as affecting attitude formation (Frewer & Shepherd, 1994). Who is used as a source affects the attribution of causation and/or solutions (Spencer, 1994). D. Miller (1999) suggested that sources speaking to journalists will not only be trying to communicate to 'the public' but also to Ministers, officials or other government departments.

The tendency is to place the responsibility for media content solely on the media. It is rarely acknowledged that (perhaps because of there being fewer science journalists so that the media relies more on press releases) the sources themselves, including scientists, have often made deliberate efforts to enter the news through press releases and other public relations efforts. Chryssochoidis et al. (2009) suggested that since the media receive information from a variety of sources information should not be considered as being produced by the media.

Most previous studies of natural-hazard- and disaster-media content have tended to comment about concerns within a particular discipline. The tendency has been to lay the responsibility for this on the media. One also might say that those working in any of the disciplines not well represented in earthquake-related media (presented in the following sections) have not been proactive in communicating their science. The results discussed in the following sections will show that actual research outputs mirror many of the disciplinary imbalances observed in the media.

### 6.1.3 Survey respondents' expectations of DRR science matched their association with DRR, or the emphasis in the media

Survey respondents in this research rarely mentioned needing to know more than earth science or engineering and occasionally aspects of health science. In interview responses regarding communicating about knowledge from other disciplines were typically forthcoming only when interviewees were prompted to consider DRR science as being multi-disciplinary. This is considered an example where pre-existing expertise or perspectives influence the responses. Respondents focused on topics that will be shown in the following sections as having received the most media attention.

## 6.2 Overall representation of disciplines

*That's all very important stuff [engineering, psychology, environmental science and social science relating to earthquakes]. I haven't tended to do much on it – I have done a few pieces on the psychology – I haven't done it because it's seen to fit into other rounds – more social welfare stuff, I've tended to cover the harder science. We've had engineering reporters – it's not to say I haven't done the odd story or wouldn't if I was asked to … I don't think there's a deliberate effort not to cover the social science, it's probably more that it's considered to be the human part of the tragedy that has been reported on already.*

Paul Gorman Science reporter and sub-editor
Christchurch Press, Interviewee I010

### 6.2.1 Some disciplines that are key to DRR were under-represented in the media

*Social scientists – they're very good at doing the analysis about the communication, but I haven't actually seen them doing the communicating.*

Kelvin Berryman seismologist, manager GNS Natural Hazards Platform (I024)

This research has found that a number of the disciplines that are key to DRR were under-represented in the media (Table 6.1).

Sources from the building- and technological, earth and planetary- and health-sciences are by far the most prevalent in the New Zealand media about earthquakes. Television broadcast items containing more building scientists (engineers) and geotechnical scientists than Stuff. Inter- or multi-disciplinary scientists (typically 'disaster researchers') were present in Stuff articles but were almost absent from television coverage. This is in sharp contrast to Masel-Walters and Hornig (1993) results and is of particular concern for DRR in New Zealand, particularly where a significant proportion of disaster researchers are originally earth and planetary scientists.

Also of concern is the collective lack of social scientists. As was introduced in section 6.1.2 social scientists are known to be generally missing from media coverage. Section 5.5.5 includes a quote from the media illustrating that some recognise the importance of social science knowledge to the Canterbury recovery. In this study social sciences collectively account for between 4 and 10% of sources (if one codes some of the planning scientists as being social rather than physical scientists). Rasmussen (2005) in the media she analysed related to the Indian Ocean tsunami also found less than 10% of the source comment came from social scientists.

**Table 6.1: Individual science sources in television and print media**

The two middle columns show the results of this research; the % proportions of individual expert sources from each science discipline group. These were individuals identified in articles of the Stuff-1000 dataset (n=1000), and from television broadcasts from the time of the Darfield earthquake on 04 September 2010 to 03 December 2011 (n=1328). The right hand column contrast the results of this study with those of Masel-Waters & Hornig's (1993) study of the 'voices' in television news relating to Hurricane Hugo and the Loma Prieta earthquake. Their results shown here are only of analysis of the 56 items relating to the earthquake. Note that Masel-Walters and Hornig combined health scientists, psychologists and social scientists. No details were given about the types of social science represented. Their undefined 'preparedness experts' are the 24.2%.

| | % of individual sources | | |
|---|---|---|---|
| **Science discipline group** | **1000-Stuff** | **TV** | **Masel-Walters & Hornig 1993** |
| Building and technological | 21.1 | 28.9 | 24.2 |
| Cognitive and behavioural | 1.2 | 0.4 | see health |
| Earth and planetary | 23.9 | 17.6 | 42.4 |
| Economics | 6.0 | 5.0 | |
| Environmental | 5.3 | 1.3 | |
| Geotechnical | 6.5 | 10.0 | see earth and planetary |
| Health | 18.3 | 21.3 | 9.1 |
| Information, decision and management | 0.5 | 0.0 | |
| Public administration and political | 0.9 | 2.5 | |
| Urban studies and planning | 3.2 | 0.4 | |
| Multidisciplinary and disaster research | 7.7 | 1.7 | 24.2 |
| Other | 5.4 | 10.9 | |

DRR would benefit from more disaster researchers and social scientists making efforts to comment about DRR, particularly on television. This conclusion is part of later recommendation 22.

It has already been shown that earth sciences have been well represented, if not over-represented in the New Zealand mass media about earthquakes (Table 5.33 showed earth scientists and engineers and were amongst the most mentioned sources along with health scientists). However there were far fewer health- and building scientist sources (recall this includes engineers), than earth and planetary scientists.

Similar, but more nuanced findings are shown when television (TV1) broadcast coverage was analysed as to whether it contained mentions of science or scientists (see Figure 6.1).

Results showed only 17.3% of television items had a focus on science, and that only 10.8% of items had a scientist source.

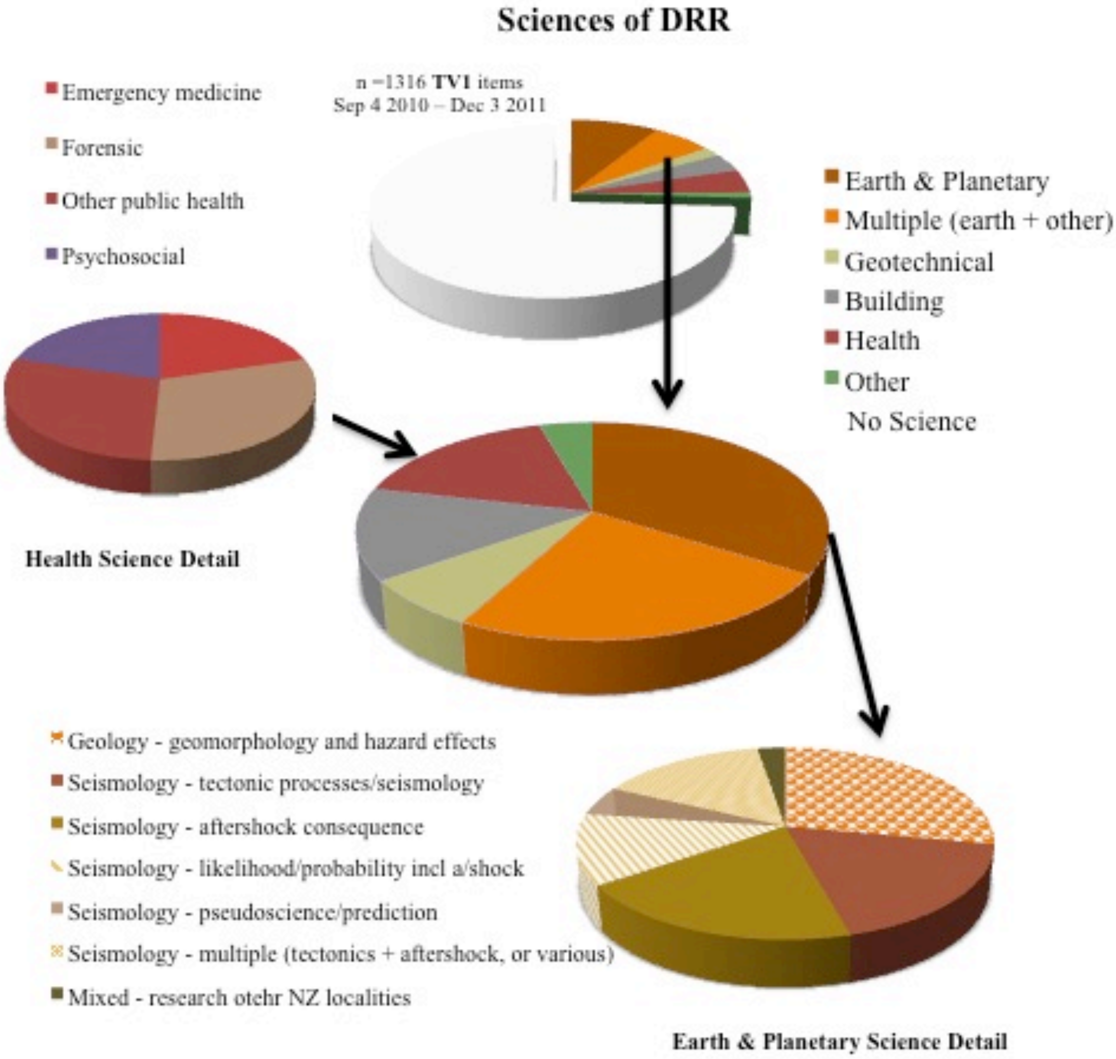



**Figure 6.1: The sciences of DRR as portrayed on television**

Shows the proportion of 1316 television items broadcast after the Darfield earthquake (04 September 2010- 03 December 2011) that contain science (top), and the detail of the proportions of science coverage (middle), earth and planetary science (bottom) and health science (left middle) coverage.

Scientific research into earthquakes on television also related predominantly to earth and planetary science (Figure 6.1). Discussion of research findings in other disciplines was uncommon.

For some disciplines (such as cognitive and behavioural sciences), the degree of media attention is not at all similar to global earthquake research attention and scientist source presence in the media. Urban studies and planning science was the only disciplinary group for which there was a rough match between all three (Figure 6.2). There was a rough match between research interest and media interest for disaster research, earth and planetary science and other sciences. There was a little more media interest than research attention for economics and environmental science, and a lot more media interest for information,

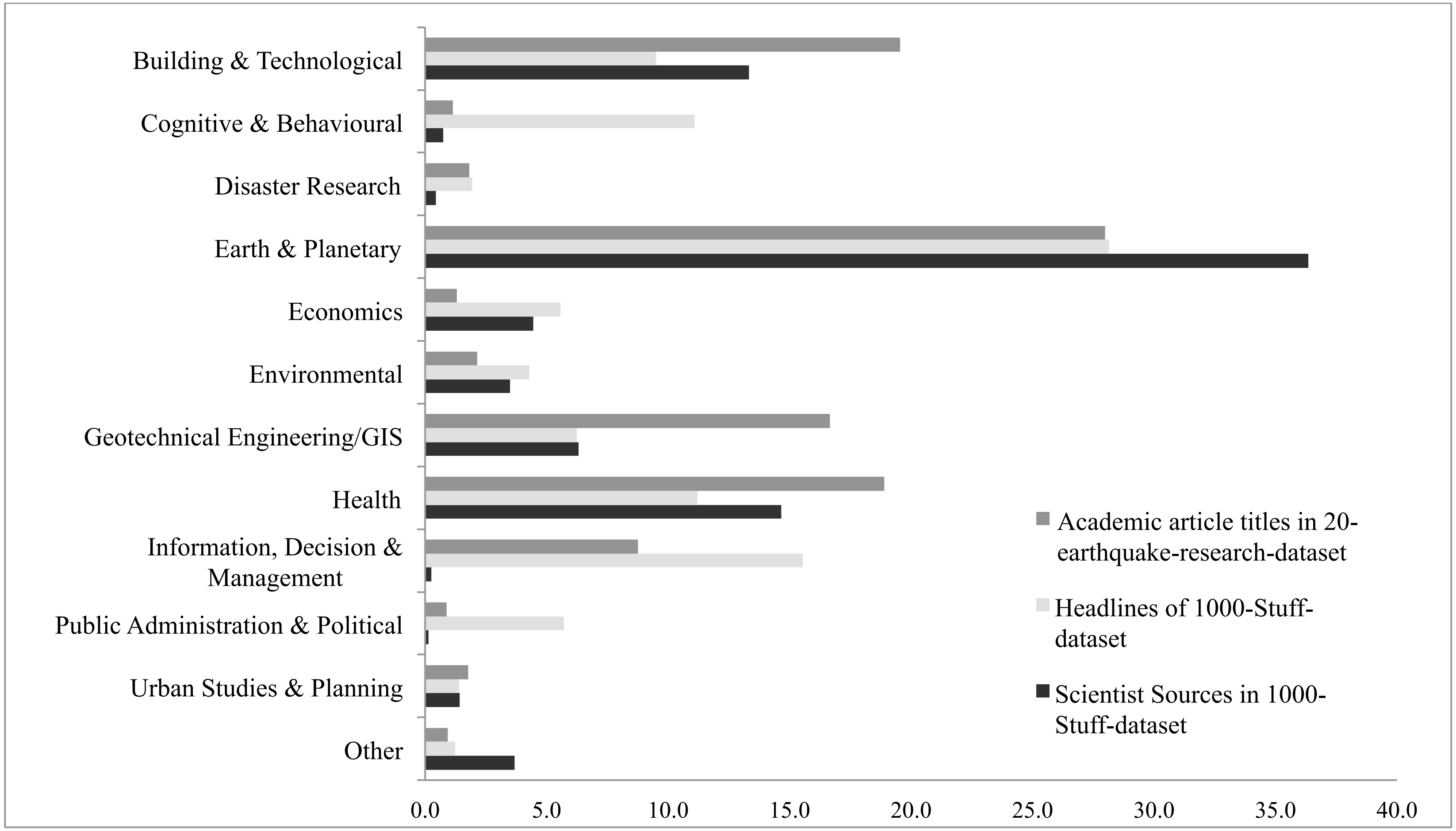



**Figure 6.2: Sciences and scientist sources in earthquake-related media and academic research**

This table shows weighted presence (%) of titles of academic articles (research emphasis 2007-2012 from 20-earthquake dataset), science disciplines suggested by media headlines and scientist sources in the media relate to each other. The media content analysed was 1000 articles published between 04 September 2010 and 03 January 2012 on www.stuff.co.nz.

decision and management science (IDMS) and cognitive and behavioural science than scientists present in the media or publishing on the topic. That said, the finding for IDMS was not particularly representative, since there was a great deal of emergency management in the media, whereas the academic research interest was on logistics. There was considerably more research than media interest for building science, geotechnical engineering/GIS and health sciences.

Reporting on environmental science and economics in the media did not always use scientific sources. In contrast, earth and planetary science, engineering and health science and other scientific articles used multiple scientific sources. The media have, in the main, not used cognitive and behavioural scientists, disaster researchers, information, decision and management scientists, or political scientists (Figure 6.1) There was a larger proportion of scientists from other science disciplines mentioned in the Stuff dataset, than the headline science emphasis.

Figure 6.3 shows the changing volumes of science coverage over time in terms of the least-represented sciences. Coverage for most discipline types spiked for each of the major earthquake and aftershock events (Figures 6.3 and 6.4). The exception was urban studies and planning science, which generated one or two articles sporadically.

Building science headlines were most prevalent in the two weeks after the Port Hills Earthquake, and from week 51 to 53 during the Darfield earthquake anniversary coverage (a few days either side of 04 September 2011) through until the end of the year (the Royal Commission of Inquiry into the building collapses sat from mid October). Earth and planetary science article headlines were the most prevalent in most cases, except at the anniversary of the Darfield earthquake during the Rugby World Cup, and whilst the building scientists were giving evidence at the Royal Commission. While information, decision and management- and cognitive and behavioural science topics were making headlines it was rare for experts representing these sciences to be in the news, as is discussed in the following sections.

The relative proportions of headline attention given to the 12 disciplinary groups are shown numerically rather than graphically in Table 6.2. That table also compares the proportion of headline attention to the proportion of individual sources in Stuff articles. The table shows that cognitive and behavioural-, and information, decision and management-scientists are not mentioned in as many of the articles as they potentially could be. Building- and health-scientists and disaster researchers were mentioned more than the proportion of headline attention suggested they might be. Detail about each discipline follows in sections 6.3-6.14.

**Table 6.2: Headline attention to science disciplines, and scientist source presence**
Percentage of headline attention to disciplinary subgroups (left-hand column) in 1000-Stuff articles after the Darfield earthquake (middle column). Compared with percentage of individual sources in Stuff articles in the same set of articles (right-hand column).

Note that for headline science attention multi-disciplinary topics are topics known to be studies by multi-disciplinary academic research teams. However, it was rare for individual sources who are part of a multi-disciplinary team study to be mentioned in the New Zealand mass media. The 7.7% individual sources relate to articles that included multiple sources, or disaster researcher sources.

| Science discipline group | % headline attention in Stuff articles | % individual sources in Stuff articles |
|---|---|---|
| Building | 8.3 | 21.1 |
| Cognitive and behavioural | 13.9 | 1.2 |
| Earth and planetary science | 22.1 | 23.9 |
| Economics | 5.1 | 6.0 |
| Environmental | 3.5 | 5.3 |
| Geotechnical | 6.4 | 6.5 |
| Health | 9.9 | 18.3 |
| Information, decision and management | 20.0 | 0.5 |
| Public administration and political | 5.3 | 0.9 |
| Urban studies and planning | 1.5 | 3.2 |
| Multi-disciplinary/ disaster research | 2.4 | 7.7 |
| Other | 1.8 | 5.4 |

### 6.2.2 A single media article or television item rarely mentioned a range of sciences or scientists

Mention of a range of scientific disciplines, individual scientists, projects, reports, or institutions in one article was rare. An exception was the article in Stuff entitled "The year the earth shook" (Dudding, 2011) carrying the by-line "*What our scientists have learned from the Canterbury earthquakes*". This article was about a report compiled from source material attributed to the Royal Society, but even so included comments from only four scientists, one earthquake engineer and three geoscientists (a geologist, an academic seismologist, and another seismologist who worked as a policy/decision-maker).

Where there were multiple scientists or expert sources in an article this was mostly in *Ask an Expert* or *Researchers/Researching* articles about groups undertaking research such as the Alpine Fault Drilling Programme (e.g NZPA, 2011d) or research into the ecology of the estuary in Christchurch in 2011 (e.g. D. Williams, 2011c-a).

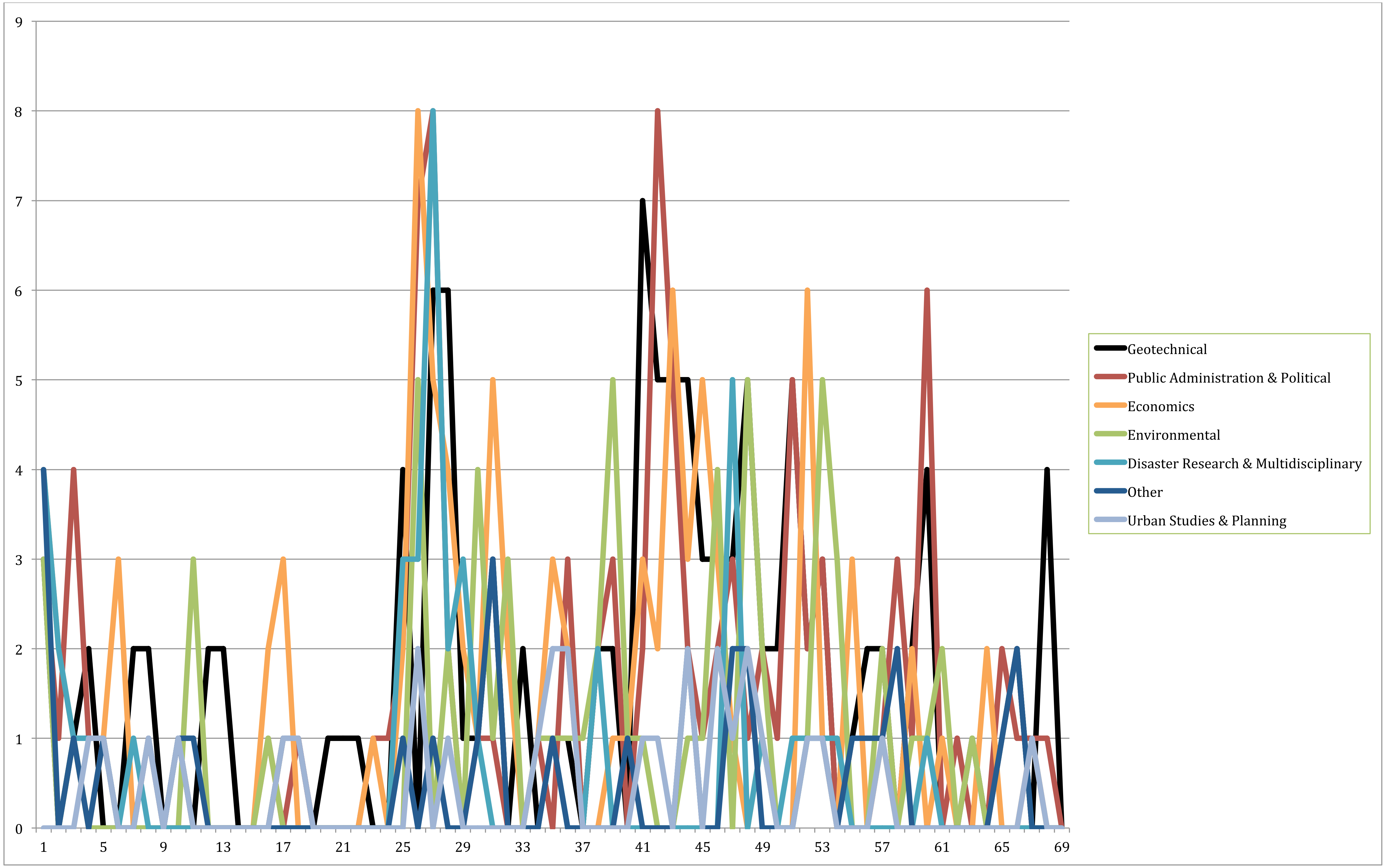



**Figure 6.3: Poorly represented sciences in the New Zealand earthquake-related media**

The vertical axis is the relative weighting of the prevalence of disciplines suggested by headlines in Stuff for each week. The horizontal axis is a time line, showing the weeks after the Darfield earthquake. Peaks relate as follows: Week 26: Port Hills earthquake; Week 42: land report release and government announcement re land zoning; Week 59: Royal Commission of Inquiry started; Week 68: December 23 aftershocks.

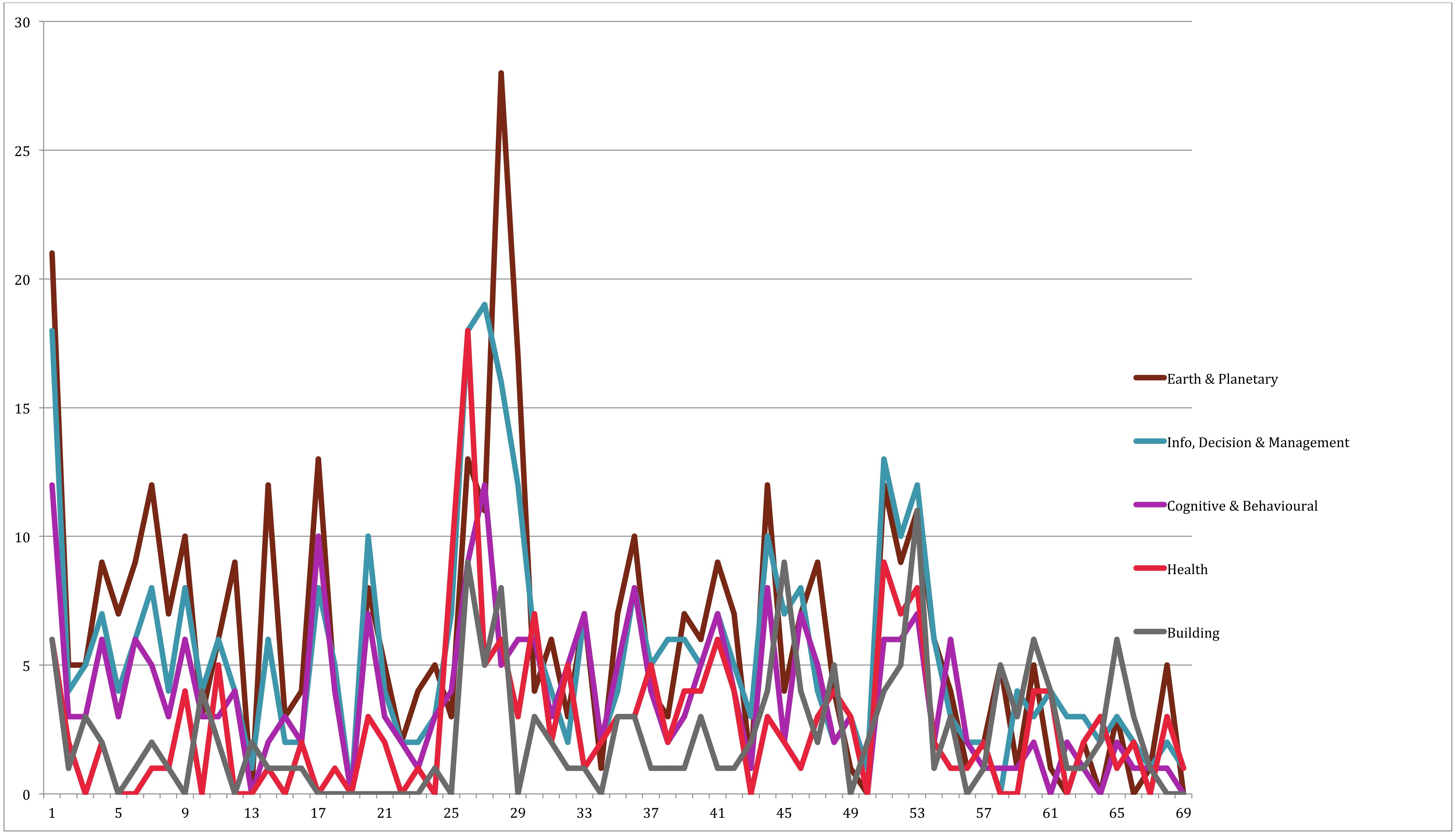



**Figure 6.4: Four most prevalent science discipline groups in earthquake-related Stuff articles (plus cognitive and behavioural sciences)**
The vertical axis is the relative weighting of the prevalence of disciplines, suggested by headlines in Stuff for each week. The horizontal axis shows the weeks after the Darfield earthquake. Peaks relate to earthquake and other events as follows Week 6: October 14 aftershock; Week 17 Boxing Day earthquake (Week17) Week 24: Port Hills earthquake; Week 26: Sendai, Japan earthquake; Week 39; June 2011 aftershocks; Week 41: geotechnical report release; Week 52: Darfield earthquake anniversary; Week 54: Rugby World Cup teams visit Canterbury; Week 59: Royal Commission of Inquiry started; Week 63 New Zealand National Election; Week 68: 23 December 2011 aftershocks. The Sendai earthquake in particular added to the number of earthquake-related articles with science content.

## 6.3 Building science – engineers, architects and other building scientists

*I was interviewed by one of the engineering magazines …and I was trying to say to him, you guys need to take some responsibility for public education, you know explain to people what base isolation is, explain to people 'how is a building earthquake-strengthened', give people the confidence, give them the questions that they need to ask about buildings before they go in, give them the confidence to go back into buildings because they know that engineering works like this… so give them understanding of what makes a building safe and what doesn't … actually people are hungry for it they are hungry for that information*

Ngaire Button, then Deputy Mayor Canterbury City Council – Interviewee I020

### 6.3.1 Academic studies about building science information in the media were rare

Building design (engineering and codes) more readily accounts for significant differences in death toll than earthquake magnitude (Smith, 1993). Therefore specific advocacy regarding building design would be beneficial (Smith, 1993). Many citizens will in the course of a life-time be involved in choices relating to retrofitting or new builds of homes, schools, community buildings and amenities, shops or other workplaces. The choices they make will impact not only themselves but also generations of users of those buildings. Basic background information about building design and construction thus seems fundamental to a proper appreciation of the possibilities in limiting building damage, and associated death and injury, financial aspects of property loss, and long-term discomfort and disruption due to damage and repair. There are however no known studies that have investigated the provision of basic engineering principles in the media to support such understanding of options in seismic design of new buildings and retrofitting.

### 6.3.2 No building science topic other than structural engineering generated more than 3 articles per week in the media

This subsection discusses the portrayal of engineering and architecture research knowledge and of engineers, architects and other building scientist sources in earthquake-related DRR in the New Zealand mass media before, during and after the Canterbury earthquakes. The discussion below will show that what is portrayed in the media is the sense that scientists and experts are making decisions on behalf of citizens. However there is little by way of explanation in the media of the design and construction solutions themselves.

The key observations from integration of results from research-article and media-content analysis are as follows.

Attention to building science in the media matched the proportion of building science sources (Figure 6.2).

The proportion of research attention to building science however far outweighed the proportion of media attention and number of sources in the media (Figure 6.2).

Building science-related articles in the 1000-Stuff-dataset showed no clear pattern over time (Figure 6.4) except for the fact that there was a peak of articles about building performance after each of the major earthquake events, and associated with preparation for the Royal Commission of Inquiry into the collapse of buildings during the Canterbury quakes. There were six articles in the week of the Darfield earthquake and ten in the week following the February 22 event. These articles typically involved comment by one or two academic or professional structural engineers.

At the other end of the coverage timeframe (in late 2012) a range of engineers, sometimes with conflicting opinions, were sources for articles relating to the Royal Commission of Inquiry There were never more than three media articles a week for any building science subtopic other than structural engineering.

### 6.3.3 Structural engineering was the focus of research and media attention

Structural engineering was the focus of both building science research attention and media attention (Table 6.3). A large proportion of the building science research attention in the 20-earthquake-dataset related to damage to school buildings in relation to the Sichuan earthquake. This may have been fuelled in part by media attention on school collapses: this was a topic of media discussion worldwide, including in the New Zealand media.

New Zealand media coverage of the Port Hills (February 22) earthquake was centred around the CTV and PGC building collapses, and to a lesser extent the fate of the Hotel Grand Chancellor, of the stairwells in the Forsyth Barr building in the February 22 event in Canterbury, and whether or how the Christchurch Cathedral could be rebuilt (e.g. "Christ "Church Cathedral: scale of demolition uncertain" Gates, 2011b).

### 6.3.4 Structural engineers were among the most mentioned scientists/experts

Turner (1980b) noted that media analyses that mention the engineer's voice are extremely rare. In this research structural engineer sources were identified as having been used in the story types spanning the DRR cycle as shown in Table 6.4.

**Table 6.3: Building science subtopics research and media articles and media sources**
Building science media source sub-disciplines from the 1000-Stuff dataset (column 2nd from left). Percentage of research articles with headlines emphasizing particular building science subtopics in the 20-earthquake-research-dataset, percentage of headlines in the 1000-Stuff dataset that suggest the subtopic, and percentage of sources who commented or were mentioned.

| | % of Research articles (n=793/4376) | % of Stuff headline science (n=1000) | % sources in Stuff articles |
|---|---|---|---|
| **Building science subtopics** | 18.1 | | 21.1 |
| Architecture | 3.7 | 3.1 | 23.0 |
| Structural (buildings) | 52.8 | 76.0 | 58.2 |
| Infrastructure | 32.4 | 9.4 | 9.8 |
| Infrastructure/environment | 5.2 | 0.0 | 1.6 |
| Technology | 4.2 | 4.2 | 1.6 |
| General | 2.1 | 7.3 | 5.0 |
| Other engineering | 0.4 | 7.3 | 0.8 |

Building science sources were the third most prevalent scientist type after earth and planetary scientists and health scientists (Figure 6.2). There were many individual building science sources (48 individuals on television alone). Building science/expert sources were mostly New Zealanders, not international experts. This holds whether one considers either the complete list of scientists (Appendix 11), or most mentioned scientists/experts (Table 5.33). More specifically building science sources were structural engineers involved in the design and construction of buildings rather than of infrastructure (Table 6.5). This prevalence of structural engineers was even more pronounced on television than in the ODT. However, compared with the volume of building science research attention and media coverage, there was not a proportionately large number of building science sources in media coverage (Table 6.3). Earth scientists and disaster researchers also commented on engineering solutions in both the New Zealand scholarly literature and mass media.

Both Stuff and television mentioned architects approximately 20% of the time that a building science source was used. That said, architects were typically only used in *Rebuild* Plans & Visions stories (e.g. "Quake paves the way for fresh thinking" Matthews, 2010). That article was also one of the few where scientists portrayed as using precedent from other disasters;

> *"Athfield's core group consists of between 30 and 40 local architects, including van der Lingen, Thom Craig, Richard Dalman, David Sheppard and William Fulton. The group plans a public exhibition for late November, presenting ideas from architetcts and other specialists along with photos, press reports and precedents from rebuilds from other cities".*

The most prevalent story types where engineer sources were used in the 1000 STUFF dataset are highlighted in Table 6.4a. There were some stories that contained building scientist sources where the headline did not hint at building science (engineering) information within (Table 6.4b).

**Table 6.4: Building science sources in NZ earthquake-related media story types**
The media headline story types that have potential to contain Building scientists/expert sources are shown in the left hand column. The right hand columns show the total number of sources per story type in the 1000-Stuff dataset (note that this is all, not unique sources for that story type). The right-hand columns are spilt into the sub-disciplines - general engineering sources, structural and infrastructural engineers, architects and those involved in technologies e.g. warning. Note that these are numbers of sources. A + and a number after denotes a brief mention. Gen. = unspecified Building scientists, Struct. = structural engineer, Infra. = engineer working on infrastructure, Arch. = Architect, Tech = other technological (e.g. thermal imaging).

**a) Story types expected to have building science sources in them**

| | Number of Engineering Sources | | | | | |
|---|---|---|---|---|---|---|
| **Media Headline Story Types** | **Gen.** | **Struct.** | **Infra.** | **Arch** | **Tech.** | **Total** |
| At Risk: Buildings | | | | | | 0 |
| Authorities update | | 1 | | | | 1 |
| Building Assessment & Decisions | | 6 +3bm | | | | 9 |
| Closure | | 1 + 1bm | | | | 2 |
| Codes, Standards, Policies | 1 | 1 | 1 | 1 | | 4 |
| Construction methods or materials | 2 | 11 | 1 | 1 | | 15 |
| Damage/Devastation | 2 | 2+2bm | | | | 6 |
| DRR is costly/Good Investment | 1 | 1 | | | | 3 |
| Heritage Building Matters | | 7+3bm | | 1 | | 11 |
| Housing, Homelessness & Shelter | 1bm | | | | | 1 |
| Infrastructure & Public Health | | | 1 | | | 1 |
| Infrastructure Damage/Restoration | | | | 1 | 1 | 2 |
| Infrastructure Upgrade | | | | | | 0 |
| Land Decisions | | 0+3bm | | | | 3 |
| Latest Update | | 1 | | | | 1 |
| Liability, Litigation & Inquiry | | 5+1bm | | | | 6 |
| Rebuild Plans & Visions | | 3 | 1 | 6 | 1 | 11 |
| Rebuild Logistics/Progressing | | | | | | 1 |
| Researcher/Researching | | 4 | | | | 4 |
| Research Findings | | 1 | | | | 1 |
| Restricted Access | | 1 | | | | 1 |
| Reviewing Construction & Codes | 2 | 7+1bm | | | | 10 |
| Safety Assessments/Soil Reports | | | | | | |
| Search & Rescue | | | | | | |
| Securing Contents | | | | | | |
| Strengthening | | 1 | | | | 1 |
| Technology for Emergency Management | | | | | 1 | 1 |

**Table 6.4 cont/.**

**b) Story types not expected to have building science sources in them that did.**

Story types not expected to have building science sources in them that did, as shown. Gen. = unspecified building scientists, includes other engineering, Struct = structural engineer, Infra = infrastructure, Arch = Architect, Tech = other technological (e.g. thermal imaging). * clinging to Cathedral cross, ** assessing the damage ***engineer 'media czars' presence at commemoration ****husband of victim who was engineer at Canterbury University.

| | Number of Engineering Sources | | | | |
|---|---|---|---|---|---|
| **Media Headline Story Types** | **Gen.** | **Struct.** | **Infra** | **Arch** | **Total** |
| About or Assisting Animals | | 1bm | | | 1 |
| Background/Expectations | | 1 | | | 1 |
| Commemoration or Memorial | | 1 | | | 1*** |
| Death Toll or Injured | 2bm | 1bm | | | 2 |
| Doing Better/More in Response | 1 | 1 | | | 2 |
| End of Year | | 1 | | | 1 |
| Fear, flee, panic | | 1 | | | 1** |
| Felt Occurrence (multiple) | | 1 | | | 1 |
| Forecasting or Prediction | 2+2bm | 1 | | 1 | 4 |
| Future Insurance/Reinsurance | | 1 | | | 1 |
| (In)action | | 1 | | | 1 |
| Inquest/ Cause of Injury | 2 | 1 | | | 2 |
| Lessons or Reflections | | 1 | | | 1 |
| Political in Recovery | | 2 | | | 2 |
| Return to normal/resilience | | 2 | | | 1 |
| Reviewing Communication: Info Release | | 1 | | | 1 |
| Secondary Land Threats | | 1 | | | 1 |
| Stressed, Scared Struggling | | 1 | | | 1* |
| Survivor/Victim Story | | 1 | | | 1**** |
| Understanding Earthquakes/Aftershock | | 1 | | | 1 |
| Weather Worries | | 1 | | | 1 |

**Table 6.5: Building science source proportions in print media and television**

This table shows the percentage of sources of the subdisciplines (left hand column) of the building science group in the media (in 1000-Stuff dataset and on television) overall (columns 2 and 3 from the left) and within the group (columns 4 and 5 from the left). With the exception of structural engineers on television there is relative correlation between print and broadcast media.

| | % of individual sources overall | | % of individual sources this group | |
|---|---|---|---|---|
| **Building science group** | **1000-Stuff** | **TV1** | **1000-Stuff** | **TV1** |
| **Building scientists overall** | 21.1 | 28.9 | | |
| Architecture | 4.9 | 6.3 | 23.3 | 21.7 |
| Structural engineering | 12.3 | 20.5 | 58.3 | 71.0 |
| Infrastructure | 2.1 | 1.3 | 10.0 | 4.3 |
| Infrastructure/environment | 0.4 | 0.0 | 1.7 | 0.0 |
| Technology | 0.4 | 0.8 | 1.7 | 2.9 |
| General | 1.1 | 0.0 | 5.0 | 0.0 |

Academic engineers were infrequent sources in the New Zealand mass media articles over the 5 years analysed. One exception was Dr Andy Buchanan, whose advocacy for DRR was exemplary;

> *Now is the time to show how Kiwi structural engineers and geotechnical engineers can contribute to a sustainable cityscape for the new Christchurch, designing attractive and safe modern buildings which will not suffer the fate of today's older buildings in future earthquakes. The tools are available, with only a modest investment in building codes, education and research necessary to make it happen.*
>
> Prof Andy Buchanan in "Time right for innovative engineers" (Fairfax NZ News, 2011i)

Structural engineers were briefly mentioned in many *Authorities Update* and *Search & Rescue* stories in the ODT. While engineers spoke out in relation to Ken Ring's earthquake predictions it was rare for engineers to make 'warnings'. An exception was Andy Buchanan who in October of 2010 warned that the Darfield earthquake had only involved moderate levels of shaking at the end of "Seismic lessons" (Squires, 2010); in the later February 2011 event higher levels of shaking were experienced.

### 6.3.5 Infrastructural engineering and sources were not prevalent in the media or research

Most attention in the New Zealand media coverage of the Canterbury earthquakes was on structural engineering, not so much other building science topics. However according to I012 (anonymous geotechnical expert interviewee) structural engineering got coverage *"only when it was a controversial topic such as bowling down old buildings, closing shopping malls, that sort of thing".*

The range of global technology research is not at all reflected in media story types or sources in them (Table 6.3) however the percentage of attention in research and the media is the same (Table 6.5). An example of a technology-related media item is "Cutting edge NASA technology helps ChCh" (TV1, 2011-05-11). Some general comment about the framing of technology in the media is made in section 7.4.13.

Infrastructure design and construction was a topic for which source comment was rare. This is significant given the success of lifelines mitigation (Fenwick, 2012) and that decisions about infrastructure are often made by local communities (or at least by elected representatives), and decisions about infrastructure affect the community at large rather than those who own or use individual buildings.

### 6.3.6 Overall the NZ media portrayal of building scientists and other engineers was that they were making decisions on behalf of citizens without explaining them

There was a general sense that engineers had not engaged in media communication to the degree or about topics that citizens would have liked (see quote at the beginning of the section). Interviewees mentioned the comparative lack of comment from building scientists (note though that they referred to building scientists as engineers and did not mention architects).

Interviewees mentioned concern that the public did not seem to understand the basis for different building codes. There was however little media discussion of the differentiation in building code requirements relating to public buildings compared with residences. Media analysis showed that engineers discussed the damage, but did not explain the assessment process, and cost comparisons were rare. Interviewee I012 suggested that basic information about structural assessments had been missing from media coverage. Expert in emergency medicine Prof. Michael Ardagh also thought building science could have been better communicated. He thought the media should have communicated answers to the following questions *"What does the inspection of a building mean, or even at the early stages, what does the USAR inspection of a building mean, and the green sticker or the red sticker?"*

Technical terms and their relevance were not explained. For example in M. Stewart (2010) engineer Weber was quoted as saying *"It's quite badly damaged with bad shear failures where there's been lateral loading. It's been cracked through brick columns"*. Nor were there any mentions of mitigation options that had or had not been employed, and their performance, let alone comparative costs for these. Articles such as "Hunt on for more robust dwellings" by Cairns (2011a) mentioned that engineers were engaged in designing better foundations, however the key elements of good foundations, associated costs, and the fact that certain things were already known about foundation design were typically not mentioned.

**Recommendation 9 (building science and architecture):** Scientists - Building scientists, architects and infrastructural engineers should be encouraged to communicate more about building materials and design, particularly in relation to infrastructure, and construction-related DRR possibilities, their costs, successes and failures.

There is further discussion about building science topics in sections 7.4.13, 7.6.4 and 7.6.5.

-blank-

## 6.4 Cognitive- and behavioural-science; psychologists, sociologists and anthropologists

### 6.4.1 Cognitive and behavioural science was poorly represented in earthquake-related media and research

This section discusses what cognitive and behavioural scientists have been researching and communicating in the New Zealand media.

Previous disaster media research literature that considered whether cognitive and/or behavioural experts have been represented in the mass media is rare, and simply presents the proportion of source representation as low.

This research found that cognitive and behavioural scientists; psychologists, sociologists and anthropologists were not well represented in either global earthquake research or earthquake-related media articles in New Zealand (Figure 6.2 and Table 6.6). DRR-related research contributions from researchers from the cognitive and behavioural sciences accounted for less than one per cent of the 4836 articles analysed.

**Table 6.6: Cognitive or behavioural science disciplines in academic article titles and media article headlines**

Percentage of research articles with cognitive or behavioural science subtopics in the 20-earthquake-research-dataset and the percentage of 1000-Stuff media articles with these science sub-disciplines suggested in the headline. For a description of the subdiciplines as observed in the research articles analysed see Appendix 8.1.

| | % Research (n=33/4376) | % Media (n=41/1000) |
|---|---|---|
| **Cognitive and behavioural science sub-disciplines** | 0.7 | 4.1 |
| Human Geography | 3 | 2 |
| Social Psychology | 24.2 | 19 |
| Sociology | 72.7 | 74 |

Table 6.7 lists 36 story types in the New Zealand media that might conceivably have had cognitive and behavioural scientist sources in them. In reality only ten of the story types contained this type of source. Most notably there were only one or two articles of each type, out of the 1000 in the dataset.

In the week after the February 22 earthquake, eleven of the 1000 Stuff print articles analysed related to sociological aspects of disaster. There was at least one print media article on Stuff relating to these topics each week most weeks of the period analysed. Yet comment was rare from cognitive and behavioural scientist sources. One of the few

**Table 6.7: Cognitive or behavioural science in earthquake-related media story types**

The media headline story types that had potential to contain cognitive- or behavioural-scientists/expert sources are shown in the left hand column *(unless italicised in which case it is not considered obvious that these story types might contain this type of source)*. In the right hand column is the number of source types for story types in the 1000-Stuff-dataset.

| Media Headline Story Types | Sociology | Psychology | Human Geography | Total Cognitive & Behavioural Sources |
|---|---|---|---|---|
| (In)action | | 1 | | 1 |
| Accommodation/Break Away | | | | |
| Antisocial Behaviour & Law Enforcement | 2 | | | 2 |
| Background/Expectations | 1 | | | 1 |
| Business Helping Out | | | | |
| Celebrity Involvement | | | | |
| Celebrity Visit | | | | |
| Change in Luck | | | | |
| Cleaning Up | | | | |
| Don’t Worry | | | | |
| Double Disaster | | | | |
| Fatalistic Beliefs | | | | |
| Fundraising/Donations by New Zealanders | | | | |
| International Aid | | | | |
| International Solidarity | | | | |
| Land Decisions | | | | |
| Leader Condolences | | | | |
| Leader Visit | | | | |
| Military or Police Relief/Aid | | | | |
| Outstanding International Individuals | | | | |
| Remembering | | | | |
| Schools Pastoral Care | | | | |
| Solidarity, Compassion & Community Spirit | | | | |
| Other Social Effects | | | | |
| Rational Reaction | | | | |
| Rebuild Plans & Visions | 1 | | | 1 |
| Return to normal/resilience | | | | |
| Sport | | | | |
| Staying/Going | | | 2 | 2 |
| Stressed, Scared Struggling | 1 | | | 1 |
| Students Staying/Going | | | | |
| (Un)prepared Citizens | | | | |
| (Un)Employment | 1 | | | 1 |
| Victim ID or Name Release | | | | |
| Ways to Feel Better | 2 | 1 | | 3 |
| Recording for Posterity | 1 | | | 1 |
| *Felt occurrence multiple* | | 1 | | 1 |

exceptions was the inclusion of comment by internationally renowned disaster sociologist Charles Fritz. Only 1.2% and 0.4% of sources on Stuff and television respectively, were cognitive and behavioural scientists.

There were no anthropologist sources. There were only seven different individual cognitive- or behavioural-science sources (Appendix 11), in only 14 of the 262 Stuff articles whose headlines suggested they were about this type of DRR-science. With the exception of two international sociologists all were New Zealanders.

### 6.4.2 Cognitive and behavioural scientist sources typically only commented about reactions to threat, or mental health consequences of disaster

The story types that cognitive and behavioural scientist sources appeared in were *(In)action, Antisocial Behaviour & Law Enforcement, Background/Expectations, Rebuild Plans and Visions, Ways to Feel Better, Recording for Posterity, Staying/Going, Stressed, Scared or Struggling, (Un)employment* and, unexpectedly, a *Felt Occurrence* story (Table 6.6).

This research has found two common themes relating to psychological and sociological topics in both research and media stories: 1) observations about reactions to threat of disaster (e.g. earthquake) and 2) observations about mental health consequences of disaster and coping with them.

Academic research relating to how people cope with the threat of disaster was summarised in Chapter 2. Detail about psychological and sociological consequences of disaster is discussed in the following chapter (section 7.5). Mental health consequences and interventions in response and recovery and the fact that psychologist sources did not mention evidence from previous disaster-related research are discussed as part of health science (sections 6.9.6 and 6.9.7).

### 6.4.3 There were many topics that cognitive and behavioural scientists could have commented on but did not

Where there was comment by cognitive and behavioural scientists, it was typically about mental well-being. This was despite the fact that over 10% of the Stuff stories were of story types relating to warnings and risk related behaviours, and at least a further 15% related to disaster-related behaviours that these scientist sources might also have commented on.

There was little research or media comment by cognitive and behavioural scientists on the social consequences in disaster such as loss of culture, heritage or amenity or the arts and other aspects affecting social fabric.

Both research and media showed similar attention to the cognitive and behavioural science sub-disciplines (Table 6.6). Most research and media articles related to sociological topics.

Analysis of the 20-earthquake-research-dataset showed that little of the recent academic research relating to psychological and sociological topics has been translated into media articles. Research topics included population shifts in disaster and the reasons for them, optimism and resilience, reactions to warnings, maladaptive behaviours in response, and mutual aid or mass collaboration in response and recovery. However these topics were not discussed by cognitive and behavioural science sources in the New Zealand media.

Cognitive and behavioural scientists might also have but did not comment on maladaptive and adaptive behaviours in response and recovery (which accounts for at least a further 15% of Stuff coverage) and about the social causes of disasters.

### 6.4.4 In summary cognitive and behavioural scientists were under-represented

Cognitive and behavioural scientists were under-represented in the New Zealand mass media during and after the Canterbury earthquakes. There was, however, a wide range of story types and over 40% of stories into which cognitive and behavioural scientists' comments could have been interwoven. There is for scientists from this disciplinary group to translate knowledge and global research findings in this disciplinary area. The observations in this section are covered by recommendation 25 at the conclusion of this chapter (p. 362).

See also recommendation 70 in section 7.6.9 (p. 457).

## 6.5 Earth and planetary science and earth scientists

A few decades ago plate tectonics was a topic that was mysterious to citizens (anonymous interviewee I022). It was thought that citizens would not be able to understand so geologists made little effort to communicate publicly. Today citizens may not understand how plate tectonics works, but they do have a basic understanding that earth scientists study plate tectonics in relation to earthquakes. Oates et al. (2012) studied media education of the public on geoscience (earth science) in relation to the Canterbury earthquakes. Their findings (see Appendix 15) were limited to 'correct' knowledge about earthquake mechanisms, liquefaction and the legitimacy and limitations of earthquake prediction, rather than implications for DRR. As for other sciences the results of a comparative analysis of research attention, media attention and interview responses are given below.

### 6.5.1 There was a lot of earth science communicated

A large proportion of the science currently communicated in the public sphere relates to earth science. The results of this research show that over 60.1% of the earthquake-related science that was communicated in the New Zealand media was either related to an earth science topic (Figure 6.1 brown) or included an earth science topic (Figure 6.1 orange).

There were 30 story types identified in the New Zealand media that discussed earth and planetary science topics that might potentially include earth scientist sources. The story types identified from the 1000-Stuff-database as having science sources are shown in Table 6.8. These story types focused on the characteristics of earthquakes, and to a lesser extent the causes of secondary geo-hazards (such as liquefaction, tsunamis and rock-fall). The five media headline story types in which earth and planetary scientists were most prevalent were *Aftershock(s), Felt Occurrence* (single or multiple), *Understanding Earthquakes/Aftershocks, Research Findings* and *Researchers/Researching*. Note however that the *Aftershock(s)* stories occurred only after the Darfield earthquake.

### 6.5.2 Seismologists and seismological topics dominated the coverage

Seismologist sources dominated the media coverage. A significant difference between the research dataset and the media is lack of media coverage of atmospheric scientists (and therefore atmospheric science). This is likely and notably a consequence of the fact that in New Zealand atmospheric scientists are not researching atmospheric precursors of earthquakes in the way they are overseas. (Note that 12.7% of the earth and planetary science research articles analysed in this study were related to atmospheric science topics (Table 6.9). The overseas research typically related to either pre- or co-seismic perturbations in the atmosphere, both part of attempts to predict earthquakes. Notably none of the articles in the 1000-Stuff dataset were dedicated to this topic.

**Table 6.8: Earth and planetary science headline story types and sources in them**
a) The media headline *story types that have potential to contain earth and planetary scientist/expert sources* are shown in the left hand column. In the right hand columns are the number of sources that there were for these story types in the 1000-Stuff dataset. Gen = unspecified or generalist Earth scientists, Ocean = oceanographers, Geol = geologists, At = atmospheric scientists including meteorologists, Multi = multiple earth-scientists in one article. There were no geographers. Note that the source might be an institution only, particularly for *Aftershock(s)* and *Felt Occurrence* story types but also for other types. Other story types that contained earth and planetary science sources are shown in b) overleaf.

| | | | Earth and planetary science sources | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Media Headline Story Types** | **Gen** | **Ocean** | **Seis** | **Geol** | **Multi** | **Geog** | **At** | **Total** |
| Aftershock(s) | 1 | 1 | 33+2bm | | | | | 37 |
| Associated Natural Phenomena | 1 | 1 | | | | | | 2 |
| Authorities Update | 1 | | 1 | | | | | 2 |
| Background/Expectations | | | | 1 | | | | 1 |
| Felt Occurrence | 1 | 1 | 66+10bm | 1 | 1 | | | 80 |
| Felt Occurrence-multiple | | | 18+1bm | | | | | 19 |
| Forecasting or Prediction | 6 | | 30 | | 1 | | | 37 |
| Historic Events | 4 | 1 | 1bm | | | | | 6 |
| Latest Update | | | 1 | 1 | | | 2 | 4 |
| Liability, Litigation or Inquiry | | | 3+2bm | | | | | 5 |
| More to Come? Link? | 2 | | 1 | | 1 | | | 4 |
| Secondary Land Threats | 1 | | 4 | | | | | 5 |
| Strange Phenomena | | | | | | | | |
| Tsunami Warning | 2 | | 1 | | | | | 3 |
| Understanding Earthquakes/Aftershocks | 7 | | 10+1bm | | 1 | | | 19 |
| Volcanic Eruption | 1 | | | | | | | 1 |
| Development Hearings | | | | | | | | |
| Making the Natural Environment Safer | | | | | | | | |
| Monitoring or Warning Systems | | | 1 | | | | | 1 |
| Background/Expectations | | | 3 | | | | | 3 |
| Doing Better/More in Response | | | 1 | | | | | 1 |
| Research Findings | 2 | | 22+3bm | | 1 | | | 28 |
| Research Plans | 3 | | 4 | | 1 | | | 8 |
| Researcher/Researching | 1 | | 18+1bm | | | | | 21 |
| Reviewing Warnings | 1 | | 2 | | 1 | | | 4 |
| Supporting Research | 2 | | 1 | | 1 | | | 4 |
| At Risk: Cities Regions/Scenarios | 1 | | 2 | | | | | 3 |
| Authorities/Experts Denial | | | 2 | | | | | 2 |

**Table 6.8 cont/-**

b) Story types that contained earth and planetary science sources in the 1000-Stuff dataset but whose headline story types did not suggest that earth and planetary scientist sources might are shown in the left hand column. In the right hand columns are the number of sources that there were for these story types in the 1000-Stuff dataset. Gen = unspecified or generalist earth scientists, Ocean = oceanographers, Geol = geologists, Geog = geographers, Multi = multiple earth-scientists in one article. Bm = brief mention

| | Earth and planetary science sources | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Media Headline Story Types** | **Gen** | **Ocean** | **Seis** | **Geol** | **Multi** | **Geog** | **At** | **Total** |
| (In)action | | | 1 | | | | | 1 |
| (Animals) Sensing Earthquakes | 1 | | | | | | | 1 |
| At Risk: Buildings/Infrastructure | 1 | | | | | | | 1 |
| Awards, Commendations or Thanks | 1 | | 1 | | | | | 2 |
| Building Assessment & Decisions | | | 1 | | | | | 1 |
| Business Recovery | | | 1 | | | | | 1 |
| Citizens in Recovery | | | 1 | | | | | 1 |
| Construction Methods & Materials | | | 1 | | | | | 1 |
| Death Toll or Injured | | | 1+2bm | | | | | 3 |
| Disaster Occurrence | | | | | | | | 1 |
| End of Year | 3 | | | | | | | 3 |
| Impact on Economy | 1 | | | 1 | | | | 1 |
| Emergency Medical Treatment | 1 | | 1 | | | | | 2 |
| Future Insurance/Reinsurance | | | 1 | | | | | 1 |
| Infrastructure Damage/Restoration | | | 1+1bm | | | | | 2 |
| Insurance Claim Process or repairs | | | 1 | | | | | 1 |
| Land Decisions | 1 | | 1+1bm | | | | | 3 |
| Other Environmental Effects | 1 | | 1 | | | | | 2 |
| Other Health Warnings | | | 1 | | | | | 1 |
| Other Social Effects | | | 2 | | | 1 | 1 | 3 |
| Reviewing Communication (Info release) | | | 2 | | | | | 1 |
| Search & Rescue | | | 1 | | | | | 1 |
| Secondary Land Threats | | | 1 | | | | | 2 |
| Stressed, Scared Struggling | | | 3+1bm | | | | | 4 |
| Survivor/Victim Story | | | 2 | 1 | | | | 2 |
| Weather Worries | | | +bm | | | | 2 | 3 |

Atmospheric science sources in the New Zealand media were either a representative of New Zealand's Meteorology Service discussing the weather in relation to the earthquake-affected areas, or self-proclaimed meteorologist 'The Moon Man' Ken Ring (see p 257, p 307 and section 7.7.3).

**Table 6.9: Earth and planetary science sub-disciplines - research article titles and print media headlines**

Of the 4376 20-earthquake-research articles 1226 related to earth and planetary science research articles. This table shows the percentage of research articles with earth and planetary science sub-disciplines (left hand column) in the 20-earthquake-research- and 1000-Stuff-datasets. For a description of the subdiciplines as observed in the research articles analysed see Appendix 8.1.

| | % research (n=1226/4376) | % 1000-Stuff (n=372/1000) |
|---|---|---|
| **Earth and planetary science sub-disciplines** | 28.0 | 37.2 |
| Atmospheric | 12.7 | 0 |
| Geology | 11.6 | 7.0 |
| Oceanography | 6.4 | 3.1 |
| Physical geography | 0.2 | 0.0 |
| Seismology | 70.1 | 89.7 |

### 6.5.3 Earth science research and media coverage alike focused on large-scale invisible processes

Table 6.9 illustrates the seismological focus in research, and shows that this focus was perpetuated in the news media. This study identified that DRR research in earth and planetary science has focused on the following DRR topics: understanding earthquake processes and mechanisms using specific earthquake disaster examples, or understanding earthquake precursors and potential for warning and forecasting/prediction (topic 1), observations of co-seismic deformation, and secondary effects, and an increased understanding of earthquake processes (topic 1 typically studied in response), or paleo-seismicity or implications for future hazard (topic 2).

The research emphasis has been on understanding the hazard itself, not on applying knowledge of the hazard. For example few research presentations linked rupture with implications for land zonation and other aspects of reconstruction. One example related to the Muzzaraffabad-Kashmir earthquake (Konagai, Johansson, Numata, Takatsu, & Ikeda, 2008) the other to the Sichuan earthquake. Zheng, Yao, Liang, and Zheng (2010) is a rare example of research that explored the interface of earth science and response decision-making and other aspects of emergency management.

A consequence of the broad-scale seismological research focus is that many secondary earthquake hazards (Appendix Table 3.2) were rather poorly represented in the media (Figure 6.5). Rock-fall, liquefaction and seiche were only rarely mentioned and aggradation of rivers was never mentioned.

The emphasis in the media was on "it's interesting that we have found out about [another fault]" or "we've found that the fault has ruptured every 15,000 years so [be alarmed/don't be alarmed]" (see also discussion in section 7.7.3). There was also little in the media about the application of earth science knowledge, the 'so what' to real life problems such as what the location of that new fault might mean for city planners, or how the return period for earthquakes would or had been applied to risk assessments and decisions about building codes and other mitigation measures.

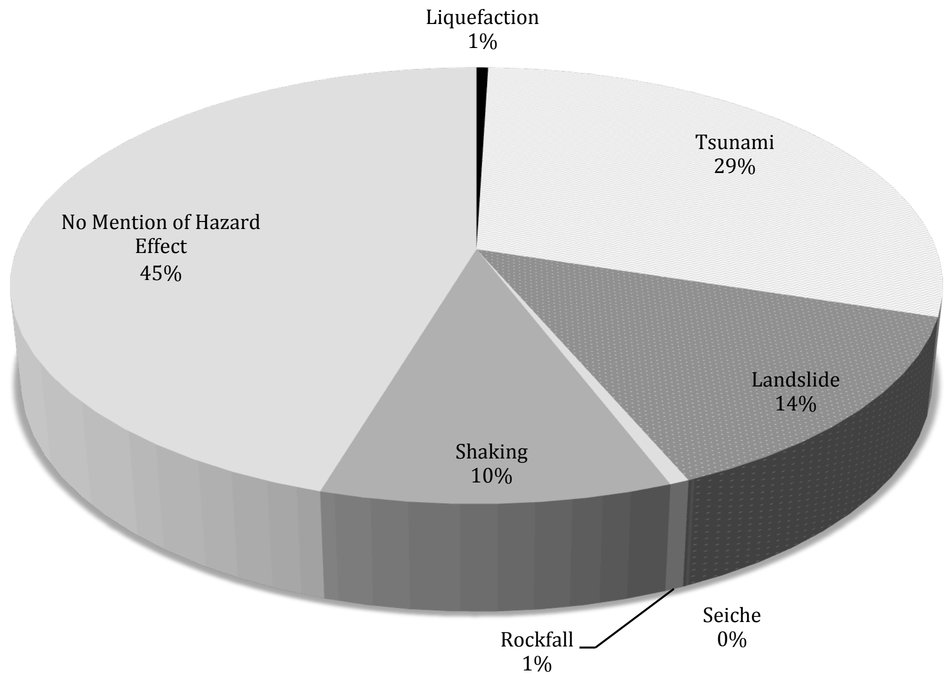



**Figure 6.5: Proportion of mentions of liquefaction and other secondary hazards**
Pie graph showing the 'earthquake' articles (n=856) in online print media (www.stuff.co. nz) in the period April 04 2009 to September 03 2010 (before the Darfield earthquake). This shows what citizens might have learnt from media coverage. There were only 4 mentions each of liquefactions and rock-fall before the Darfield earthquake.

### 6.5.4 What citizens might see and experience in an earthquake was not in media, except as descriptions of citizen sources or 'earthquake summaries' on event

What citizens would see and experience in an earthquake, secondary hazards, effects or consequences were not presented in the media prior to, and even after the Darfield earthquake.

Aftershocks were only mentioned infrequently prior to the Darfield earthquake. Unsurprisingly then, survey respondents and interviewees frequently suggested

‘information about aftershocks’ needed to be better communicated (Table 6.10). Notes describing the findings presented in Table 6.10 are presented in Appendix 14.
Within a few weeks of the Darfield earthquake and its first flurry of many aftershocks The Press did not attribute magnitude, depth and location information to GNS or Geonet as *“everyone knows this is where it is from”.* To a certain extent *“everyone had become seismologists”* (Interviewee I029). Much of the citizen comment in the media described how the main quakes and aftershocks felt and sounded. These comments contributed to other citizens’ expectations of earthquakes.

Liquefaction, which caused a large proportion of the damage in the Canterbury earthquakes, was only mentioned four times in the 15 months prior to the Darfield earthquake. Even then there was no explanation of what liquefaction was, or what it might mean for communities if a large earthquake Occurred. None of those mentions explained the term liquefaction, how it was caused, or ways land might be treated to reduce the chance or degree of liquefaction occurring.

Rock-fall risk in the Port Hills was not mentioned either before or after the Darfield earthquake. This meant that rock-fall experienced in the Port-Hills event (the large aftershock on February 22, 2011) was to a large extent unexpected by citizens there.

Of concern also is that fire was rarely mentioned in the New Zealand media in the five years of analysis. Fire caused the most damage and loss of life in the 1906 San Francisco earthquake. Even after the Canterbury earthquakes the potential for a large conflagration and what might be done by home- and business-owners to lessen the possibility of major fire after an earthquake was not emphasised in the media.

This was even though much of the initial television coverage after the Darfield earthquake occurred with the backdrop of a building in the central business district on fire. Of all the survey and respondents only one of the interviewees mentioned fire. A likely consequence is that the importance of mitigating risk of fire after an earthquake is not something citizens have thought much about.

Each of the aforementioned secondary hazards was known by academics and officials to be an issue for Canterbury; however the ‘Key Facts’ had not been communicated. The ‘Q-file’ documents published on the regional Council’s website (e.g. ECAN, 2007a, 2007b; ECAN, 2008a) had not been converted into more accessible, everyday print media and television copy.

**Table 6.10: Summary of survey and interview responses regarding aftershocks**

This table shows the number of survey and interviewee respondent mentions of a range of aftershock-related topics listed in the left-hand column. Explanatory notes about the types of comments made by respondents is given in the right hand column. For further discussion about this table see Appendix 14. Interviewee comments are presented in Appendix 10. Portrayal of aftershocks in womens magazines is shown in Appendix 16.

| | No. of Topic mentions | | | | |
|---|---|---|---|---|---|
| | **Q2** | **Q3** | **Total** | **Summary** | **Explanation & Notes** |
| **Aftershock topics and subtopics** | | | | | search-words "aftershock", '"future earthquake', 'earthquake sequence' - also 'earthquakes' (only mentions related to aftershocks selected) |
| ***Problem Definition*** | | | | | |
| **Hazard characteristics & cause** | | | | | |
| Describing aftershock - terminology | 2 | 3 | 5 | *Hazard Cause (6-15), and Characteristics (15)* | Need for explanations of what aftershock are or are not, or differentiating between earthquake, foreshock and aftershock. |
| Aftershock 'cause' | 0 | 6 | 6 | | Aftershock processes - understanding why aftershocks occur. Includes understanding the possibility of triggered seismicity on adjacent faults. Respondents were two interviewees with seismology background and one web respondent who felt that this could have been better communicated. Two face to face and one web respondentrequested information as to why aftershocks happen. |
| | *4* | *5* | *9* | | Nine respondents who mentioned aftershocks (2 from categroy above and 7 others) referred in their responses to the aftershock sequence as having been 'unusual' or 'unprecedented.' These respondents did not request this aspect to be communicated, or be better communicated. However this finding highlights an 'information gap' that it may be useful for seismologists to address. [Background - GNS were asked by the Royal Commission to investigate various aspects of the Canterbury sequence to identify if these were exceptional. It appears that it was not, with the exception that "only 1.4 % of all the earthquakes analysed [from 1900-2008 global Centennial Catalogue) had more than three such major aftershocks". 'Such major aftershocks' means aftershocks within a magnitude of 1.1 of the initial shoc. {Royal Commission, 2012}p39-40]. |
| 'About' aftershocks | 1 | 8 | 9 | | General, unspecified - "more information" or "about" aftershocks. One respondent wanted to have known more about noise of aftershocks. |
| Other | 1 | 0 | 1 | | This respondent believes that people should be told "*Excluding the aftershocks from the major event a major earthquake should reduce the risk*". See section x.x for discussion of this topic. |
| **Exposure &** ***Probability*** | | | | *Potential exposure to aftershock, or aftershock forecast (52) or typical duration of seismic sequences (47)* | |
| Potential for aftershocks | 7 | 4 | 11 | | 'Awareness' of possibility of exposure to aftershock (not 'risk' or 'likelihood') |
| Aftershock 'likelihood' or 'risk' | 6 | 5 | 11 | | Request for aftershock 'likelihood', or reference to 'risk' of aftershock |
| Aftershock forecast trends | 10 | 8 | 18 | | Reference to magnitude and frequency trends - specifically what to expect after a major earthquake (Omori's Law) |
| Forecasting Limitations | 3 | 9 | 12 | | References to difficulties in 'prediction' or 'modelling' or 'forecasting' of aftershocks. Typically this is a suggestion to highlight the limitations - and interestingly only one of the respondents is an 'expert' in any facet of DRR or DRR-science. While one respondent is asserting the failure to 'predict' the severity of the February earthquake, and in two instances the respondents are unhappy with the lack of certainty, the majority of the respondetns think that there should be more acknowledgement of the limitations of aftershock forecasting. |
| Aftershock duration | 18 | 29 | 47 | | Reference to need to emphasise potentially lengthy seismically active period (includes reference to 'ongoing' or 'continuuing' aftershocks). One reference does not mention aftershock but states that in Canterbury 'the erthquakes might [still] keep going'. |
| **Consequences or Vulnerability** | | | | *Potential severity (21) and nature of consequences (29)* | |
| General potential severity | 5 | 16 | 21 | | Reference to the 'extent' of effects, or effects potentially being as 'severe', 'intense' or greater than the initial earthquake. A few respondents noted that this was dependent on depth and distance from, or proximity to a population centre. Includes one reference to aftershocks having the potential to kill. |
| Built environment | 2 | 6 | 8 | | Ongoing or increased vulnerability of built environment due to aftershocks, or cumulative consequences on built environment caused by aftershocks. Phrases used include "heightened risk', 'damage exacerbation', 'hidden danger' (Includes 1 implied vulnerability to aftershocks where the word aftershock is not mentioned). |
| Natural enviroment | 2 | 4 | 6 | | Ongoing effect/cumulative consequences on land including multiple liquefaction (2), and increased possibility of rockfall (1) event could be better communicated, and dust/pollution needs to be communicated (2 - both Q2). There were no references to flooding in relation to aftershock. |
| Human community | 7 | 8 | 15 | | Psychosocial effects - 'stress', 'mental' (anguish), 'traumatic', 'psychol'(ogy/ical) effects, 'emotion' - and 'disruption'. Of those respondents who mentioned psychosocial aspects of aftershocks most wanted 'awareness','acknowledgement' or 'expectation of, or to 'understand' effects. Requests for treatment recommendations or advice for PTSD etc are coded separately in Solutions below. Includes one reference to the [stressful] effect of poor communication about aftershock. Seven of the fifteen mentions of the psychosocial consequences of aftershock were from six respondents who referred only to the relationship between psychosocial consequences and aftershock specifically. These six respondents did not otherwise refer to the psychosocial effects of earthquakes in general, or the presentation of related advice.*1 |
| Economy | 0 | 0 | 0 | | There are no references to the economic impact of aftershocks |
| **Recovery** | | | | | Aftershock impact on recovery, including significance for insurance |
| **Communicating Risk** | 5 | 17 | 22 | *Telling it like it is (22)* | Respondents resoundingly request warnings ('alarm') rather than reassurance, although two respondents emphasise concerns about causing public panic*2. 'Tell it like it is', 'warn', 'do not patronise' or reassure. . This is an issue that predominantly came out in longer interview responses (11 respondents cf 2 face to face and four web survey respondents). There is also one comment that the language used to explain aftershock information was 'wrong' - presumably too technical. |
| ***Communicating Solutions*** | | | | *Risk reduction measures relating to aftershocks (11)* | |
| ***Readiness/Preparedness*** | | | | | |
| Keeping safe in aftershocks | 3 | 3 | 6 | | These respondents refer to the need for communication relating to actions to take when aftershocks occur. |
| Be prepared for aftershocks | 2 | 2 | 4 | | General - eg '"How to prepare for aftershocks", beyond 'drop, cover and hold'. This includes two references to the need for advice re the psychosocial effects of aftershocks (one as part of readiness the other in relation to advice in the response period.)*3. Note two respondents made references to both keeping safe and general preparedness. |
| ***Response*** | | | | | |
| Be prepared for aftershocks | 0 | 1 | 1 | | |
| Risk management decisions | 0 | 2 | 0 | | Two interviewees referred to discounting of the risk of aftershock and downplaying of the vulnerability of the built environment after Sep 2010. One suggested that the failure of risk managers to choose more risk averse options, rather than 'business as usual' should have been communicated , while the other focussed on the need for better communication of the building assessment and stickering/placarding process*4. |
| ***Recovery & Reduction*** | 0 | 0 | 0 | | There were no aftershock-related recovery or reduction phase solutions mentioned. |

*1 A total of 40 respondents made mention of psychosocial effects in Qs 2 & 3. Note also that there were many more references to the psychosocial effect of earthquakes in relation to Q7 - how respondents were affected.*2 see section x.x for discussion re alarm vs reassurance *3 One interview respondent mentioned 'comment from psychologists' including treatment recommendations. Another interviewee specifically suggested (as opposed to implying) that citizens would be better emotionally prepared for aftershocks if they knew more about them. *4 Non-aftershock-specific assessment and stickering).

-blank-

The reason that earth and planetary science sources in the New Zealand mass media did not explain what the range of possible hazard effects were at every opportunity (for example in relation to small earthquake (felt occurrences)) was most likely because these are not new findings to scientists. This is however the very type of information that needs to be repeated for communities whose demographics are continuously changing and whose citizens are unlikely to have direct experience of natural hazard effects.

Other earth science topics this research has identified as being important to better communicate are the understanding of magnitude, the association of earthquakes with volcanoes and the triggering of further events (see sections 7.4.8 and 7.7.14).

### 6.5.5 Earth science, and in particular seismologists contributed the most scientist sources in New Zealand earthquake-related media

As discussed in a previous section, earth science sources far outnumbered other science sources in the earthquake-related media both before and after the Canterbury earthquakes. Twelve earth scientists were either mentioned in the most print articles, or appeared on television more than any other scientists from other disciplinary groups (Table 5.33). While the sources in these articles came from the variety of earth and planetary science sub-disciplines (Table 6.11) the headlines themselves were heavily skewed to seismological topics. Only occasionally were there one or two articles whose headlines suggested atmospheric, oceanographic or other geological (non-seismological) topics. This was reflected in the overall number of these types of scientist sources identified in the articles.

### 6.5.6 None of the earth science sources on television were referred to as geographers

Note also that only eighteen of the 4376 20-earthquake research articles were related to dedicated geographical journals or conferences (not including those relating to geographic information systems). The topics discussed were spread across the disciplinary groups from cartography (in information decision and management sciences) through to human geography and health. Only three related to the earth and planetary science sub-disciplines or topics as described in Appendix 8.1. None of the sources that appeared on television were identified in the broadcast as geographers.

**Table 6.11: Earth and planetary science sources in print media and television**
This table shows the percentage of sources of the subdisciplines (left hand column) of the earth and planetary science group in the media (in 1000-Stuff dataset and on television) overall (columns 2 and 3 from the left) and within the group (columns 4 and 5 from the left). Note some geotechnical sources (geodesy and surveying) are included. No other geotechnical sources could be identified to a subgroup level from references to the sources in the media.

| | % of individual sources overall | | % of individual sources this group | |
|---|---|---|---|---|
| | 1000-Stuff | TV1 | 1000-Stuff | TV1 |
| **Earth and planetary science group** | 23.9 | 17.6 | | |
| Atmospheric | 0.1 | 0.1 | 0.4 | 0.6 |
| General | 7.2 | 5.4 | 30.1 | 30.7 |
| Hydrology | 0.7 | 0.0 | 2.9 | 0.0 |
| Oceanography | 1.8 | 2.1 | 7.5 | 11.9 |
| Seismology | 13.4 | 10.0 | 56.1 | 56.8 |
| Geography | 0.0 | 0.0 | 0.0 | 0.0 |
| Geodesy/Surveying | 0.7 | 0.0 | 3.0 | 0.0 |

### 6.5.7 Earth scientists were the subject of a variety of controversies

Perhaps because earth and planetary science was the most visible of the sciences, it was the subject of the most controversies in the media (see Appendix 13). Otherwise earth and planetary science sources seem to be held in relatively high regard and trusted.

Controversy about the value of earth science in DRR was notable both in media coverage itself, and in citizen on-line comment surrounding the issues of Earth scientists forecasting and predicting, particularly in relation to aftershocks but also in relation to predictions by 'The Moon Man' Ken Ring. One strand of comments on earth science articles was 'earth scientists make it all up in retrospect' the other 'geoscientists can't forecast, so let someone who can do so'. There was public dismay (reported in the earthquake-related media analysed and mentioned by survey respondents and interviewees) to find that there is so much uncertainty, in particular that it is unreasonable to expect absolutes regarding the location of faults and probability (forecasting/prediction).

Other aspects of media coverage of earth science that was mildly controversial, at least in the eyes of earth scientists, are misconceptions about earthquake magnitude, what magnitude scales are used and references in articles to magnitude discrepancies between different agencies. As none of these affect DRR directly they are not discussed further here.

### 6.5.8 Dr Quigley, science communicator of the year for 2011 aligned his communications with citizen needs

A lot more could be said about earth science and earth scientists because a lot more was written about them in the New Zealand media. Earth and planetary science received the 'lion's' share of earthquake-related DRR science communication in the New Zealand mass media. Rather than needing more, or longer articles, or more television items on earth science topics, it is suggested that the stories should be better tailored to people's needs. Dr Mark Quigley reflected that he had received the accolades he did with respect to science communication, because he looked at questions raised in print media, radio talk-back etc. and explained them briefly and simply in his next media briefing. If the topic was outside his direct field of expertise, Dr Quigley made an effort to research what the science was (Quigley, 2012).

### 6.5.9 Earth scientist sources frequently mentioned the need to prepare but did not clearly articulate how their research contributed to DRR

One of observations from this research was that earth scientists more than any other sources commonly gave at least some specific DRR advice; advice that is about preparation, and might be described as being outside their direct area of expertise. For example geophysicist Dr Stuart Henrys' statement in "Seismic study for lower North Island" (Kirk, 2011b) *"It is hoped information about the nature of the tectonic plates' activity would help prepare people for "whenever the big one hits"*.

In the five years of coverage analysed, five different hazard-related research projects featured in the media: 1) research related to Canterbury earthquakes, 2) 2003 and 2009 Fiordland earthquake, 3) Alpine Fault Deep Drilling Project 4) Wellington: It's Our Fault Project (Wellington) and 5) North Island subduction and/or slow-slip earthquakes. Just how this research contributes to reducing disaster risks was however not explained. Even though the fourth project involved researchers from a range of disciplines (Van Dissen, 2015) the media coverage rarely mentioned these other aspects of the project, and focused on fault identification (the hazard).

A final point to make is that simply because there is a lot of earth science coverage, and most sources in the media were earth scientists this was no guarantee that hazard and probability were being communicated in ways that citizen found fully useful, this is discussed briefly in chapter 7. Recommendations relating to the communication of earth and planetary science are: a) that the inclusion of physical geographers in New Zealand DRR commentary would likely be useful for DRR (this becomes part of recommendation 22 relating to ‘missing disciplinary voices’ at the end of the chapter), b) to describe the value of research to DRR, and c) the need for earth scientists to bring comment back to simpler concepts that will otherwise be forgotten by a non-specialist public who may not have experienced earthquakes (with global migration even a decade after a major event (sequence) like the Canterbury earthquakes there will be many residents in New Zealand who will not know what occurred there). This latter becomes recommendation 10 below.

**Recommendation 10 (earth science):** Scientists - Basic information about secondary and tertiary hazards, including aftershocks needs to be explained as much if not more than latest research findings.

A recommendation about explaining the value of scientists concisely describing the value of their research to DRR that is applicable to any science as it is to earth science, is made at the end of the chapter (recommendation 23). Chapter 7 makes further general recommendations regarding improvements in the communication of hazards, of seismic risk (assessments and warnings) and of risk solutions.

## 6.6 Economics and economists

*We've been saying from day one you can take a rough first estimate of the cost of the disaster of an earthquake and multiply it by 21/2 and that is effectively what is playing out now. "We're going to end up with a cost to this earthquake – which I've been saying since February 23rd – of $30b and that's where it's tracking"*

Robin Clements, UBS senior economist in "Christchurch Rebuild Predicted to Run 15 Years" (T. Stewart, 2011)

### 6.6.1 Research into economic topics of earthquakes is in its infancy

This study identified little previous research in the 20-earthquake-dataset that discussed the economics of disasters, or disaster risk reduction, or its communication.

Major disasters can have global financial implications and require international co-operation (Lahidji, 2004). Economic and financial planning for DRR should occur as a partnership between governments and the private sector in all four phases of DRR cycle (Lahidji, 2004)p9. Yet, according to Noy (2009) few economists participate in developing the DRR research agenda, and economic research on natural disasters is considered to be in its infancy. This is reflected in the analysis of the 20-earthquake research dataset. Compared to other disciplines little economic research has been conducted in DRR reflected in the 20-earthquake research dataset Figure 6.2. Analysis showed though that a broader range of topics relating to economics was published in academic journals than Noy has suggested (Table 6.12).

While direct losses of disasters are regularly studied and reported in both academic literature and popular media, indirect damages, flow losses and secondary effects such as inflation, the economic ramifications on disaster aid and lost investment rarely are (Pelling, Özerdem, & Barakat, 2002). Analysis of the New Zealand mass media in this research concurs with that finding.

### 6.6.2 Previous media effects studies were of isolated economics topics; other factors should also be considered when studying these effects

There have been few studies of media content or media effects related to economics. The studies that do exist have revolved around isolated subtopics, mostly tourism or aid. One study was identified that explored the news media's impact on financial markets (Nacher & Ochiai, 2011). However, while this used the Tohoku earthquake as a bad news example, it did not publish findings regarding the relationship in any detail. CARMA (2006) suggested a reverse relationship; that there was a clear correlation between the perceived economic impact of a disaster on western markets and the quantity of media coverage. Rudimentary analysis of the coverage of international disasters in the New Zealand media did not suggest a particularly strong relationship between the volumes of coverage, and the perceived economic impact of a disaster on New Zealand (section 5.2.11).

**Table 6.12: Economics subtopics in media headlines and research article titles**
Percentage of each of the economics subtopics within economics research articles (n=35 0.8% of all research articles) and economics media articles in the 1000-Stuff post-Darfield datatset (n=95 0.9% of articles). Note that aid as a topic did not exist in either earthquake-related economics research or on the Stuff website. For a description of the subdiciplines as observed in the research articles analysed see Appendix 8.1.

| Economics subtopics | Research % | Media % |
|---|---|---|
| Business & Industry | 54.3 | 10.5 |
| Employment | 0.0 | 4.2 |
| Financial/Economy/Markets | 25.7 | 61.1 |
| Insurance | 11.4 | 17.9 |
| Multiple economics topics | 8.6 | 1.1 |

There may be an indirect relationship with the financial impact on countries where New Zealand has strong international relations.

The effects of mass media on tourism are almost the only business effect for which a media effect is claimed (e.g. Mazzocchi & Montini, 2001 ). Many of the statements relating to effects on tourism from media comment appeared to be anecdotal and qualitative. This was particularly notable when compared with the strongly empirical work of van Belle and colleagues regarding the impact of foreign media on aid (Drury, Olson, & Van Belle, 2005; Potter & Van Belle, 2004, 2009; Rioux & Van Belle, 2005; Van Belle, 1999, 2000, 2003; Van Belle & Hook, 2000). For example Mazzochi and Montini's statement *"the deep public concern about the wide media coverage of the earthquake damage and persisting risks contributed to a significant decrease in tourism."* (Mazzocchi & Montini, 2001, p. 1032) did not appear to be based on content analysis, or any other evidence-based proof of this link. There is discussion of related findings from this research below.

### 6.6.3 Media attention to economic aspects was high, greater than in economic research

In contrast to the paucity of published research relating to this discipline, the economic aspects of earthquake events drew significant attention in the media post-disaster. Both this study and (Houston et al., 2012) found that disaster economics was an important topic in post-disaster media (Figure 6.2).

Economics-related media articles accounted for only just over 5.1% of the 1000 Stuff science-related articles selected and analysed. This compares with 17 per cent of the articles on Hurricane Katrina having focus on its economic issues—the greatest for any disaster analysed by CARMA (2006). If however, one totals all of the articles in the ODT that had story types that referred to the economy, financial assistance, businesses, insurance or reinsurance, aid, fundraising or donations this accounts for 20.6% of all of the ODT articles (before and after the Darfield earthquake). The messages (brief mention story types) that were prevalent in financial articles in the media and television were shown in Tables 5.23 and 5.24 and discussed in section 5.3.5.

### 6.6.4 The few economics sources were mostly non-academics

The sources of economic comment in the New Zealand media were usually an indicator of research being done outside academia, for instance by insurance companies, within banking institutions, government ministries and Treasury. The only specialised disaster economist mentioned in the New Zealand media was international expert Ass. Prof. Ilan Noy in "Big shocks yet to be felt" (Hartevelt, 2011a). Economics sources accounted for only 5 and 6% of all sources on television and Stuff respectively. Sub-disciplinary background and qualifications were typically unknown. Most economics sources were from banks.

### 6.6.5 There was little translation in media of the DRR implications of economics-related academic or government research

Neither academic research outputs nor government reports on economics were 'translated' by the media. The comment in the media was not supported by a significant amount of academic research. Economic sources were rarely academic ones. There was virtually no comment in the New Zealand media, post Canterbury, and certainly nothing before, about previous learnings relating to the economics of disasters or DRR, for example the findings of economic aspects of lessons learned from large-scale disasters (OECD, 2004).

### 6.6.6 The science behind insurance was not well researched or covered in the media

*Are we being held hostage by the institutions upon which our insurers' reinsurers ultimately rely to meet their obligations - the international banks?... is the Government unwilling to release any recovery plans to which their finance-sector masters have not given prior approval?*

"Where is leadership?" (Trotter, 2011)

Insurance was a topic discussed without supporting scientific evidence or expert scientist sources. Insurance was however a topic of much relevance to Cantabrians, and almost 20% of economics-related media articles related to insurance (Table 6.12). Media articles on the topic of Insurance fell into one of 3 media story types; *Future Insurance or Reinsurance, Insurance Claim Process or Repairs* and *Insurance Claim Numbers or Costs*. Of these only *Insurance Claim Numbers or Costs* was in the media prior to the Darfield earthquake. Insurance topics in the media after the Canterbury earthquakes ranged from problems gaining insurance after the earthquakes whilst insurers either stopped cover, or increased costs to the long time taken for assessments and pay-outs. Scientists were not drawn into the debates in these story types, as they were not sources in those story types (Table 6.13). Figure 6.2 and Table 6.12 show that there was comparatively speaking at least, little academic research on the topic to be drawn from.

Even with a universal requirement in New Zealand for all insured homes to include a portion of earthquake levy there was little discussion about the different types of insurance. Nor was there information about business continuity insurance etc. in the media, either before or after the Darfield earthquake. Information about relative costs of contents damage compared with structural damage, and projections of what could have been and what could be saved in future for what relatively small investment was also absent.

### 6.6.7 The macro-economics of disaster and DRR were not discussed in the media

Pelling et al. (2002) suggested that the macro-economic impacts of disasters and the frameworks for assessing these need to be reported to the public. Aspects of the macro-economics of disaster rarely received mention in the New Zealand media analysed. While effects macro- and on individuals and households were noted in the mass media analysed, in depth discussion about the impacts was rare.

There was much early speculation regarding loss estimation in the New Zealand mass media. While it is known that the precise evaluation of the direct economic loss from earthquakes is a rather difficult issue (Wang et al 2009) no scientist/expert economist cautioned about this in the mass media. Another economic topic that could have been more prevalent in the media was that although disasters cause a short term reduction, long-term improvements in GDP (Kellenberg & Mobarak, 2011) are likely to follow. There was also nothing in the media that identified the significant gains in GDP growth achieved when disaster damage is reduced (Nagatomo, Otsuki, & Hirano, 2015). Nor was there mention of

**Table 6.13: Economics sources related to earthquake-related media story types**

The media headline story types that have potential to contain Economics scientists/expert sources are shown in the left hand column *(unless italicised in which case it is not considered obvious that these story types might contain this type of source).* The right hand columns show the total number of sources per story type in the 1000-Stuff dataset column (note that this is all, not unique sources for that story type). The right-hand columns are spilt into subtopics – Business and Industry (B&I), Insurance, Financial/Markets, Employment and Property. Note that these are numbers of sources. There were no sources involved in brief mentions. This table shows that there are few expert sources that comment from the Insurance perspective, and highlights that the sources present in the media commented on stories of a national economic scale, more so than those relating to business activities in DRR.

| | Number Economic sources | | | | | |
|---|---|---|---|---|---|---|
| **Media Headline Story Types** | **B&I** | **Insur.** | **Fin./Mkt** | **Emp.** | **Propty** | **Total** |
| Aid Issues | | | | | | |
| Aid Projects in Recovery | | | | | | |
| Business or Industry Effects | 2 | | | | | 2 |
| Businesses Helping Out | | | | | | |
| Business Recovery | 3 | | | | | 3 |
| Business Response Initiatives | | | | | | |
| Celebrity Involvement | | | | | | |
| Economy in Recovery | 5 | | | | | 5 |
| Economic vulnerability | | | | | | |
| Financial Incentives | | | | | | |
| Financial Planning & Preparation | | | | | | |
| Fundraising/Donations by New Zealanders | | | | | | |
| Future Insurance or Reinsurance | | 1 | | | | 1 |
| Government Assistance | | | 1 | | | 1 |
| GDP/Development Saves Lives | 1 | | | | | 1 |
| Impact on Economy | | | 11 | | | 11 |
| Insurance Claim No.s or Costs | | 1 | | | | 1 |
| Insurance Problems | | | | | | |
| International Aid | | | | | | |
| Leaders & Aid | | | | | | |
| NGOs and Aid | | | | | | |
| NZ Authorities Aid | | | | | | |
| *(Un)Employment* | | | | 2 | | 2 |
| *Background/Expectations* | | | 2 | 5 | | 7 |
| *Government Recovery Initiatives* | | | 1 | | | 1 |
| *Housing, homelessness or shelter* | | | | | 1 | 1 |
| *Lessons or Reflections* | | | 1 | | | 1 |
| *Other Social Effects* | | | 1 | | | 1 |
| *Rebuild: Plans & Visions* | | | 1 | | | 1 |
| *Recovery Progress* | | | 2 | | | 2 |
| *Researcher/Researching* | | | 1 | | | 1 |
| *Skills Shortage* | | | | 1 | | 1 |
| *Staying or Going* | | | 1 | | | 1 |

the debate about the effect of neoliberal economic policies on DRR outcomes; 'GDP saves lives' or whether such policies contribute to disasters by increasing vulnerability (Kellenberg & Mobarak, 2008). Any such discussion would have been an opportunity to highlight that increasing income sometimes leads to housing location choices that increase exposure to risk (for example with views on cliff-tops or in a potential tsunami inundation zone) (Kellenberg & Mobarak, 2008).

Another macro-economic aspect is that *"the public's trust and consumer and investor confidence are key ingredients of recovery; they need to be strengthened through credible communication and effective action"* (Lahidji, 2004)p15. Lack of information creates lack of confidence and distrust and lack of hope and confidence in the future increases psychological stress, which places an economic burden on governments. Zahran et al. (2001) also discussed links between social vulnerability, mental health resilience and economic cost consequences. These were not discussed in the New Zealand mass media.

### 6.6.8 Media attention to economic possibilities or cost:benefit in DRR was limited

There were very few comments made about individual and nation-wide economic readiness for a future event in the New Zealand media. Those media articles that did mention this topic were not articles raised by scientists or supplemented by their comments (e.g. FairfaxNZNews 2011a) about the need for individuals to have a 3-month post-disaster cash cushion and the financial risk to New Zealand with the EQC being out of cash in the event of another disaster. The one warning–economic environment story type (*Economic Vulnerability*) in the 1000-Stuff dataset (a) had no economics sources.

There was only one item on television and two articles in the ODT prior to the Darfield earthquake of the *Financial Planning/Preparation* story type (Table 6.13). While both print media and television covered *Business Recovery Initiatives*, other news took precedence to coverage of response-related initiatives. There was an emphasis on the effects (harms) to business, over DRR actions.

The value of economic development in terms of general well-being and in terms of DRR was debated in a few isolated articles (as was mentioned above). Meanwhile the concept that there might be economic disaster research science to support decision-making appears to have been lost. Relatively few articles framed the cost versus benefit of mitigation measures.

### 6.6.9 Aid was not treated as an economic topic in academic research or media

The impact of media coverage on foreign disaster aid is an area of research in media analyses (Potter & Van Belle, 2004, 2009; Rioux & Van Belle, 2005; Simon, 1997; Van Belle, 1999, 2000, 2003; Van Belle & Hook, 2000). There has been no similar research into the impact of media coverage on other aspects of economic of disasters, such as job losses, business choices. This study showed aid to earthquake victims was not a feature of either economics research, nor did it feature in the Stuff science articles. Perusal of Table 6.13 shows that aid was treated as a humanitarian or social, rather than economic science topic in the media. In earthquake-research it was also treated from a logistics (information decision and management sciences) perspective.

### 6.6.10 Business & Industry stories did not reflect research or contain scientist sources

There were many 'What's Being Done in Response' group story types including *Economic Response Initiatives, Business Response Initiatives* and *Government Assistance*. However these stories and other economics stories typically discussed financial aid, donation, fundraising, grants, assistance in terms of availability, rather than ways that would reassure all citizens that best-practice DRR was occurring. For example Interviewee I004 noted, *"people should perhaps know that research has been done on the fraud and misuse rate and it's less than unemployment benefit fraud – even without all usual checks and balances".* This was not reported in the media.

Corporate social responsibility is a significant proportion of academic research but is rarely highlighted in media articles. There were a number of media stories about the lack of compassion shown by some companies but many more about the generosity of businesses to victims.

While two thirds of global earthquake-related economic research was about businesses or industry, business and industry articles in the New Zealand media were only the third most prevalent of the economics story types (Table 5.51) - (accounting for 10% of the economics media coverage). Expert sources were even more uncommon. Not even Powell (2010) whose article on learnings from the effect of an earthquake event on urban business in the context of the 2007 Gisborne earthquake in New Zealand, featured as a source in these articles. Typically business and industry articles were about consequences rather than response and recovery strategies let alone business continuity management or other mitigation strategies.

One exception where research findings were presented was in Stuff article ‘Big shocks yet to be felt’ (Hartevelt, 2011a) where it was stated (in relation to the 1994 Northridge, USA earthquake) that *“across a sample of 1100 affected Los Angeles firms, University of Delaware researchers were surprised to find that businesses in financial trouble before the quake were significantly more likely to be better off afterwards”.*

### 6.6.11 This research suggests the relationship between media and tourism is complex

Overall Business & Industry articles were heavily weighted to tourism, either individual businesses or regional, whether full articles or brief mentions. Scholars have previously suggested that the media should be assisting in ‘destination marketing’ in recovery (e.g. Cioccio and Michael 2007, Chacko and Marcell 2008) . The suggestion has been that media portrayal of negative consequences of earthquake negatively affects tourism.

In this research there were tourism stories in the media in relation to the effects of international earthquake disasters (e.g. Sichuan and Tohoku) on New Zealand tourism. A considerable portion of the media articles after the Canterbury earthquakes related to tourism, and indeed economics overall, emphasized that Canterbury was again ‘open for business’ and in particular ‘open for tourism’.

Qualitative analysis in this research showed that media’s relationship with tourism is more nuanced than the simple negative effect referred to above. This research showed that after international disasters (both pre- and post the Canterbury earthquakes), media framing was for New Zealanders to stay away from the disaster areas unless assisting in the response so as not to use up precious resources or interfere with the aid effort, or to allow victims the space to recover. After the Canterbury earthquakes however there was a concerted effort in the New Zealand mass media to promote tourism to Canterbury. Perhaps the most obvious of these was in the women’s magazine Next with the title “10 Great reasons to visit Christchurch” (Santamaria, 2010). This does not identify whether news media outside New Zealand also promoted Canterbury this way. Note also that coverage relating to the Rugby World Cup, which emphasised the risk of on-going aftershocks and announced that matches in Christchurch would be transferred to other localities, would have complicated the media-tourism effects relationship also.

### 6.6.12 More research about earthquake-related economics topics is needed to support media coverage

This research showed that research attention to economics topics has been limited. The range of economics topics in the New Zealand media was quite narrow and there were few economics sources, although over 20% of media attention had economics-related headline story types.

In particular articles with discussion of the economic cost benefit of DRR options were rare (this is further discussed in section 7.7.9).

The discussion and examples in the preceding subsections show that care should be taken not to perpetuate claims about the media that are not supported by data. Such suggestions that apply to all sciences as well as to economics will become one of the general recommendations at the end of this chapter.

This leads to the following recommendation:

**Recommendation 11 (economics):** Scientists and Media - More research about economics topics (for example about macro-economics and insurance, and DRR possibilities) needs to be communicated to provide the evidence base to match volumes of media coverage of economics topics.

-blank-

## 6.7 Environmental science and environmental scientists

*Dr Kennedy Graham stated "Christchurch can be a model of a green city that delivers prosperity and protects the environment. We also need to future-proof our city and build resilience to earthquakes, rising oil prices and environmental hazards".*

"Recovery plan in nine months" (van Beynen, Stylianou, & Mathewson, 2011)

### 6.7.1 Environmental topics were not a feature of either research or media articles

Mileti (1999) wrote that to mitigate hazard in a sustainable way the first of six equally necessary objectives is to ensure that environmental quality should be maintained and enhanced. Human activities to mitigate hazards should not reduce the carrying capacity of the ecosystem, for doing so increases losses from hazards in the longer term (Mileti, 1999). It is therefore of concern that environmental topics feature so little in both research and media articles analysed in this research.

This research has shown that academic research articles with a focus on environmental science account for 87, or just fewer than 2% of the 4376 research articles in the 20-earthquake-research-dataset (Table 6.14). How this compares with media coverage of other disasters is unknown, as mass media content has rarely been studied in relation to its portrayal of environmental matters and DRR topics. One exception is Ashlin and Ladle (2007) study of correlations between media content and environmental policy.

**Table 6.14: Environmental science subtopics**

Proportions of research articles in each of the environmental science subtopics (left-hand column) in the 20-earthquake-research-dataset (middle column) and media articles in the 1000-Stuff post-Darfield datatset with headlines suggestive of each of the environmental science subtopics (right hand column). For a description of the subdiciplines in research see Appendix 8.1. Attention on infrastructure from an environmental rather than building science perspective had not been identified as a subtopic when analysing research articles.

| | % Research (n=87/4376) | % Media (n=55/1000) |
|---|---|---|
| **Environmental sciences subtopics** | 2 | 5.5 |
| Air | 0.0 | 18.2 |
| Ecology/Ecosystem/Habitat | 56.3 | 30.9 |
| Flora/vegetation/forest | 13.8 | 0.0 |
| Land | 0.0 | 56.3 |
| Marine/Coastal | 4.6 | 16.6 |
| Non-structural aspects of infrastructure (incl. nuclear) | - | 14.5 |
| River/stream/aquatic/groundwater | 17.2 | 10.9 |
| Zoology-Faunal | 8.0 | 3.6 |

The 87 research articles had a strong focus on wildlife, habitats, denudation, particularly in relation to landslides in Sichuan and Pakistan, and more specifically giant panda habitat in China. It is notable however that the research article titles in relation to panda habitat focus on the damage (using words such as effects, impacts, degradation, harm and loss), rather than recovery and restoration. What research there is on environmental and ecological restoration derives in the main from China. There was little in the 20-earthquake-dataset on ecosystem impacts in relation to the earthquakes in other countries. Coastal impacts associated with tsunami in Peru, Chile and Samoa, are exceptions (e.g. Lomovasky et al, 2011, Castilla, Manriquez, and Camano 2010, Witt, Young and Yin 2011). No research publications related to hazardous substance releases on land in disaster such as L. J. Steinberg and Cruz (2004) were identified in the 20-earthquake-research-dataset. Contreras (2010) did however write of 'what to do with waste', and Tanabe and Subramanian (2010) of possible marine environmental contamination by toxic pollutants in relation to the Sendai earthquake.

Given the dearth of research attention to environmental aspects of earthquakes the relative absence of media attention to this topic is unsurprising. There were no articles in the New Zealand media on environmental topics prior to the Canterbury earthquakes. Afterward there were three story groups that were part of the 'What's Happened/Being Done in Response' story category. The story types were the two story types of the 'Environment in Response' group Assisting *Animals* and *Other Environmental Effects* (an example of the latter was a story about drifting debris on beaches by Sachdeva, 2011b), and from the 'Health in Response' group *Environment and Public Health* (e.g. a story about E. coli counts in Christchurch city rivers by D. Williams, 2011a). The latter articles typically contained a health scientist local or regional council scientist source. Articles at the intersection of the environment and public health that were treated primarily as a public health rather than ecological issue are discussed in section 6.9.4. Examples are articles about sewage in the Christchurch estuary, or radiation from the Fukushima nuclear plant damaged in the Sendai earthquake such as "New Zealand safe from Japanese radiation" (Chug, 2011c).

*About or Assisting Animals* stories typically contained veterinarians or zoologically trained sources. These 'expert scientists' were portrayed in a volunteer/mutual aid role. An exception was a story about the use of homeopathy to calm dogs in recovery "Dog gets a sniff of remedy" (Rudd, 2012).

### 6.7.2 There were three environmental science story types in recovery

There were three environmental science-related story types in recovery. Two were at the intersection with the built environment and therefore of the 'Issues and Adaptations Built +' group; *Recycling Earthquake Waste (or not)* (e.g. "Rubble disposal 'nothing to do with council'" by Gorman & Heather, 2011) and *Rebuild Plans & Vision* (e.g. "Plan to build a 'city in a garden'"Sachdeva & Mathewson, 2011). The third story type about the environment in recovery was *Environmental Rehabilitation* the only story type in the similarly named 'Environment in Recovery' group (examples are "Quake planting plan takes hold" (Sachdeva, 2010) and an article in the ODT about the Waimarakiri Council using Environment Task Force Green subsidy funding to clean up the beach for social summer use "ETG funding for Canterbury" (NZPA, 2010o)).

From late 2011 more stories began to emerge noting long term environmental losses or gains. Examples are "Christchurch earthquake silt chokes rivers" about tonnes of earthquake-related silt killing native wildlife (Gorman, 2011n) and another "Birdlife flocks to estuary despite liquefaction fears" (D. Williams, 2011c-a) that described how the New Zealand scaup, a native 'diving duck' had doubled its population in the estuary).

There were no environmental science sources in any of the *Rebuild Plans & Vision* stories.

### 6.7.3 Few articles included an environmental science source

Ironically it was a very different headline story type *(Government Assistance)* that contained one of the few mentions of environmental concerns, albeit not solutions beyond who to call to assist in response.

> *Environment Canterbury pollution prevention manager Don Chittock said people going in to business premises this morning were discovering spills of hazardous substances. About half a dozen spills had been dealt with already. The major concern was hazardous substances leaking into groundwater supplies or into stormwater systems. "Contain it on site, if you can," he said. Significant spills should be reported to the Fire Service and smaller discharges to ECan's pollution hotline.*
>
> (Fairfax NZ News, 2010b)

This was also one of the few articles that included an environmental science source. There were few environmental science sources even in expected story types (Table 6.15).

Articles of the response media story type *Infrastructure and Public Health* typically had a local or regional Council scientist source such as Mark Christison of the Christchurch City Council. Mr Christison was one of the most mentioned scientist sources in (Table 5.33).

While Mr Christison's institutional title was provided, his science qualifications were not given. Christison provided pragmatic understanding of infrastructural issues and implications. For example he quite simply stated:

> *You've not only got the issue of the broken and damaged pipes, but if the [slope] of the pipes goes in the opposite direction to where you want the flow to go that causes problems as well.*
>
> Mark Christison 'Costly hi-tech systems vital to sewer rebuild' (M. Wright, 2011e)

The lack of research and media interest in environmental topics was mirrored in survey results. The only reference to environmental science or scientists by a survey respondent was by F022 who mentioned that people should be told about how pollution can be minimized. The above clearly supports the assertions of H. Chen, Wu, Yuan, Gao, and Zhu (2009) that recovery attention is focused on rebuilding cities and infrastructure and not ecological restoration. It would likely require a joint effort by the media and environmental scientists to change this.

**Table 6.15: Environmental science sources in earthquake-related mass media**

The media headline story types that have potential to contain Environmental scientists/expert sources are shown in the left hand column *(unless italicised in which case it is not considered obvious that these story types would contain this type of source).* The right hand columns show the total number of sources per story type in the 1000-Stuff dataset (note that this is all, not unique sources for that story type). The right-hand columns are spilt into the sub-disciplines – Zool = zoology, Env Eng = environmental engineering, coastal, hydrogeology, Biol = biological science, Gen = general. Note that these are numbers of sources. bm = brief mention

| Media Headline Story Types | Zool | Env Eng | Coastal | Hydro-geology | Biol | Gen | Total |
|---|---|---|---|---|---|---|---|
| About or Assisting Animals | 2 | | | | | | 2 |
| Background/Expectations | | 1 | | | | | 1 |
| Environment & Public Health | | 5+1bm | 3 | 1 | | 2 | 14 |
| Other Environmental Effects | | 1 | 1 | 1 | 1 | 1 | 7 |
| Environmental Rehabilitation | | | | | | | |
| Recycling Earthquake Waste or not | | | | | | | |
| Sustainability | | | | | | | |
| *Felt Occurrence* | | | | | | 1 | 1 |
| *Infrastructure & Public Health* | | 2 | +1bm | | | 5 | 8 |
| *Infrastructure Damage/Restoration* | | 1 | | | | | 1 |
| *Other Financial Effects* | | | | | | 1 | 1 |
| *Recovery Legislation* | | 1 | | | | | 1 |
| *Return to normal/Resilience* | | | | | | | |
| *Reviewing Land Use* | | | | | | 1 | 1 |

### 6.7.4 Research and media coverage about animals or the rural environment were both rare

*About or Assisting Animals* stories were typically about either animal survival or humans assisting them e.g. “After hours vets had to carry on” (Lynch, 2011a) which told of police rescue dog injuries and gastroenteritis. Both of these story sub-types analysed in this research are typically about animals that have significance to humans as pets, or zoo animals. There were only two stories analysed in this study that dealt in detail with the effects on farmed animals. Both were about chickens laying. One article in The Press announced that chickens were again laying 5 days after the Darfield earthquake. The other article emphasised that chickens were not laying after the 1910 Manawatu earthquake. However few are likely to have read this article coming as it did in an ODT *This Day in History* story under the headline “Improvement in sight for St Clair” (Unattributed, 2010a). The ODT also carried a brief mention of an injury to a racehorse on the day of the February 22 event, but it was not clear whether the earthquake caused the injury. Although ODT article “WSPA responds to natural disasters” (Unattributed, 2010b) discussed assistance for animals afforded by the World Society for the Protection of Animals (WSPA) in relation to the 2009 Samoa-Tonga and Indonesian earthquakes there was no information about what is done for animals or their injuries etc. This is a story topic area or type rarely discussed in either academic DRR or media disaster/risk literature, nor was there any comment made on this story type by survey or interviewees in this research. This lack of coverage of information pertaining to agricultural topics in disaster extends into horticulture and beyond into rural effects and recovery in general.

### 6.7.5 Media comment about conservation, biodiversity or sustainability was rare

*Rebuild Plans & Vision* stories sometimes emphasized green spaces, and sustainability (see quote at the beginning of section 6.7.1). However the term ‘sustainability’ did not feature in media headlines or body text, given that sustainability is a DRR goal, sustainability’s general popularity in the public sphere and that (as is noted in section 6.12.1 in the discussion on urban design and planning science) sustainability in recovery is a prevalent framing in planning science research. A rare exception is in a quote about sustainable building design (see section 6.3.4). Research and media coverage of conservation and biodiversity were rare.

*Other Environmental Effects* stories (part of the ‘Event & Effects group) headlined little damage to the conservation estate (e.g. “Damage to conservation estate light” D. Williams, 2010a) however on reading the article it was found to discuss damage to structures on conservation land rather than environmental damage).

This and the observations in the previous subsections leads to:

**Recommendation 12 (environmental science):** Scientists and Media - More research and media coverage into all environmental aspects of DRR are required if sustainability goals in DRR are to be achieved.

## 6.8 Geotechnology and geotechnical scientists/engineers

*When a big financial shock occurs and a company hits the rocks, the analysts pore over the balance sheet and give their views on whether it can be saved. ... In the case of our quake-damaged housing stock, those analysts have simply morphed into geotechnical engineers who are wading through liquefaction and poring over the small volcano-like mounds in backyards.*

Janine Stark, business reporter ‘Tremors in Equity’ (Starks, 2010)

### 6.8.1 Communication of geotechnical subject matter or by geotechnical engineers/experts has rarely been studied.

While communication of earth science has been repeatedly studied, communication of geotechnical expertise or by geotechnical experts has not. None of the natural hazard media content analyses reviewed as part of this research related solely to communication of geotechnical subject matter or communication by geotechnical engineers/experts.

### 6.8.2 Most geotechnical research and media attention was on the observation of effects

Analysis of the 20-earthquake research dataset showed contemporary geotechnical research to mostly relate to either studies of a) peak ground acceleration and ground movement and associated flooding (with or without descriptions of land damage or site effects and discussion of site selection), or b) slope failures (debris flows, rock falls, land-slides and associated ‘quake lakes’ and flooding caused by landslide dam failures and their assessment, and related warning and mitigation (Table 6.16). Only 4% of studies related to geo-observation (the observatories, remote sensing processes and geospatial information and data process and their application to hazard and loss assessment) and their application to emergency management, monitoring earthquake early warning, DRR or recovery. Fifteen per cent of research related to some combination of the other geotechnology topics (Table 6.16).

In the 1000-Stuff dataset the geotechnical topics discussed were primarily ground motion, liquefaction and land damage and to a lesser extent, remediation. The number of mass media articles that mentioned remediation was if anything a greater proportion than the research articles published on the topic of remediation. In both the media and in research articles much of the emphasis was on observation of effects.

Of the ‘geotechnical’ academic articles in the 20-earthquake dataset related to technologies and systems the focus was on remote sensing and its application to disaster response. There were far more references to research observation technologies than early warning technologies, and even fewer relating to technologies for remediation in recovery or mitigation before an event. It would be interesting from a science in society perspective to explore whether that has been driven by the revenue-generating potential of the technology. Note that Harwell (2000) has also observed that scientists promote the use of remote sensing to measure the 'problem' in disaster.

**Table 6.16: Geotechnical subtopics in the research titles and media articles**
Proportions of research articles in each of the geotechnical subtopics (left-hand column) in the 20-earthquake-research-dataset (middle column) and media articles in the 1000-Stuff post-Darfield datatset with headlines suggestive of each of the geotechnical subtopics (right hand column). (Informatics applied to earth science or built environment is included here otherwise was coded as information science). For a description of the subdiciplines in research see Appendix 8.1.

| | **% Research (n=678/4376)** | **% Media (n=81/1000)** |
|---|---|---|
| **Geotechnical Subtopics** | 15.5 | 8 |
| Geo-spatial information geo-observation & DRR | 4 | 5 |
| Motion/damage, site effects/remediation | 35.1 | 66.7 |
| Slopes and/or associated flooding | 45.4 | 28.3 |
| Multiple geotechnical subtopics | 15.5 | n/a |

There was a similar proportion of attention to geo-observation technologies or geospatial information systems in the New Zealand mass media to the global research attention (Table 5.55). This was either for the utility of geo-observation technologies or geospatial information systems in emergency management or early warning e.g. "Satellite shows Christchurch earthquake's ripples in earth" (Fairfax NZ News, 2011b). However the number of media articles that this 4% represents suggests that it would be quite possible for citizens never to have seen a technology story.

The differences between earthquake research and media attention in Table 6.16 can be accounted for as follows. Research was weighted more toward slope failure due to the prevalence of this secondary hazard occurrence in the Sichuan earthquake and the proliferation of Chinese researchers who studied slope failure as a consequence. In New Zealand research about the Canterbury earthquakes, and media alike there was more research attention to ground motion and liquefaction. Media articles tend to focus on one rather than multiple topics.

### 6.8.3 Geotechnical topics in the media were the subject of debate

Geotechnical topics in the New Zealand mass media following the Darfield earthquake were liquefaction, lateral spreading, land damage, land remediation and land use. A second strand of geotechnical debate in the media was taken up after the Port Hills earthquake due to slope collapse and rock-fall risk as large boulders on the Hills had been de-stabilised. Some homeowners on the Port Hills considered they should be able to decide whether to stay in their homes or evacuate e.g. "Port Hills residents' deputation over rockfall issues" (Gorman, 2011l).

**Table 6.17: Geotechnical sources in earthquake-related media story types**

The media headline story types that have potential to contain these scientists/expert sources are shown in the left hand column *(unless italicised in which case it is not considered obvious that these story types might contain this type of source).* In the middle and right hand columns are the number of geotechnical sources mentioned in the media (1000 Stuff dataset) who were involved with ground and slope effects, or earth observation technologies respectively. bm= brief mention.

| Media Headline Story Types | Number of Geotechnical Sources: Earth science/ Engineering | Earth observation technology | Total |
|---|---|---|---|
| Associated Natural Phenomena | 2 | | 2 |
| Code, Standards & Policies | 3 | | 3 |
| Land Decisions | 4+15bm | | 19* |
| Infrastructure Damage & Restoration | +1bm | | 1 |
| Infrastructure & Public Health | | | |
| Infrastructure Upgrade | | | |
| Making the Natural Environment Safer | 5+1bm | | 6 |
| Monitoring or Warning Systems | | | |
| Rebuild: Plans & Visions | 1bm | | 1 |
| Rebuild Logistics/Progressing | 3bm | | 3 |
| Safety Assessments/Soil Reports | | | |
| Technology | | | |
| *(In)action* | 1bm | | 1 |
| *Aftershock(s)* | 1bm | | 1 |
| *Awards Commendations, Thanks* | | 1 | 1 |
| *Building Assessment & Decisions* | 3+1bm | | 4 |
| *Construction Methods or Materials* | 1 | | 1 |
| *Damage/Devastation* | 2 | | 2 |
| *Disruption* | 1bm | | 1 |
| *Environment & Public Health* | 1bm | | 1 |
| *Future Insurance or Reinsurance* | 1+1bm | | 2 |
| *Impact on Economy* | 1bm | | 1 |
| *Political in Recovery* | 1bm | | 1 |
| *Recording for Posterity* | 1bm | | 1 |
| *Researcher/Researching* | 1 | | 1 |
| *Reviewing Communication: Info Release* | 1bm | | 2 |
| *Recovery Legislation* | 1 | | 1 |
| *Secondary Land Threats* | 1 | 1 | 2 |
| *Stressed, Scared, Struggling* | 1 | | 1 |

Notable aspects of what was communicated about science and liquefaction, lateral spreading, land damage, land remediation and land use stories are:

- what was reported immediately after the Darfield, Boxing Day, Port Hills and 13 June 2011 events was typically citizen experience of liquefaction, data was limited to volumes of silt generated, even depth was rarely provided
- excellent info-graphics were produced to explain what had been an unknown phenomenon (cf. section 4.2.6)
- lateral spreading cracks were not explained as distinct from surface rupture; citizens therefore described cracks as 'faults' and might therefore not recognize the potential for mitigating the former
- there was little to no contextualization with historical liquefaction events in New Zealand or globally
- primary sources were not geotechnical experts, but the Recovery Minister and Mayor of Christchurch
- geotechnical experts were not typically part of regular multiple agency media briefings after the Canterbury earthquakes
- the Minister and Mayor emphasized that decision-making was being well-informed by science, however the parameters being applied to the analysis and the decisions were not disclosed in the media
- both the above 'non-expert' sources emphasized that 'science takes time' as deadlines for reports relating to land remediation possibilities and land use decisions were pushed back
- the reasons given for 'red zoning' land (not allowing owners to rebuild on certain land) were variously a) the degree of damage and land instability b) to the time it would take to remediate land
- the time given for remediation changed from 2-4 years (TV1, 2011-03-08) to 7-20 years (TV1, 2011-06-23b) there were no academic geotechnical expert sources represented on television
- expert sources were represented in the field, and as working hard gathering data and preparing reports
- there were no examples given of successful remediation measures elsewhere; and
- there was no discussion of the relative cost of various land remediation or structural engineering solutions.

### 6.8.4 Citizens wanted to understand the geotechnical basis for decision-making

> *So from our perspective the science is clear. Those who want to pick through and second-guess the data which informed our decisions are welcome to do so when we've completed zoning all the land in the greater Christchurch region. In the meantime you can find all the major scientific data which informed the Government's decisions on the CERA website here."*
>
> Minister Brownlee in "Gerry Brownlee Defends Red Zone Decisions" (Fairfax NZ News, 2011l)

Some citizens made references to wanting to understand decision-making that related to geotechnical issues such as implications on planning and building codes, because of potential for soil liquefaction, rock-fall or slope movements. Otherwise, geotechnical topics were not ones that citizens voluntarily expressed an interest in having communicated in the mass media. Whether this was a self-perpetuating situation, because there were in fact few simple explanations of geotechnical matters in the mass media, and citizens expect to be mystified by, rather than understand the science, is something that would be useful to explore further in future.

There was not much evidence of *"the geotechnical engineers will tell us what is possible, and the Government will tell us what we can afford"* as Christchurch East MP Lianne Dalziel was quoted as suggesting would occur in "Can we fix it?" (McCrone, 2011).

Geotechnical expertise was implied rather than being overt in the media headline story types and the headlines in both print media or television e.g. "Liquefaction data can't be ignored" (Heather, 2011k), "$100000 for liquefaction study" (D. Williams, 2010b), or "Liquefaction across Christchurch" (TV1, 2011-02-23c). Most of the geotechnical scientist/expert sources identified as having been present in the New Zealand media were in articles or items relating to a) data-gathering in relation to research or assessments relating to liquefaction in the response period(s) of the five earthquake events that caused liquefaction, or b) reporting of the proceedings of the Royal Commission of Inquiry held late in 2011. However as Table 6.17 shows most mention of geotechnical sources were only brief mentions of geotechnical engineers rather than paraphrasing, let alone quoting geotechnical engineers. Often this comment or reference to geotechnical engineering came from either the Earthquake Recovery Minister Gerry Brownlee or the Mayor Bob Parker.

While the quote at the beginning of this subsection shows the government transparently providing raw data to which a link is provided, this data would be of negligible use to any non-experts who wished to understand the decisions, whether those non-experts were residents or local decision-makers. Nor were the terms of reference of the geotechnical assessments ever explained in the media.

The above leads to the following recommendation:

**Recommendation 13 (geotechnical experts):** All - More geotechnology sources are required to explain the evidence basis for the many decisions made by authorities based in their science.

### 6.8.5 Geotechnical experts were portrayed as working very hard

In the print media geotechnical experts from a range of universities, local Councils, a crown research institute, a government agency, a separate government department and a private company, were however portrayed as working collaboratively, and tirelessly, to provide the scientific basis for land decisions. For example, "*New Zealand only has so many geo-tech engineers to call upon to do this work"* in "Rebuild new PM's biggest challenge – Election 2011" (Hartevelt, 2011c), and

> *These challenges are being addressed day and night by probably the largest team of geotechnical engineers and scientists ever to work on a single project in this country. Over a dozen agencies are working together, including GNS Science, Land Information New Zealand, the University of Canterbury, EQC, private insurers, geotechnical engineers Tonkin & Taylor, the Department of Building and Housing, and the engineering and infrastructure teams of the region's three councils Christchurch City and the Selwyn and Waimakariri district councils.*
>
> "Some areas 'simply not feasible to rebuild'" (Heather, 2011e)

## 6.9 Health sciences, health scientists and earthquake-related DRR

*To the public health professional, news is about the absence of conflict. Loss of life is minimized and injured survivors receive prompt and appropriate treatment. Additional trauma is prevented through timely dissemination of information that could save lives. The community recovers from the disaster and learns something about preventing similar occurrences in the future.*

Anzur (2000)

### 6.9.1 Health scientists' messaging showed evidence of being 'top-down'

In contrast to much contemporary thinking in relation to science- and risk communication (discussed in Chapters 2 and 4), public health literature relating to DRR-communication, and health scientists respondents in this research, have emphasised the importance of persuasiveness. Examples are the media analyses conducted by health scientists (see Appendix 4 and bibliography for details) or Keselman et al. (2005, p. 332).

Analysis of New Zealand media articles in this research reflected a top-down approach when media public health sources framed warnings and advice about disasters and disease risks. The body text of public health articles did not provide an evidence basis for the advice. In interview Dr Alistair Humphrey (I008 - Chief Medical Officer of Health for Canterbury at the time of the earthquakes and involved at an international level in DRR) was insistent that citizens would not want this level of detail; they simply wanted the advice.

Two examples discussed in interview were the basic advice about what to do to avoid injury during an earthquake (see also discussion in section 7.6.7) and the boiling of water afterward whilst there is a risk of contamination (section 6.9.8). This advice is presumably underpinned by science, but the evidence basis was not communicated even in its simplest form in the mass media. Dr Michael Ardagh (I007) observed that there was no research that could be quoted relating to the former, but that this would be relatively easy to collect.

### 6.9.2 Health-related research articles did not combine 'lessons learnt' from multiple disaster events and are not well aligned to citizen needs

Twenty per cent of the 4376 published earthquake-related research articles were from a health science perspective (Figure 6.2). Over 50% of that research was about emergency medical treatment (Table 6.18). Much of that academic research literature though, rather than being research-derived, provided personal reflections about providing medial aid at single events such as Haiti, or Sichuan or observations of, 'lessons identified' or 'lessons learnt' by emergency medical teams (similar to Ardagh et al. (2011), an article published relating to the Port Hills earthquake that was not part of the dataset). There was however only one article that brought together observations from multiple earthquakes that might be used by health science sources to explain collective knowledge directly in the media, or to media for use in articles. That article was a review of earthquake-related literature published in medical journals (Youping Li et al., 2009).

Health science correlations between researcher interest and media coverage were variable (Table 6.18). 'Other Public Health', 'Health Communication' and 'Health Technology' sub-disciplines showed similar research interest and media coverage. One of the notable disparities between the health-related earthquake research and media attention to the topic was the proportion of forensic science. Advances in forensic science research and particularly research about disaster victim identification relating to earthquakes were either not being published or were not being published on Web of Science or Scopus.

Conversely while there were many academic papers in the 20-earthquake-research-dataset about emergency medicine and medical aid these did not translate into articles in the New Zealand media with health scientist sources. This is possibly because the above-mentioned research papers documented the experience and practices of health practitioners from other countries rather than New Zealanders. Another reason is likely a result of there being very little published research that explored health-science understandings or lessons that citizens need; ones that might readily translate into simple decision-making in relation to their own actions (e.g. the relationship between actions in response, injuries experience and/or injury

**Table 6.18: Health science sub-disciplines in research and media articles**

Proportions of research articles in each of the health science sub-disciplines (left-hand column) in the 20-earthquake-research-dataset (middle column) and media articles in the 1000-Stuff post-Darfield datatset with headlines suggestive of each of the health science sub-disciplines (right hand column). For a description of the subdiciplines in research see Appendix 8.1.

| | **% of research articles (n = 857/4367)** | **% of media articles (n=117/1000)** |
|---|---|---|
| **Health science sub-disciplines** | 19.6 | 11.7 |
| Emergency Medicine | 50.8 | 15.3 |
| Other Public Health | 25.2 | 23.9 |
| Psychosocial | 22.1 | 33.3 |
| Forensic Science | 0 | 26.4 |
| Technology-Health | 1.4 | 0.9 |
| Communication-Health | 0.6 | n/a |

reduction, health implications of hazardous substance release, or the implications of a decision to remain in homes that have flooded with contaminated water long into recovery).

### 6.9.3 There were few previous media studies of health science and DRR

Of the 164 published studies of natural-hazard-related DRR media content only 9, or 5.5% were from a health science perspective or made observations or recommendations in relation to the media communication of health science topics. Of the health-related studies most took some form of public health perspective. For example Barnes et al. (2008); Cox et al. (2008); De Ville de Goyet (1999, 2004); Greenberg, Sachsman, Sandman, and Salmone (1989b); Gribble (2012); Lobb et al. (2012) considered quite different aspects of humanitarian aid and impact on public health. McCartney (2011) and Cotter (2011) considered coverage of and available knowledge in relation to Tohoku-earthquake-related nuclear issues. Houston et al (2012) looked at frame changes in relation to a variety of topics including health.

Literature about the communication of health science in relation to DRR was typically either personal reflections about communication of public health (e.g. Kizer 2000) or made behavioural recommendations for public health professional engagement with media before, during and after disaster (Anzur, 2000; Ball-Rokeach & Loges, 2000). These focussed on response-related health science communication and to a lesser degree readiness. Others who focused on response include Yang et al (2010) and Sakamoto et al (2011). Vasterman et al. (2005) looked for empirical studies of media influence on health outcomes and found none in relation to natural disasters. However, other than the calls to avoid disaster myths (e.g. Ball-Rokeach and Loges 2000 and Anzur 2000) there were few articles discussing portrayal of health science, and the health science content it might be useful to communicate. Some exceptions are Barakat and Ward (1995), Kodrich and Laituri (2005) and articles by Spence and other researchers (e.g. Spence, Lachlan, & Burke, 2008).

It would appear that no one has published findings about media coverage at the intersection of environment and public health, or coverage of forensic science or health technology advances in relation to DRR. Nor were these topics prevalent in either the research or the media articles analysed in this research. Some of the clearest explanations given in the media were by forensic scientists (e.g. by odontologist Viv Levy on television, and Hugh Trengrove, national forensic dentistry adviser to the police in “Identification process much harder at home” (Newton, 2011a).

### 6.9.4 Media coverage at the intersection of public health and the environment focussed on immediate disease risks; there was no discussion of possible long-term public health issues

Detail of the portrayal of health science in the media was shown in Figure 6.1.

There was much emphasis including in multiple media briefings on the possibility of contracting gastroenteritis through contaminated water, and ways of avoiding this. There was also some coverage of the possibility of the dust caused by liquefaction irritating people with chronic illnesses such as asthma (e.g. “Silt harbours unknown dangers” Chug, 2011a).

Articles at the intersection of environmental health and disease in the New Zealand media articles analysed were primarily from a humanitarian disaster perspective or related to public health warnings in response (related to the Canterbury earthquakes). There was also some discussion relating to the Sendai earthquake (already discussed in section 5.6.8). Other science story type ‘triggers’ of environment and public health stories were citizen views or opinions about health risks, authorities’ announcements, scientist’s warnings or observations in early recovery about consequences. Warning about disease risks accounted for much of the 24% of articles of the *Other Public Health* story type.

As introduced in Chapter 4 there is no evidence basis for many of the public health topic concerns raised around dead bodies and disease (De Ville de Goyet, 2004). Public health myths were not perpetuated in the New Zealand mass media after the Canterbury earthquakes (section 7.6.7).

The topics of potential asbestosis, and damp and mould growing under houses that had suffered flooding as a result of liquefaction or other earthquake-related land subsidence, were topics that became important to the Canterbury public one to three years after the earthquakes (and were occasionally reported on Stuff in that period). However, these topics were neither covered in the 20-earthquake-research-dataset nor in the New Zealand media in the period analysed. With the exception of one television item screened in 2013 that showed the mouldy state of homes, citizens outside the disaster area would only have gained a reiterated experience of some of the injuries that result from earthquakes and immediate health consequences, not of longer-term consequences or of ways of avoiding those injuries or other health consequences.

### 6.9.5 Coverage of emergency medicine did not include comments on injury prevention

Emergency medicine only accounted for 15% of all health science topics in the mass media compared with over 50% in research. The research topics were as described in Appendix 8.1, focussed on treatment of injuries, rather than prevention of injuries.

There was a string of articles that recorded an increase in heart attacks after the Canterbury earthquakes. For example *"It's undoubtedly due to the quake. It's well documented that natural disasters do this. It's not people panicking, just the sudden surge of adrenaline."*, in "Quake – surge in heart attacks" (Fairfax NZ News, 2010e).

As noted in an earlier section Dr Michael Ardagh (I007) observed that there was no research that could be quoted relating where survivors were in relation to injuries. No articles headlined that injuries might be sustained in rescue and clean-up and no research was identified that discussed this either.

### 6.9.6 The New Zealand mass media focused on psychological response

Chambers and Henderson (2011) described the New Zealand Southern Medical Health Service's public awareness regarding psychological and behavioural response and disease risks. These were two areas that were covered in some depth by the New Zealand mass media. There was however no research literature identified in the 4376 research articles, regarding the value of different types of prevention or summarizing mental-health related lessons identified or learnt from multiple disaster events that psychologist sources could have used when commenting in the media.

It took some time for the message to come through in the media that, as the title suggests "Mental Health Earthquake Recovery Can Take Time" (Godoy, 2011). Renzulli, Mebane, and Sieff (2006) provided subjective comment about news coverage of mental health in relation to the Canterbury earthquakes. There is further discussion of aspects of the coverage of mental health in section 6.9.6, 6.9.7 and 7.5.8).

### 6.9.7 Media representation of treatment for psychological effects did not draw on previous research

There was an emphasis in both academic research and media communication on individual mental well-being, the prevalence of post-traumatic disorder symptoms in people affected by natural disaster and that recovery takes a long time. Other researchers have identified this as a significant change from mid-20th century to contemporary portrayal of the human response to disaster (Dunal et al. 1985, Dunrodié 2003). These authors focussed on ‘less individualized, more socially-oriented matters’ including physical injury (rather than post traumatic stress disorders) and collective recovery and resilience.

A panel of experts have summarised previous studies (Hobfoll et al. 2007) into the psychosocial effects of disasters, and grouped possible interventions into those that promote a) a sense of safety, b) calming, c) a sense of collective efficacy, d) connectedness and e) hope. The many articles in a special issue on Psychology and Disasters (volume 40 of the New Zealand Journal of Psychology) provide further insights and reflections on treatment. A summary of studies into the psychosocial effects of disasters and an evidence-based framework on psychosocial recovery is provided in Mooney et al. (2011). Black and McLean (2011) consider that the emphasis should have been that differences in individual journeys from disaster to psychosocial recovery are expectable, and daily improvements should be recognised and celebrated (this becomes part of recommendation 15 below, and is also discussed in section 7.5.8).

All of these aspects were mentioned in New Zealand mass media articles. The fact that the recommendations made drew on knowledge and studies from multiple earthquakes was not. This was most likely because a) coping advice was often not given by health science sources. (For example the advice to look after each other was given by Mayor Bob Parker and Canterbury Medical Officer of Health in *Latest Update* and *Health in Response* story types.), and b) when it was those sources typically give ‘top-down’ advice.

This gives rise to recommendation 15 at the end of this section.

### 6.9.8 There was confusion about advice relating to boiling water

A health-related advice topic that one of the interviewees (I014) raised as an example of what might have been better communicated was the confusion related to advice regarding the need to boil water for 5 minutes, or not. Initially Cantabrians were told to boil water for five minutes (including by World Vision director of international policy and procedure Seth Le Leu in the article by V. Robinson (2011) ‘Cantabrians urged to keep up hygiene’). Advice a few days later (on 28 February 2011) from authorities was that there was only a need to *“bring water to the boil once, allowed to settle, and then brought to the boil again”* – see “Christchurch quake: essential information” (The Press, 2011). This was more practical in terms of saving gas and other portable forms of heating but did not fit with what some Cantabrians felt they knew about the public health knowledge regarding water quality. The Canterbury Medical Officer of Health (I028) acknowledged in interview that there had been confusion caused by the change in advice. He did not consider however that there needed to be any explanation as to the scientific basis for the advice.

### 6.9.9 Compared to other sciences there were many health science sources in health science-related media articles, however there were many articles without sources

Barnes et al. (2008) considered that public health roles were not well represented in the media; only 6% discussed disease, injury prevention or public health response. The proportion of public health sources in the New Zealand articles analysed was 18.3% and 21.3 % respectively for online print media and television (Table 6.19). When considering the range of topics and sciences that might potentially be covered by the media, this proportion is not considered insufficient (recall that with 10 discipline groups a balance of disciplines would be achieved with coverage of 10%). The most prevalent media stories in relation to clinical psychiatry and psychology *Stressed, Scared, Struggling* and *Ways to Feel Better* for emergency medicine were *Emergency Medical Treatment*, and for public health was *Environment & Public Health*. These story types also contained the most scientist sources (Table 6.20).

**Table 6.19: Health science source proportions in the media**
Health science sources in the media (in 1000-Stuff dataset and on television) overall, and within health science disciplinary group. The table shows that proportions are generally similar in both media although forensic scientists were used more as sources on television than in the 1000-stuff articles analysed.

| | % of individual sources overall | | % of individual sources this disciplinary group | |
|---|---|---|---|---|
| | 1000-Stuff | TV1 | 1000-Stuff | TV1 |
| **Health science sub-group** | 18.3 | 21.3 | | |
| Emergency Medicine | 5.6 | 6.7 | 30.8 | 31.4 |
| Forensic | 1.6 | 3.8 | 8.7 | 17.6 |
| Other Public Health | 6.7 | 5.9 | 36.5 | 27.5 |
| Psychosocial | 4.4 | 5.0 | 24.0 | 23.5 |

As noted in a previous section, Canterbury Chief Medical Officers were the ‘media czars’ of health-related media after the Canterbury earthquakes. Health scientists accounted for approximately 20% of the scientist sources in earthquake-related New Zealand media (Table 6.19). Health scientists (mainly from the public health sector) were used as sources

**Table 6.20: Health science sources in earthquake-related media story types**
The media headline story types that have potential to contain Health scientists/expert sources are shown in the left hand column *(unless italicised in which case it is not considered obvious that these story types might contain this type of source).* In the middle and right hand columns are the number of Health science sources mentioned in the media (1000 Stuff dataset) who were involved with emergency medicine, public health, clinical psychology/psychiatry, forensic science and multiple health science topics. bm= brief mention.

| Media Headline Story Types | Number of Health Science Sources: Emergency Medicine | Public Health | Clinical psych | Forensic Science | Multi | Total |
|---|---|---|---|---|---|---|
| Background/expectations | | | 2 | | | 2 |
| Death Toll or Injured | 1 | 1 | 1 | | | 3 |
| Emergency Medical Treatment | 17 | 2 | 2 | | 4 | 25 |
| Environment & Public Health | 1bm | 28+4bm | | | | 33 |
| Infrastructure & Public Health | | 6 | | | | 6 |
| Injury Rehabilitation | 7 | | 1 | | | 8 |
| Inquest/Cause of Injury | | | | 1+6bm | | 7 |
| Latest Update | 1bm | 3+6bm | 1 | 1+4bm | | 16 |
| NGOs and Aid | | | | | | 0 |
| Stressed, Scared Struggling | | 5+1bm | 14 | 2 | | 22 |
| Staying/Going | | 1bm | 3 | | | 4 |
| Other Social Effects | | 3+5bm | 5 | | | 13 |
| Victim ID & Name Release | | | 1 | 3+2bm | | 6 |
| Ways to Feel Better | | 1+3bm | 12+2bm | | | 18 |
| Community/Health Preparations | 1 | 1 | | | | 2 |
| Other Health Warnings | | 1 | | | | 1 |
| *Aftershock(s)* | | 1 | | | | 1 |
| *Antisocial Behaviour & Law Enforcement* | 1bm | 1 | 1 | | | 3 |
| *Authorities Update* | 2bm | 2bm | | | | 4 |
| *Awards Commendations or Thanks* | 2 | 1 | | | | 3 |
| *Damage/Devastation* | 2bm | 2bm | | 1 | | 5 |
| *Disaster Occurrence* | 1 | 1 | | | | 2 |
| *Disruption* | | 1 | 1 | | | 2 |
| *End of Year* | | 2 | | | | 2 |
| *Felt Occurrence multiple* | | 2 | 1 | | | 3 |
| *Impact on Economy* | | 1 | | | | 1 |
| *Making the Natural Environment Safer* | | | | 1bm | | 1 |
| *Other Environmental effects* | | 1+3bm | | | | 4 |
| *Recording for posterity* | | 1bm | | | | 1 |
| *Recovery Progress* | | 1 | | | | 1 |
| *Restricted Access* | | | 1 | | | 1 |
| *Sport* | | | 1 | | | 1 |
| *State of Emergency* | | 1 | | | | 1 |
| *Survivor/Victim Story* | | 1 | 1 | | | 2 |
| Technology in EM | 2 | | | | | 2 |
| Weather Worries | | 1 | 1 | | | 2 |

in one to two articles from each of a wide range of article types published in the New Zealand media (in italics in Table 5.58). There were health scientist sources in all of the expected media headline story types. The percentage of articles without a source was however high. Furthermore the comment by sources in each story type typically did not explore the subjects in particular depth.

*Victim ID & Name Release* and *Inquest/Cause of Injury* stories involved forensic scientist sources. This was useful, in that as the identification and burial is vital in avoiding psychosocial trauma (De Ville de Goyet, 2004). Many of the sources used in articles about forensic science have been coded as institutional experts. For example Paul Kench was coded as an institutional expert as he gave the summary of all forensic evidence at Coroner's inquests. His science background was however unknown. In contrast Police Superintendent Dave Cliff was not included in coding as, although he spoke often of the disaster victim identification team, this was from an operational rather than expert perspective.

Sources involved in emergency medicine were predominantly in articles and items published or broadcast immediately after events. Other public health sources were mostly involved in disease-related warnings. Psychologist sources were typically involved in addressing the issue of distress from the main events, grief, loss, and fear of aftershocks.

As with other sciences successful interventions were typically mentioned in passing rather than being emphasised in headlines, and did not refer to knowledge from previous earthquakes or other disasters.

### 6.9.10 Overall comments about media coverage of health science

The article that provided the most health advice in one place was "Quake - Govt gives $5 million" (Fairfax NZ News, 2010b). However no expert health sources were used in the articles. Health Minister Tony Ryall gave most of the public health advice, and "Dr. Johnston ... director of the Joint Centre for Disaster Research" was quoted as commenting on psychological matters. Prof. Johnston, an earth scientist by qualification with many years leading JCDR, which has a number of psychologists associated with it, was also quoted making generic comments about psychological trauma and recovery in "Post-quake fear 'a missed opportunity'" (Fea, 2011). The comments in these two articles drew attention from psychologists and are an example of the care scientists should take when commenting outside their area of expertise.

Aspects of the coverage of health science in the New Zealand mass media relating to earthquakes that DRR would benefit from addressing are: 1) the relative lack of scientist sources in the numerous articles that have health-related headline story types 2) health scientist tendency to consider top-down communication in the media as the most appropriate; 3) the absence of certain health science topics such as cause of death (which might assist in understanding what to do to prevent death), or how sport assists mentally and physically with coping in response and in recovery (e.g. as found by R. B. Wang & Xiao, 2010) 4) successful interventions were only mentioned in passing and did not refer to knowledge from previous earthquake-related disaster events.

Given the UN's emphasis on DRR occurring in a participatory paradigm DRR will likely benefit from scientists communicating the evidence basis as well as advice (this applies to all scientists but has been identified as a particular departure from idealised practice by health scientists). A general recommendation regarding the need for scientists to communicate the evidence-basis for advice and decisions (25) is made at the end of this chapter.

**Recommendation 14 (health science):** Media and scientists – Make efforts to include a range of health scientist sources to discuss health science topics that are currently missing from the media discourse (such as cause and prevention of death and injury, long-term public health issues, and the evidence-basis from previous events).

**Recommendation 15 (health - psychosocial):** Scientists - Show the multiple earthquake event evidence basis for long-term psychological distress, and highlight the individuality of 'personal journies', and options that assist in recovery.

## 6.10 Information, decision or management science and scientists

### 6.10.1 IDM sciences were treated very differently in academic research and the media

Information, decision and management sciences were a disciplinary area that showed one of the greatest disparities between research attention, media attention, and source presence in New Zealand media articles on Figure 6.2.

### 6.10.2 Research attention to IDM sciences was on information as a decision-support tool, emergency management, social learning and media discourse analysis

As described in Table 3.14 and Appendix 8.1 researchers from the information, decision and management sciences in 2007-2011 focused largely on:

1) information modes, modelling and assessments and ‘situational awareness’ as decision support (for individuals and authorities’ response). Topics included casualty-, loss-estimation, logistics and co-ordination of rescue, shelter, relief supplies etc.

2) studies of best practice and review of DRR management.

3) communication as a tool in DRR either as:

a) an information gathering tool - analysis of social and traditional media, (disaster discourse) to understand citizen behaviour, perception and opinions, and studies examining crisis communication performance (e.g. Hjorth & Kim, 2011)

b) for education/awareness/social learning (e.g. Muhari et al. (2010) which related to participatory technology assessment and Moore, Burrows, Collins, and Roderer (2011) which was about publishing disaster-related research and knowledge); and

c) media discourse studies that communicated content about aspects of disaster, risk, risk reduction and scientific involvement for general use– relating to various topics (e.g. L. Yin & Wang, 2010).

The commentary on media discourse typically related to disaster not recovery or reduction. Research articles relating to information and decision management science accounted for almost 4% of the total DRR research output (Table 6.21). The research focus was firmly on management topics, followed by information tools. The latter related to assistance with logistics and decision-making in response (e.g. Jalayer, Asprone, Prota, & Manfredi, 2011).

Management studies also focussed on response, for example NGO practices in emergency management, success of delivery of cash grant schemes, financial strategies in general, post-earthquake business management such as tourism regeneration strategies etc. There were few studies relating to readiness, or recovery planning. A Canterbury-related example of relating to emergency (response/crisis) management is an article about the logistics relating to portable toilets (Potangaroa, Wilkinson, Zare, & Steinfort, 2011). Of particular note is the absence of academic research into recovery rather than response-related management. The third most prevalent 'other' communication-information studies were typically about emergency management (in response), in particular social media and internet influence on emergency management and the use of information platforms for scientific data-sharing.

**Table 6.21: Information, decision and management science subtopics**
Proportions of research articles in each of the information, decision or management (IDM) science subtopics (left-hand column) in the 20-earthquake-research-dataset (middle column) and media articles in the 1000-Stuff post-Darfield datatset with headlines IDM science sub-disciplines (right hand column).

| | % Research (n=173/4376) | % Media (n=377/1000) |
|---|---|---|
| **Information decision and management science subtopics** | 4.0 | 37.7 |
| Information and computation | 37.4 | 1.5 |
| Management – emergency management (response) | 41.4 | 32.4 |
| Management – readiness | 1.9 | 0 |
| Management – recovery including reduction in recovery | 7.5 | 43.2 |
| Other communication-education, awareness or social learning | 2.9 | 9.2 |
| Other communication-information | 12.6 | 7.6 |
| Other communication-media discourse | 5.2 | 6.1 |

### 6.10.3 The media focus was primarily on recovery management, crisis management, pre-disaster awareness, and availability of information

As a weighted average there was more media coverage in the New Zealand mass media of information and decision management science topics than there was research into these topics. Tracking the number of information and decision-management-focused media articles in the 1000-Stuff database over the period of analysis showed that the proportions of sub-discipline types remained essentially the same over time. The focus simply switched from education, awareness, and social learning to response and then on to recovery over time. In contrast to management topics in the academic literature, management-related media headlines focussed on both crisis and recovery management. Logistics was a topic discussed in the media but no scientist/expert sources were included.

### 6.10.4 IDM science source comment was rare

As with other social sciences information, decision or management (IDM) science sources were hardly used in earthquake-related media in New Zealand between 2009 and 2012. There were a large number of story types in the New Zealand media analysed that could have included comment from scientists about information, decision or management science but did not (Table 6.22). Given the emphasis on media headline story types relating to activities in response (Table 5.13) it is remarkable that media comment was so rare from academics, other experts in this disciplinary group, or from emergency management professionals about advances in emergency management or comparing New Zealand's emergency management practice with that of other countries. Officials without science backgrounds discussed emergency management topics, with officials informing and advising citizens of a state of emergency without explaining what arrangements had been made to assist them in the response period.

No communications source (IDM science source), official or politician (policy- or decision-maker) commented in the media articles analysed about concerns about communication of warnings, transparency of information in recovery etc. on. Scientists were mentioned in these articles, however they were typically the sources from the discipline that the information, decision or management related to. For example, seismologists commented on the communication of warnings in relating to the L'Aquila earthquake in Italy (a series of articles in September 2011 dealt with the topic of the geoscientists under trial in Italy), geotechnical experts spoke of decision-making and information relating to slope failures and liquefaction effects, health scientists discussed the value of information and restrictions relating to public health, DRR researchers commented on communication and response to preparedness messages, economists about recovery issues.

The three named IDM science sources of the 1000-Stuff dataset were not information scientists or academic or professional/practicing emergency management experts using IDM science tools or practices. Two of the three were communication science sources either involved in creating a digital archive of Canterbury residents' earthquake experiences, an international academic who had researched the effect of September 11 attacks in USA, commenting in a Stuff article on 01 March 2011 about the effect of television coverage of the February 22 event. The third was Dr Regan Potangaroa who was referred to as a risk communication expert, and was commenting on recovery decision-making.

**Table 6.22: IDM science in earthquake-related media story types**
Information, decision or management science in earthquake-related New Zealand mass media..

| Media Headline Story Types | Number of IDM Science Sources |
|---|---|
| Aftershock(s) | |
| Authorities update | |
| Death Toll or Injured | |
| Disaster Occurrence | |
| Felt Occurrence | 1 – management (emergency) (bm) |
| Felt Occurrence-multiple | |
| General Emergency Management | |
| Latest Update – Live Update, News | |
| State of Emergency | |
| Antisocial Behaviour & Law Enforcement | |
| Authorities Response Planning | 1 – management (emergency) |
| Burying Dead | |
| Celebrity Visit | |
| Cleaning Up | |
| Military or Police Relief/Aid | |
| New Zealander Relief Volunteers | |
| NGOs and Aid | |
| Restricted Access | |
| Search & Rescue | |
| Skills Shortage | |
| Thanks for Relief | |
| Victim ID or Name Release | |
| Aid Issues | |
| Rebuild Logistics/Progressing | |
| At Risk: Cities, Regions/Scenarios | |
| Communication in Response | |
| Doing Better/More in Response | |
| Forecasting or Prediction | |
| Reviewing Communication | 1 - communication |
| Reviewing Authorities Preparation | |
| Technology in/for EM | 1 - information science |
| *Infrastructure Damage & Restoration* | 1 - communication |
| *Land Decisions* | 1 - communication |
| *Political in Recovery* | 1 - communication |
| *Recording for Posterity* | 1 - communication |

### 6.10.5 IDM science has not been well-represented in the New Zealand media

With such poor representation of information, decision and management science topics in the media citizens cannot easily know of IDM science's contribution to DRR nor how New Zealand compares with other countries in relation to IDM science topics.

**Recommendation 16** (information, decision and management sciences): DRR Advocates - DRR institutions might consider seeking out IDM science sources and linking them with media so there is an established relationship for commentary whenever the need arises.

## 6.11 Political science, public administration, and political scientists

*The director of a 15-year-old documentary outlining the effects of a major earthquake on Christchurch's eastern suburbs and heritage buildings says lives could have been saved if officials had heeded the film's warnings. ... An edited eight-minute clip of the 1996 documentary, Earthquake!, had received nearly 30,000 views on video website YouTube by night. … The made-for-television film rated well but was greeted with "a deafening silence" from officials. "I would have thought that the council and concerned citizens would take heed and make sure that something was actually done, but nobody took it for real," he said." … he regretted not making his point more forcibly. "In hindsight, I should have gone and sat outside the mayor's office and demanded that something happened.*

"Quake Doco warned of danger" (Sachdeva, 2011a)

### 6.11.1 Academic research into the effects of legislation, policy and leadership on earthquake-related DRR accounted for only 1.3% of all research

DRR is a political issue; defining events and constructing meaning, answering "what happened?" is as much political as it is scientific and technical (Birkland, 1997; R. S. Olson, 2000). Earthquake strengthening and DRR is the primary responsibility of states, and DRR governance is Priority 2 of the Sendai Framework (UNISDR, 2015). Yet, academic research into the effects of legislation, policy and leadership on earthquake-related DRR is almost non-existent (comprising only 1.3% of research articles analysed).

Some have suggested the use of disasters for political, ideological and social ends (Klein, 2007; Platt, 1999; Schencking, 2008). Disastrous earthquakes may also be seen as a window of opportunity for policy change when problems, potential policies and political conditions come together (Lan, 2009; Schencking, 2008). While the Canterbury earthquakes inspired policy and legislative change, survey and interviews suggest that there is public resignation to the fact that these changes are unlikely to be discussed by political experts in the media. Consequently there was little expectation that political science topics would be discussed, even though this was described as desirable. While general conversation suggests that short-term political cycles are generally accepted in New Zealand as contributing to poor adoption of DRR measures, there is no research supporting this, nor obvious efforts to measure, let alone influence the perceptions of policy and decision-makers of the value of the implementation of DRR measures (cf. the widespread effort to alter 'public perceptions').

### 6.11.2 None of the sixteen story types related to political science topics existed before the Canterbury earthquakes

Table 6.23 shows that there were over a dozen story types in the New Zealand mass media that related to political science topics. (Note that these topics were all present only after the Darfield earthquake).

### 6.11.3 Political science sources were rarely used

Political science sources were however rarely used in the New Zealand media. The only two political science researcher sources named in the 1000 Stuff articles analysed were both from the University of Canterbury; John Hopkins, a School of Law senior lecturer, and political scientist Bronwyn Hayward. There was reference to a group of constitutional law experts from all six New Zealand law faculties, who took issue with recovery legislation the Canterbury Earthquake Response and Recovery Act 2010 (CERR Act 202) when it was first introduced. However all were un-named.

**Table 6.23: Public administration and political science sources related to New Zealand earthquake-related media story types**

The media headline story types that have potential to contain political scientists/expert sources are shown in the left hand column. In the right hand columns are the number of source types for those story types in the 1000-Stuff dataset.

| Media Headline Story Types | Legal/Social | Leadership/ Management-Governance | Totals |
|---|---|---|---|
| Doing Better/More in Response | | | |
| Government Recovery Initiatives | | | |
| International Aid | | | |
| Leaders & Aid | | | |
| Leader Visit | | | |
| Political in Crisis | | | |
| Recovery Legislation | 1+1bm | | 2 |
| Recovery Progress | | 1 | 1 |
| Reviewing Authorities' Preparation | | | |
| Authorities Update | | | |
| Closure | | | |
| Development Hearings | | | |
| Latest Update – Live Update, News | | | |
| Leader Condolences | | | |
| Ministry of Foreign Affairs and Trade (MFAT) Info/Missing New Zealander(s) | | | |

### 6.11.4 The effects of leadership and governance on building codes was not interrogated as much as the earth- and building science on which they were based

The aforementioned discussion about recovery legislation arose because New Zealand's pre-existing legislation did not contemplate a disaster situation and the need for quicker decision-making time-frames (Gall, 2012). This was possibly due to the lack of serious disasters since the 1930s, but in spite of legislative requirements for comprehensive disaster planning in New Zealand (see Appendix 4). This lack of foresight was all but ignored in the media. This opportunity for blame (see section 7.4) did not feature strongly in either the Stuff articles analysed, or in distal media (media outside Christchurch).

The Royal Commission of Inquiry, and its head Justice Mark Cooper were mentioned in a number of articles. At the Royal Commission however, and therefore in the media the effects of leadership and governance on building codes in New Zealand were not interrogated in nearly as much detail as the earth- and building- science on which they were based.

Critical comment including quotes from the media about research and researchers not having been used by public administrators was discussed in section 5.5.14. There was no response to this by policy or decision-makers or political scientists.

The limited media portrayal of the importance of governance, and absence of political science sources leads to the following recommendation:

**Recommendation 17 (political science):** All - Public understanding of DRR and the importance of governance in achieving DRR needs to be improved; including by broadening DRR source representation to include political scientists.

-blank-

## 6.12 Urban studies, planning and planning scientists

*Whether the land was suitable for residential, I don't know. That's where there are questions to be asked. The town planner's report there's not even a mention of any instability. It's all about the birds and the bees. It doesn't strike you as terribly robust." ... "Whether the rules are suitable for an area like Bexley is another matter. New Zealand's building standards, given the earthquake and leaky homes, seem to have been off-beam for some time." Star-Times inquiries show the council backed the development because land in the city was scarce. Staff warned about sea-level rises, given the area was prone to flooding, but there was nothing noted about liquefaction or seismic activity, and documents make no mention of tests to determine the land's suitability for housing.*

"Quake-hit residents may sue council" (Wall, 2010)

### 6.12.1 What research into earthquake-related urban studies and planning science there is focuses on reduction in recovery, the environment and sustainability

Previous research into the media communication of planning topics or planning scientists in relation to hazards, disasters or DRR is negligible. There is consequently no additional discussion from previous research that can be added to the findings of this research.

Earthquake-related research into demographics, planning, urban design and landscape architecture topics was shown by this research to have been negligible (Table 6.24). What research there was, was related to 'Reduction in Recovery' topics with an emphasis on planning and the environment and planning and sustainability. There were also some research articles on considerations in pre-event zoning or decisions regarding siting for reconstruction or codes. These same topics were discussed in the New Zealand mass media, but only in small proportions and mostly only after the Port Hills earthquake.

### 6.12.2 Only 1.2% of earthquake-related media articles had headlines suggestive of planning science topics

Media articles in New Zealand after the Canterbury earthquakes with headlines suggestive of urban studies or planning science topics accounted for only 1.2% of all Stuff science articles (Table 5.24).

There has been comparatively little planning and urban design research specific to earthquakes, little communication of topics relating to planning and urban design and few planners and urban design experts were sources in the New Zealand earthquake-related media (Table 6.24).

**Table 6.24: Urban studies and planning science research and media articles**
Proportions of research articles in each of the urban studies and planning science sub-disciplines (left-hand column) in the 20-earthquake-research-dataset (middle column) and media articles in the 1000-Stuff post-Darfield datatset with headlines suggestive of urban studies and planning science sub-disciplines (right hand column).

| | % Research (n=20/4376) | % Media articles 1000-Stuff (n=12/1000) |
|---|---|---|
| **Planning science sub-disciplines** | 4.0 | 1.2 |
| Human Geography/Demographics | 30 | 0 |
| Landscape Architecture | 10 | 8.3 |
| Planning | 60 | 91.7 |

Six story types were initially identified as being likely to include planning scientists. However planning scientists featured less in those New Zealand media stories than they did in a further five story types - those in italics in Table 6.25.

For the small number of individual sources that were present planning scientists commented on a variety of mostly recovery-related media headline story types (Table 6.25).

**Table 6.25: Planning science sources in earthquake-related mass media**
The media headline story types that have potential to contain urban studies and planning science scientists/expert sources are shown in the left hand column *(unless italicised in which case it is not considered obvious that these story types might contain this type of source).* In the middle and right hand columns are the number of sources mentioned in the media (1000-Stuff dataset) who were involved with landscape architecture, planning science, urban studies and demographics. bm= brief mention.

| Media Headline Story Types | Landscape Architecture | Planning | Urban Studies | Demographics | Totals |
|---|---|---|---|---|---|
| Codes, Standards and Policies | | | | | |
| Environmental Rehabilitation | 1 | | | | 1 |
| Land Use & Zoning | | | | | |
| Land Decisions | | | | | |
| Rebuild Plans & Vision | 4 | 2 | | | 6 |
| Reviewing Land Use | | | | | |
| Staying/Going | | | | 1 | 1 |
| Lessons or Reflections | | 1+1bm | | | 2 |
| Political in Recovery | | 1 | 1 | | 2 |
| Recovery Legislation | | 1 | | | 1 |
| Secondary Land Threats | | 1 | | | 1 |

### 6.12.3 There were no planning science sources on TV, and few in the print media

Planning scientists accounted for only 3.2% of all scientist sources in the print media. On television there was mention of planners, but no planning scientist source appeared. There were 18 individual planning science sources identified from the 1000 stuff articles covering a variety of the disciplinary subgroups (Table 6.26).

The variety of story types planners commented on was wider than was initially anticipated, but there was no comment about topics that were expected. The one demographics expert source in all of the coverage analysed was featured in a Staying/Going story.

*Rebuild Plans & Visions* stories typically had landscape architects as sources.

Planners were the subjects of blame in the post-Canterbury media (see quote at the beginning of this section). However they did not comment on this in the media analysed. Oddly, but in keeping with this, the *Land Use & Zoning* story types, along with *Reviewing Land Use and Codes,* and *Standards and Policies* contained no planning scientist sources. This is perhaps a function of the fact that academic planning scientists were not engaged in much research about these topics (favouring environmental and sustainability topics) and expert officials avoided comment about past decisions.

A headline suggestive of planning science did not guarantee mention of science. For example "Ecan rewrites regional planning policy" (Gorman, 2011j) contained nothing to suggest scientific input into regional planning policy.

**Table 6.26: Number of individual urban studies and planning science sources in 1000-Stuff dataset**

| | % of individual sources overall | | % of individual sources this disciplinary group | |
|---|---|---|---|---|
| | 1000-Stuff | TV | 1000-Stuff | TV |
| **Planning sciences sub-group** | 3.2 | 0.4 | | |
| Demographics scientist | 0.4 | 0.0 | 12.5 | 0.0 |
| Geography | 0.2 | 0.0 | 6.3 | 0.0 |
| Landscape architect | 0.7 | 0.0 | 21.9 | 0.0 |
| Multi/Other | 0.8 | 0.0 | 25.0 | 0.0 |
| Planning | 1.1 | 0.4 | 34.3 | 100.0 |

### 6.12.4 The paucity of planning scientist comment meant citizens had little opportunity to understand how planning decisions were being made

The overall paucity of planning scientist sources in the New Zealand media means citizens have had little access to scientific information or expertise to inform their understanding of the options and possibilities that planners and urban designers can draw from in preparing their cities to become more resilient to disasters (readiness planning). The lack of comment expert opinion used by authorities means that citizens had little opportunity to understand how planning decisions were being made.

Given the above, it is concluded that those who have knowledge to influence the volume of earthquake-related DRR planning research and the numbers of planning scientist sources commenting in the media should remedy this omission. They should be aware that shying away from contentious topics in the media leaves citizens without the evidence-basis they require to make informed judgments and decisions about DRR topics. These sources should be heard in disaster recovery, and there should also be an effort to include readiness planning and design topics in the media in regions that have not experienced disaster.

**Recommendation 18 (urban design and planning science):** All - deliberate efforts to introduce more DRR-related planning and urban design topics in the media, along with more urban design and planning scientist sources in the media would be beneficial for DRR.

## 6.13 Other sciences and other scientists

### 6.13.1 Source representation of 'other sciences' was much greater than academic or media attention

For the eleven distinctly grouped disciplinary groups already discussed the subtopics are related. This twelfth group is an arbitrary one including a range of 'other' science types. These 'other' sciences include sociology of science, resource sciences (e.g. energy), sustainability science, agricultural and veterinary sciences), mathematics/statistics and sports science.

This 'other sciences' group is distinct from most other disciplinary groups (except earth and planetary sciences) in that source representation was greater than research or media attention this 'other' disciplinary group is the exception (see Figure 6.2). The 'other science' code accounted for 4.9% of sources in Stuff and 10.1% of the named scientist sources on television (Table 6.27). Only 0.5% of research attention and 1.3% of media attention was on 'other science' topics (Table 6.28).

**Table 6.27: Percentages of other scientist sources on television and in on-line print (Stuff) articles**

This table shows the percentage of sources of the subdisciplines (left hand column) of the 'other' science group in the media (in 1000-Stuff dataset and on television) overall (columns 2 and 3 from the left) and within the group (columns 4 and 5 from the left). With the exception of nuclear scientists in the 1000 Stuff dataset, which is an artefact of a sample rather than full dataset, proportions in print media and on television are similar.

See Appendix Table 8.1 for description of sub-disciplines in research articles.

| | % of individual sources overall | | % of individual sources this group | |
|---|---|---|---|---|
| | 1000-Stuff | TV | 1000-Stuff | TV |
| **Other science subgroup** | 4.9 | 10.1 | | |
| Archaeology/heritage/history | 1.1 | 1.7 | 22.4 | 16.8 |
| Astronomy | 0.0 | 0.4 | 0.0 | 3.9 |
| Criminology | 0.2 | 0.4 | 4.1 | 3.9 |
| Resource - agri-/horti-cultural | 0.0 | 0.0 | 0.0 | 0.0 |
| Resource - energy/nuclear science | 0.0 | 2.1 | 0.0 | 20.8 |
| Resource - veterinary science | 1.1 | 2.1 | 22.5 | 20.8 |
| Science - general | 2.3 | 1.3 | 46.9 | 13.0 |
| Other – non-DRR | 0.2 | 2.1 | 4.1 | 20.8 |

### 6.13.2 Most sources for 'other science' were nuclear or veterinary scientists

Almost half of these 'other science' sources were either energy or nuclear scientists, or veterinary scientists. The energy or nuclear scientists' media comments were about to the Tohoku (Sendai) earthquake and the nuclear reactor breach caused by it.

**Table 6.28: Other science subtopics in academic research and the media**

This table shows the percentage of research ariticles with 'other' science subtopics and disciplines (left-hand column) in the 20-earthquake-research-dataset (middle column) and media articles in the 1000-Stuff post-Darfield datatset with headlines suggestive of these sub-disciplines (right hand column). Note that the percentages below the line relate to the proportions of subdisciplines out of the 0.5% of research articles and 1.3% of media articles overall. (Of the 4376 20-earthquake-research articles 22 related to research articles that did not fit into the other 11 disciplinary groups).

| | **% Research (n=22/4376)** | **% Media (n=13/1000)** |
|---|---|---|
| **Other science subtopics** | **0.5** | **1.3** |
| Archaeology/historical restoration | 22.7 | 23.1 |
| Criminology | 0 | 15.4 |
| Resources-agri-/horticultural | 13.7 | 0.0 |
| Resources-energy | 22.7 | 0.0 |
| Resource - veterinary (non-resource) | 9.1 | 30.7 |
| Science and technology studies | 0 | 0.0 |
| Sport | 31.8 | 15.4 |
| General | 0 | 15.4 |

Archaeological/heritage/history experts were used as sources in relation to *Heritage Building Matters, At Risk Buildings/Infrastructure, and Building Assessment & Decisions* articles as shown in Table 6.29. Police discussed criminology or forensic science, however it was not obvious those commenting had a related science qualification. The science background of those who commented on behalf of the police was never specified. For further comments related to crime science see section 7.6.9 about maladaptive behaviour.

The "other non-DRR" scientists included an asbestos removal specialist, and a food scientist on television. Those sources classified as general scientists ("science-general" in Table 6.27) included New Zealand's Prime Ministers' Chief Scientist Sir Peter Gluckman. References to historical figures Galileo and Darwin were also part of this code.

Veterinary scientists commented in *About or Assisting Animals* media stories, and *Authorities Updates* stories in relation to the Canterbury earthquakes (Table 6.29). Vets were typically portrayed in a volunteer/mutual aid role.

**Table 6.29: Other science sources in earthquake-related mass media.**
The media headline story types that have potential to contain scientists/expert sources other than the 11 disciplinary groups shown in Table 3.14 are shown in the left hand column. In the right hand column are the number of source types for those story types in the 1000-Stuff-dataset. * relates to the Energy Efficiency and Conservation Authority ** the (Canterbury) university becoming an international centre of earthquake studies. *** died in the Port Hill's earthquake.

| Media Headline Story Types | Number of Other Science Sources |
|---|---|
| About or Assisting Animals | 2 - veterinary science |
| Sports (Sports Science) | |
| Recording for Posterity | |
| Animals Sensing Earthquakes (Vet)/Zoo | |
| At Risk: Buildings/Infrastructure | 1 – archaeology/heritage/history |
| This Day in History (Archaeology / Heritage/ Historical Restoration) | |
| Heritage Building Matters | 3 – archaeology/heritage/history (2+bm) |
| Area's History & Culture | |
| Closure | |
| Don't Worry (Authorities/Experts Denial of Risk (STS) | |
| Antisocial Behaviour & Law Enforcement (Crime Science) | |
| *Authorities Update* | 1 –veterinary science |
| *Building Assessment & Decisions* | 1 – archaeology/heritage/history |
| *Codes, Standards or Policies* | 1 –general science |
| *Doing Better/More in Response* | 1 – general science *** |
| *End of Year* | 1 – general science |
| *Government Assistance* | 1 – other* (bm) |
| *Infrastructure & Public Health* | 1 – other* (bm) |
| *Other Environmental Effects* | 1 – other* (bm) |
| *Recovery Legislation* | 1 – other* (bm) |
| *Recording for Posterity* | 1 – general** |
| *Reviewing Communication (Info Release)* | 1 – general science |
| *Supporting Research* | 1 - other |

### 6.13.3 There was little mention of agricultural, horticultural or other resource science or scientists in the NZ earthquake-related media

Despite New Zealand's strong ties to primary industries there were not only few sources of this type, but few stories that gave the rural perspective of any aspect of the disaster response and recovery beyond the "Farmy Army" that went to town with their tractors to clear silt, and brought food aid. There were no agricultural or horticultural science sources in the New Zealand media analysed, nor did any media articles do much to communicate the consequences of earthquakes on, or DRR actions by the agriculture or horticulture industries. One rare example was one sentence about a Gisborne winery as quoted on p. 424. Global earthquake-related research attention to such topics was also nil (Table 6.28).

The proportion of research articles in respect of any of the ‘other’ sciences not listed or other disciplinary groups is only a fraction of that (Table 6.2). Clearly there is an opportunity to increase scientific understanding of many other aspects of earthquake-related DRR through research and media communication.

It is concluded that there are a range of sciences and scientist sources that are resource and technology related that could be better represented in both DRR research and the media.

**Recommendation 19 (other sciences):** Disaster and DRR researchers and Media – Find ways to ensure that agricultural- and horticultural science, and other resource and technology-related sciences and scientists are represented in the DRR literature and in the media.

## 6.14 Stories about inter- or multi-disciplinary studies or with risk- or disaster-researcher sources accounted for 9% of all stories

Scientist sources in the New Zealand media were most often portrayed as being part of one discipline.

Issues involving risk and uncertainty warrant a trans-disciplinary approach (Beck, 1992; V. Sarewitz, 2004). This section discusses academic research that was identified as inter- or multi-disciplinary in nature and the portrayal of such studies, and how knowledge and the associated scientists were represented in the earthquake-related media in New Zealand.

Inter- and multi-disciplinary science and research teams are becoming more common, both within and outside DRR. For example the Natural Hazards Platform in New Zealand and the Joint Centre for Disaster Research (JCDR) are involved in cross-disciplinary work.

Previous science-, risk, or natural hazard media studies analysed as part of this research have not considered the portrayal of inter- or multi-disciplinary teams.

Multi-disciplinary research is represented in Table 6.30. Nine percept of the 20-earthquake-academic-research articles included titles and/or abstracts showing a multi-disciplinary approach to the research, or research of a topic at the intersection of two or more disciplines. More than a third of these studies related to disaster research (e.g. Comfort et al., 2011; I. Davis, 2011), and a further 30% and 20% respectively to building science, or information decision or management science, plus at least on other discipline.

Just over 10% of the media stories analysed in this research contained more than one media headline story type. However, media articles only rarely mentioned the work of interdisciplinary teams, and fewer than 5% of articles in the Stuff dataset included sources from a variety of disciplines.

As was noted earlier JCDR was infrequently mentioned in the New Zealand media analysed. One of the few examples was Stuff article “Expert says Canty will rebound” (Kirk, 2011a), which quoted Associate Professor David Johnston as being a director of JCDR. These articles did not represent the inter-disciplinary nature of the centre. The articles in which the then centre leaders Johnston and Glavovic were used as sources were related to disaster recovery alone, and other articles related to health topics alone.

**Table 6.30: Main disciplines in multi-disciplinary earthquake-related studies**

| Main discipline | % of all research (n=4376) |
|---|---|
| Building | 2.3 |
| Cognitive and behavioural | 0.3 |
| Disaster and risk research | 3.45 |
| Earth and planetary | 0 |
| Economics | 0.2 |
| Environmental engineering | 0.3 |
| Geotechnical | 0 |
| Health (public) | 0.4 |
| Information, decision and management | 1.7 |
| Political | 0 |
| Urban studies/planning | 0.2 |
| Other science | 0.1 |
| Total multi-disciplinary studies | 9.0 |

Notably one might have expected stories of the *Lessons Learnt* and *Government Recovery Initiatives* story types to include sources from a variety of disciplines in one article, or even different articles with different sources in them, yet they did not. This may be a function of scientists mostly not considering themselves DRR advocates (section 5.7.6). It may also relate to a desire not to be seen as 'political'.

Of all headline story types *Political in Recovery* and *Recovery Progress* included the most stories with sources from at least two disciplines. It was however typically only response stories that included three or more scientist sources from different disciplines. For example "Christchurch earthquake: Latest news – Wednesday" (NZPA, 2011c) a *Latest update* story included a public health scientist, structural engineers and forensic scientists (mention only). Another *Latest update* story "Christchurch quake/ latest info" (Unattributed, 2011a) included an earth scientist, a vet, and two health scientists (one emergency medicine, one pubic health) and briefly mentioned engineers.

Other story types that were found to have a range of scientist sources in them included *Forecasting & Prediction* and *Other Health Warnings*. Some examples of the combinations of sources in the *Forecasting & Prediction* story type are: seismologist plus clinical psychologist; structural engineer plus pseudo-scientist; economist and seismologist; and general scientist plus pseudo-scientist.

*Infrastructure and Public Health* and *Other Health Warnings* stories lie at the intersection of public health, engineering and the environment (e.g. "Quality of drinking water unchanged" Fairfax NZ News, 2011g). Practicing health scientists or infrastructure engineers commented in these stories, but there was little contribution from academics from health, building or environmental sciences (that is with the exception of the stories relating to the Sendai earthquake and nuclear waste release such as "NZ safe from nuclear fallout" (Easton, 2011). Articles relating to the nuclear issue and the Sendai earthquake explored a range of topics that are inter-disciplinary in nature. For example a) the impact of radioactive particles in the atmosphere, or sea (earth-atmospheric or oceanographic, or environmental science), b) human effects and knowledge of dosage limits (pubic health), c) alternatives to nuclear energy (physics and engineering) d) engineering infrastructure from, or e) 'other-nuclear' in terms of knowledge containment, siting in relation to seismic and coastal (tsunami) zones (planning or geography and earth science, the effect on energy industry in Europe (at the intersection of energy and economics, biosecurity and bioterrorism).

Without the headline suggesting as much Stuff article "Quake – govt gives $5 million' (Fairfax NZ News, 2010b) contained the greatest number of mentions of scientists from a variety of disciplines. These were multiple references to structural engineers who would be assessors, water engineers, a geophysicist, seismologist, civil defence planners, a pollution prevention expert, and the head of JCDR. However these sources were not working on a team together; they were fronting media at the same post-Canterbury earthquake media briefings.

While the proportions of academic research and headlines in the media were similar (Figure 6.2) there were few disaster researchers quoted or even mentioned in the New Zealand media.

**Recommendation 20** (inter-disciplinary): DRR advocates - Consider ways to ensure that there is better representation of inter-disciplinary studies in research and the mass media.

-blank-

## 6.15 Chapter 6 Summary: DRR needs willing scientist sources from all scientific disciplines

This chapter explored the representation of scientific disciplines in global earthquake-related research and the New Zealand media. The key risk and DRR-media communication related learnings from the research presented in this chapter have been summarised as recommendations 9-20 (Appendix 18).

Many subsections noted missed opportunities for scientists with different disciplinary perspectives to comment on topics for which there are research. Truly comprehensive communication of research knowledge requires a wider range of scientist sources to comment on many of the certain story types, rather than only one repeated disciplinary perspective being presented.

For example scholars in many disciplines including sociology, geography, political science, law, public administration and economics contribute to understanding of human and organizational behaviour in crisis and disaster (Scanlon, 2011). These are the *What's Happened/Being Done?* group of stories; one of the most prevalent groups (Table 5.18). However it was rare for any of these scientists, not even sociologists to be involved in the large body of these stories in the mass media analysed. Examples of story types in this group that would particularly benefit from a range of scientist source input are *Antisocial Behaviour & Law Enforcement* story subgroup or *Stressed, Scared Struggling, Other Social Effects, Political in Response*, or *Sport* to name but a few.

Other themes throughout the chapter were that 1) previously identified 'media biases' are mirrored by earthquake researchers in many disciplines, 2) there are few explanations in the media of how policy and decision-makers (governments and officials) use scientific research for DRR, and 3) the evidence basis for advice was not presented often.

Perhaps because scientists communicating about earthquakes do not necessarily consider themselves to be DRR advocates, and perhaps because of reticence to be in the limelight there were not many personal interest stories linking research to DRR opportunities or successes.

This chapter concludes with a further five recommendations relating to these observations.

**Recommendation 21** (all sciences): All - Care should be taken not to perpetuate claims about the media that are not supported by data (see also section 7.5.3).

**Recommendation 22:** (all sciences): Media - a wide range of scientist views including those of social scientists, physical geographers and disaster researchers should be sought for DRR stories.

**Recommendation 23** (all sciences): Scientists – An engaging way of explaining DRR concepts would be for scientist sources to explain how their research contributes to DRR solutions.

**Recommendation 24** (all sciences): All - Government research and policy could be communicated more frequently (relating to multiple DRR topics and disciplines).

**Recommendation 25** (all sciences): Scientists - Communicate the evidence basis as well as advice (this is key part of 'bottom up' communication and the UN advocates that DRR should occur in a participatory paradigm to achieve better DRR success).

# 7 Communicating DRR: what content matters most

*DRR success requires a clear understanding of what will happen if we do nothing, and what can happen if we take steps to make a city resilient.*

(Moehle et al., 2009)

## 7.1 Communicating DRR Comprehensively

### 7.1.1 Chapter overview: a 'culture of DRR' requires comprehensive communication

*"It's a form of suicide, isn't it? We build houses that kill ourselves [in earthquakes]. We build houses in flood zones that drown ourselves," said Roger Bilham, a professor of geological sciences at the University of Colorado.*

("The year the earth struck back/ 2010 disasters" Associated Press, 2010d)

In earlier chapters it was established that DRR success is be achieved through a 'culture of DRR' that is strongly influenced by how DRR is framed in the media. Amongst other factors, how 'considerate', 'complete' and 'comprehensive' communication about DRR is will determine the DRR culture. The following sections describe the framing of DRR in terms of issues identified by previous researchers, and as identified from analysis in this research of earthquake-related academic articles and media articles. Recommendations specific to the communication of DRR-topic content are provided in this chapter.

In Chapter 4 core science- and risk communication recommendations selected from the sixteen features of well-regarded science and risk communication, and the seven elements of a strategy were for 'considerate' and 'complete' communication.

The overarching recommendation from Chapter 5 was the need for DRR research to draw from a broader range of disciplines that combine and distil what is known from multiple hazard events, so that its essence can be communicated and applied to DRR. This chapter brings together other observations and recommendations that are specific to DRR.

The recommendations made in this chapter are based on a combination of observations and recommendations identified from previous research through literature review, and the results of analysis of issue, responsibility and motivational frames in the research, media and survey/interview datasets from this research (described in Tables 3.5 and 3.6). These frames have been chosen because, as discussed in Chapter 2 risk reduction behaviours are affected by diagnostic (issue), prognostic (responsibility) and motivational (action possibility) frames (Feindt & Kleinschmit, 2011).

Without frameworks DRR-communication might be an overwhelmingly broad and confusing subject area to discuss and present recommendations about, or for. In this chapter DRR-communication is discussed in terms of:

<u>Motivational frames</u>

g) DRR goals

h) DRR outcomes

<u>Responsibility frames</u>

i) the characters attributed with blame for disaster

j) the characters attributed with responsibility for DRR

<u>Issue frames</u>

k) the 3 stages of risk management (identification, assessment and actions)

l) the four phases of the DRR cycle (4Rs – Figure 2.6)

m) the 12 DRR topics (Figure 3.4); and

n) four environments (Figure 3.5).

Two overall recommendations – the need for considerate and complete, and comprehensive communication were identified in chapter 4. The previous chapters (5 and 6) presented twenty-five scientist and media-specific issue (DRR)-related-topic frames.

Seventy-five DRR-topic-related recommendations are presented within the body of this chapter, along with fifteen motivational (goal-related) and eleven responsibility-related recommendations (some recommendations relate to multiple frame types). Previous researchers made many of the recommendations, but no previous research has combined and presented them in one place.

A combination of one or more of the following supports the conclusions and their associated recommendations:

- observations, conclusions and recommendations from previous social-psychological-, media- or earthquake-related research
- what New Zealand survey and interview respondents indicated as important in relation to these topics; and
- how the topics were discussed in the New Zealand mass media in the years 2008-2012, before, during and after the Canterbury earthquakes.

Unlike most previous research the recommendations therefore do not favour one stakeholder group's needs over the others. With the recommendations supported in quite different ways their relative value is undefined. What this research has done is to bring the full range of recommendations together under the clearly stated contemporary goal frameworks of considerate communication and DRR through sustainable development situated in a public participatory democracy paradigm. It is recognized that many of the recommendations have not yet been the subject of media effects research, however they are a starting point for improving issue-related aspects of DRR communication. It is expected that future researchers will test the value and success of any or each of the recommendations to DRR.

### 7.1.2 An overall recommendation is therefore to communicate comprehensively

The first recommendation relates to the need for communicated DRR content to be comprehensive.

**Table 7.1: What comprehensive DRR involves**
These aspects of DRR are discussed in sections 2.3, 2.4 and 3.6.3-3.6.6.

<table>
<tr><td rowspan="4">Solutions as well as problems</td><td>All of society involved (Responsibility)</td><td colspan="2">Motivation/Goal: Vulnerability reduction and resilience building in a sustainable development paradigm balancing attention on the below</td></tr>
<tr><td rowspan="2">All disciplines<br><br>involved in all stages of DRR (identification analysis / evaluation and management)</td><td>Hazard – primary, secondary and tertiary effects<br>Exposure<br>Vulnerability<br>Resilience</td><td>All 4 environments</td></tr>
<tr><td>Response<br>Recovery<br>Reduction<br>Readiness</td><td>All 4Rs</td></tr>
<tr><td></td><td colspan="2">Diagnostic (Issue) framing</td></tr>
</table>

Scanlon (1980) suggested that 'complete' portrayal is desirable. Barnes et al. (2008) proposed that media should focus on all phases of the DRR cycle and the range of possibilities in DRR. Since no one, including Scanlon, Barnes et al, had defined how one might measure 'completeness', or that range of possibilities, various frameworks were developed in this research to do this (Chapter 3). Combining those frameworks to establish comprehensive DRR communication involves all the factors shown in Table 7.1.

A proportionate balance of attention to these various aspects of DRR would be most beneficial.

**Recommendation 26 (all DRR issues):** Any/All - Understand and convey what comprehensive DRR involves (Table 7.1 shows this).

### 7.1.3 DRR-communication recommendations should be aligned with DRR goals

The importance of goal framing lies at the heart of 'considerate' communication (see the 7Ts strategy as introduced in section 4.3), and is the rationale for the next recommendation.

**Recommendation 27 (motivation):** Any/All - Be considerate: be clear and transparent about the desired outcome (goal), who benefits and implications of goal framing when communicating about DRR.

The rationale for this recommendation was introduced in section 3.1.1. Both media and sources can be clear about goals in the body of articles or broadcasts. Headline framing recommendations 28 and 29 relate to contemporary motivational framing of DRR goals introduced in Chapter 2. Recommendations 30 and 31 relate to further ways of portraying achievement in ways other than what has traditionally occurred.

**Recommendation 28 (motivation):** Any/All - Portray DRR in a sustainable development framework to achieve long-term resilience.

This recommendation was discussed in sections 2.4.6 and 2.5.10.

**Recommendation 29 (motivation): Any/All -** Show DRR in both a resilience and vulnerability (risk) framework.

Reporting should relate community resilience measures (sections 2.4.6 and 2.5.10) with readiness or success in DRR, since resilience indicators highlight opportunities and possibilities in DRR throughout all 4Rs. Covering both vulnerability and resilience will balance government with individual DRR measures (section 7.2). This is a significant step forward from frames that emphasise response-related preparedness measures (identified in this and historic research – see section 7.6.6), and disaster losses such as financial cost, or deaths noted by Anbarci et al. (2005).

DRR outcomes have traditionally been measured in one of three ways. These are the success or otherwise of 1) check-list style surveys of items gathered or plans made (e.g. Farley et al., 1993); 2) assessments of cognitive process behind preparedness behaviours (Paek et al., 2010); and 3) referring to DRR success by declining death toll. Media analysis in this study has indicated that these are also the three ways that DRR success has been most frequently framed in the New Zealand media. Neither the economic cost of disasters nor cost-savings through disaster are frames that have been utilised. Given the Canterbury earthquakes cost more than 15% GDP (CRED, 2012) this was a lost opportunity. Communication about DRR cost versus benefit is discussed further in section 7.7.19.

**Recommendation 30 (motivation and DRR topics 3, 6, 9, 12):** All - Portray DRR achievement in terms of a variety of success indicators (e.g. in all 4 environments, 4Rs and 12 topics).

### 7.1.4 Post-event functionality, not only life-safety should be portrayed as a DRR goal

A particular framing that scholars in New Zealand consider will be more useful to citizens and society in general is 'post-event functionality' - rather than only 'life-safety'. The Canterbury earthquakes have heightened their awareness of the importance of post-event functionality.

DRR has long been said to be about more than life-safety (Showalter, 1993). According to Wilkins and Patterson (1987) 'lives lost' or 'life-safety' is a 'lay perception of risk'. This research showed that citizens do focus on life-safety and injury prevention (these accounted for most of the human consequence survey responses in Table 4.3). However this research has shown that 1) life-safety is the DRR goal frame that New Zealand policy and makers (officials and politicians) *and* scientists most often mentioned when they were media sources, and 2) there is little more that officials, scientists in other disciplines, or citizens can readily know about post-event functionality as a goal since it is 'lives lost' data that is regularly provided to citizens (for example in 'Summary on Event' subgroup of stories).

This second point is hardly surprising though since global earthquake-related research databases such as CATDAT (EM-DAT, 2014) have only relatively recently added data for number of persons affected, or financial loss figures. In respect of the second point one needs to understand that earthquake resistant design is very high in New Zealand, and the corresponding New Zealand design codes have been the basis for seismic design codes world-wide since the early 1980s (H. Cowan et al., 2009). Those codes are based on life-safety (DBH, 2005). This was never expressly stated in the New Zealand media articles television broadcast items examined.

Some have asked whether life-safety is still a valid performance target for design performance of modern structures (e.g. Kam & Pampanin, 2011). In New Zealand those involved in natural hazard research, research in Canterbury after the earthquakes, and DRR projects such as ‘Wellington: It’s Our Fault’ speak of the importance of achieving post-event functionality, not only life-safety (personal communication, Dr Russ van Dissen, Hochstetter lecture 13 September 2011). In interview Dr Pampinin a civil engineering academic from the University of Canterbury noted with some dismay that not only was life-safety the dominant framing in the media, but also in consultation documents regarding changes to the building code.

Examples of such framing include:

> *MP Clayton Cosgrove said it would be "common sense" to support the recommendations. "When experts come to a commission with recommendations and proposals about heeding the loss of life, then they all have to be taken extremely seriously," he said.*
>
> “Earthquake-Strengthening Steel Rods Failed in Christchurch” (Gates & Carville, 2011)

Nelson City council's environmental information officer’s Rob Smith’s statement in “Liquefaction risk tagged” (Murdoch, 2011) *“No-one died from the effect of liquefaction in Christchurch's earthquakes, he said. Its main issue was property damage.”* illustrates the framing of property damage as being of far lesser importance than death.

The perpetuation of the life-safety framing as the ultimate or only goal post-Canterbury was referred to as a lesson not having been learnt. Dr Pampanin questioned whether New Zealanders who were involved in consultation on earthquake prone building policy understood that life-safety was the focus of the policies, and whether they would be comfortable with this if they knew.

In Stuff article “Quake policy nears completion” (Fairfax NZ News, 2010a) published before the Canterbury earthquakes, there was reference to commercial buildings built before 1976 as likely being earthquake-prone. However there was no mention of either the relevance of the 1976 date, or a definition of earthquake-prone. Both could have been provided in no more than an extra sentence.

An emphasis on life-safety has significant ramifications for DRR in New Zealand as it informs such things as New Zealand’s Earthquake-prone-building policy (e.g. TTAC-Limited, Taig, & GNS-Science, 2012). There was no mention in the aforementioned report of the 15% GDP or other social, cultural, environmental or economic losses, including the fact that New Zealand’s second major city will likely not be rebuilt for at least 20 years (see section 7.5.7).

Few citizen survey respondents mentioned the need for post-event functionality to be communicated. It was however implicit in the distress communicated by Cantabrian respondents, and by citizen sources in the media that DRR actions need to achieve more than a reduction of loss of life.

**Recommendation 31 (motivation):** Any/All - Post-event functionality should be portrayed as a DRR goal (not only life-safety).

The information citizens require in order to be involved in setting the criteria against which DRR assessments are made, and cost: benefit analyses that have more than life-safety as the sole goal are discussed in sections 1.1.1 and 7.7.20.

A further point is made by Borah (2009) who noted that visual frame types in the media emphasised 'lives lost' rather than 'lives saved' and suggested that the imbalance needed remedying. This echoes the need for a solutions focus in discussed in section 7.6.5 and becomes recommendation 61 (p. 445).

In short, for communications to be 'considerate' citizen's information needs should be ascertained.

**Recommendation 32 (motivation):** Any/All – Research is required to determine what information aligns with citizen needs.

-blank-

## 7.2 Attributing responsibility in DRR

*After a disaster or a risk event occurs, a variety of social actors, including the media, are involved in a struggle to define what happened and why, and what can be expected in the future*

Vasterman et al. (2005)

### 7.2.1 Responsibility for DRR and accountability for disaster are distinct

In this research it has been considered important to clearly differentiate between 1) accountability for DRR failings (which typically results in disaster), and 2) responsibility for DRR solutions. There is also a third type of responsibility that has been considered in this research and that is, 3) the responsibility for DRR communication. This third type relates to experts in all disciplines being responsible for communication as was discussed in Chapter 5.

Responsibility for disaster is implicit in media stories that include attribute blame or discuss accountability for failings (disaster). Much of the discussion in the science-, risk- and disaster communication literature has focused on the accountability for problems; the contributing or exacerbating factors in disaster, i.e. cause, or ‘accepting responsibility’ for past failures (cf. Hendriks, 2005). However responsibility has another dimension, ‘taking on responsibility’ for solutions, and this, not only culpability should be communicated. Clear communication of responsibilities in DRR is required (Godschalk et al., 2003; G. Gregory et al., 1997).

**Recommendation 33 (responsibility):** Any/All - Responsibility for DRR not only accountability for disaster should be showcased in the media.

### 7.2.2 Natural-hazard-media responsibility and accountability studies typically did not acknowledge similar studies

Over 10% of the natural hazard-media content analyses relate to some form of study of responsibility or accountability (e.g. Alexander, 1980; Barnes et al., 2008; Bellegarde-Smith, 2011; Benoit & Henson, 2009; Brunn, 2010; A. Burgess, 2012; Gros, 2011; A. Hall, 2011; Harwell, 2000; Holm, 2012; Hornig et al., 1991; Littlefield & Quenette, 2007; Low, Varughese, & Pang, 2011; Robert Park, 1995; Pasquarè & Oppizzi, 2012; Pasquarè & Pozzetti, 2007; Paveglio et al., 2011; Phillips, 1986; Spencer & Triche, 1994).

However this is the first study to collate findings from previous studies. The aspects studied varied from depiction of cause and responsibility in newspapers, portrayal of earthquake cause in literature, government responsibility and politicians' image repair or media influence on portrayal of volunteers. Perhaps because of the variability of approach, from focus on the hazard (earthquake) to individual or political responsibility, it was uncommon for any of these studies to mention other research. None of the studies collate previous research about individual framing of responsibility, let alone framing of responsibility in relation to a variety of stakeholders.

### 7.2.3 Empowering individuals through improved media framing of locus of control and self-efficacy is important

If people do not recognise individual responsibilities for DRR this contributes to worse disaster consequences (cause 6e). This subsection provides five recommendations that relate to the ways that individual responsibility may be best framed to achieve DRR.

In a democracy where public participatory process is an aim, citizens should not only have the right to define risks but to determine which risk management measures are to be implemented. Citizen empowerment is important (Pomeroy, 2010; Schanne & Meier, 1992) – see Table 4.2. See also quote from an interviewee in this research in section 4.3.2 (p. 176).

Recommendations that risk communications should illustrate or demonstrate DRR-related-self-efficacy or locus of control have derived from a variety of research perspectives. The likes of Renn (1998b) suggest portrayal of self-efficacy from a democratic-public-participatory-communicative ideal perspective.

Most researchers have shown value in terms of uptake of particular DRR behaviours. For example Duval and Mulilis (1999), Lindell and Whitney (2000), and Paton et al. (2001) have all shown that individuals who have a high degree of confidence in their abilities to reduce risk are likely to engage in risk reducing behaviours. Paton and colleagues' research into preparation for seismic and volcanic hazards in New Zealand has shown that it is important for individuals to recognise their own responsibility for DRR (Paton et al., 2001; Paton et al., 2003). Showing citizens the value of DRR in specific situations reduces the beliefs that there is nothing that can be done to mitigate earthquake risks (fatalism).

People rarely have the opportunity to assess the effectiveness of mitigation measures from direct experience and are therefore reliant on information and advice from expert sources as to which actions are likely to have the outcome of increased DRR. Following from the discussion in Chapter 4, Ledingham's (1985) potentially top-down suggestion of providing the 'appropriate' action may be considered ethically appropriate if the evidence basis for the suggestion is provided. The actions should be linked to outcomes (Basolo et al., 2009).

Practical knowledge is required; information about possibilities for individuals to engage in DRR (ter Huurne & Gutteling, 2009). Spencer et al. (1992) found that the public reacted more to television reports of effective responses to hazard than of the hazard's *consequences*. The implication was that this was because the television reports provided behavioural models that may be imitated. Note that Spencer et al. (1992) suggested that television is best suited to showing responses, while newspapers are more suitable for detailed discussions of consequences.

Whether people internalise or externalise their locus of control has an effect on their actions and in particular predicts mitigation actions (Rotter & Strickland in McClure, Walkey, & Allen, 1999) and (Spittal, McClure, Siegert, & Walkey, 2008). Likewise attribution of personal responsibility is a factor in determining the adoption of seismic adjustments (Julia S. Becker et al., 2012; Jackson, 1981; Lindell & Perry, 2000; McClure, 2006; Mulilis & Duval, 1995). Such research has led to recommendations about how individual responsibility is portrayed in the media and is in part motivational, part responsibility framing. Emphasising that individuals (not only officials) can positively affect DRR is recommended (integrated into recommendation 35). An example of this is natural hazards planning being portrayed as something landowners can affect at an individual site level (Godschalk, Brody and Burby 2003).

Conversely, outrage may be caused by feelings of helplessness (Sandman, 1987). Since helplessness is counter to self-efficacy (Wilkins, 1985, 1986) any portrayal of individuals being unable to cope should be balanced with 'images' of efficacy. Flippancy toward lack of household preparation is likely to undermine positive portrayal of self-efficacy. This framing of household preparation was not uncommon (e.g. Boniface, 2009).

It is one thing to attribute responsibility for an action; it is another to demonstrate that those responsible are able to control the outcome, and have the capability to do so, or even the details of how that might be achieved. So that there is also a need to:

**Recommendation 34 (motivation and responsibility):** Any/All - Balance any portrayal of individuals being unable to cope with 'images' of efficacy.

In particular there is a need for, as (Paton, Bajek, et al., 2010, p. 779) put it;

> *show[ing] that and how risk management strategies may be dovetailed with community development activities that are immediate benefits showing a return on investment in everyday life, not just in the event of disaster at some indeterminate time in the future*.

The range of specific actions that might be suggested is detailed in section 7.6. To achieve perception of individual responsibility (Major, 1998) suggested using 'social influence' including 'testimonials' of leaders. Paek et al. (2010) suggested linking personal responsibility to familial or peer-group norms. For example, asking the question "What will your friends do, or your family want in an emergency?'' to establish subjective norms. An overarching recommendation regarding individual responsibility follows

**Recommendation 35 (responsibility and motivation):** All - Illustrate individual responsibility by showing DRR as something friends, family and leaders consider and act on.

Section 7.6.10 discusses the portrayal of helplessness in the New Zealand media.

### 7.2.4 Portray DRR as a shared responsibility in the media

> *The message needs to go out that mitigating a disaster is having a well-prepared, well-networked and engaged community who have planned for an event and its recovery, as well as emergency management teams who can swing into action when they have to*.
>
> Interviewee I020

Beyond individual factors *"collective efficacy has a positive effect on empowerment and empowerment tends to have a positive influence on adjustment intention, if relations between communities and authorities are trusting and respectful"* (Solberg et al., 2010, p. 167). Consequently it has been suggested that risk communications, like risk management will be most effective if they are viewed as every affected party's responsibility (Rowan, 1994b; UNISDR, 2015). Communications should delineate the boundaries between private and public responsibilities (McClure, 2006). J. Gregory and Miller (1998) suggested that it is a government responsibility to clearly communicate these expectations.

Paveglio et al. (2011) recommended that journalists and sources alike should be encouraged to frame of DRR as a shared responsibility.

The following subsections (7.2.5 and 7.26) explain that, and why it is recommended that there is a balance of frames suggesting both state and individual responsibility for DRR.

### 7.2.5 Portraying 'command post' official actions can impact on citizen involvement in DRR but is likely needed for resourcing

It has also been common for disaster media researchers to criticise the media for emphasising governmental or official actions, responsibilities and solutions. This was termed 'command post' by Quarantelli (1975) and Quarantelli (1981), and also discussed in papers such as Littlefield and Quenette (2007), B. F. Liu (2009), Masel-Walters and Hornig (1993), Hornig Priest et al. (2006), Quarantelli (1996c) and Wilkins (1986). Such framing has also been termed a bias towards 'organisational framing' (Spencer & Triche, 1994) or towards 'political or technological elites' (Nimmo, 1984). Tierney et al. (2006, p. 75) referred to "*strategic response measures*" being justified by media reports. Cox et al. (2008) referred to the media privileging 'expert discourse' over locals' specific, contextual, and experiential knowledge, and that the latter was minimized and constructed as potentially dangerous. Hiroi et al. (1985) suggested that excessive use of official sources resulted delays in reporting. The need for authorities' help was cemented and perpetuated by 'helpless victim' framing in the media (P. Hughes et al., 2007; Mitchell et al., 2000; Quarantelli, 1996c; Spencer & Triche, 1994; ter Huurne & Gutteling, 2009; Wilkins, 1985, 1986).

These comments were typically made without acknowledgment of the importance of authorities' actions in DRR and communication about those actions. If nothing else, both economic resources and political will are required to achieve DRR (Eiser et al., 2012). Disaster media researchers also rarely acknowledged that the media was simply continuing to portray what had been the prevailing DRR approach to responsibility for DRR.

Late in the 20th century the prevalent DRR message was one of expert and government decision-making and control of preparation and mitigation (Turner et al., 1986). Earthquakes were viewed as something governments considered on behalf of citizens. This became mirrored in citizen expectation. Russell, Goltz, and Bourque (1995) wrote that there was a public overestimation of government ability and willingness in response and recovery. Citizens from the USA and Japan surveyed by Palm (1998) indicated that *"individuals can not do much to prevent an earthquake from harming them, but that cities and communities can take actions to lessen the effects of earthquakes"* (Palm, 1998, p. 41). More recently in the USA Arceneaux and Stein (2006) found that local governments and mayors were typically held most responsible for natural disaster. By implication decision-makers and officials were then held responsible for DRR.

Increasingly however, there is a tendency for DRR advocates to define responsibility for DRR as being shared between government and community (Basolo et al., 2009). Top-down guidance, legislation and provision of resources are acknowledged as helpful, but DRR activities are best achieved at the local level with community involvement (Kelman & Mather, 2008). This requires a shift in the framing of responsibility from having governments and authorities as competent and willing protectors, to frames that support individual and community participation in DRR (de Jesus, 1995; Harries, 2008; Paton, 2006; Paton et al., 2001; Paton et al., 2003).

There has been discussion by disaster researchers as to whether governments and officials favour resilience framing over vulnerability framing because the resilience frame shifts the spotlight of responsibility from authorities to individuals and communities (personal communications RADIX, 2013-2016). To achieve a balance requires both frames to be communicated. This led to the recommendation that a mix of both vulnerability and resilience framing is communicated (Recommendation 29).

Part of the success of DRR lies with trust in those responsible for DRR. A note of caution is that trust in government and preparedness are also correlated (Basolo et al., 2009). High levels of trust in institutional measures for DRR may result in a transfer of responsibility that negatively influences perception of the value of individual DRR actions (Julia S. Becker et al., 2012; Sims & Baumann, 1983). Griffin et al (2008) showed causal attributions due to poor management to be linked to outrage, which in turn linked to greater perceived future flood risk and decreased trust in authorities, but also to increased levels of self-efficacy. Portrayal of successful government DRR initiatives should therefore be balanced with portrayal of the need for individual action and vice versa.

### 7.2.6 Attitudes to individual and government responsibility for DRR have changed with time

That a shift has occurred away from solely government responsibility framing described in the previous section (7.2.5) was reflected in survey results from Italy, where almost half of respondents surveyed after the L'Aquila earthquake believed government and citizens should be equally involved in earthquake safety (Marincioni, 2012).

Literature review and interviews conducted as part of this research confirm that the New Zealand government's approach to responsibility for DRR has mirrored this shared approach since 1995. For example the New Zealand Civil Defence and Emergency

Management (CDEM) vision is "A Resilient New Zealand – communities understanding and managing their hazard" (Finnis, 2004; MCDEM, 2005a). The CDEM Act 2002 places emphasis on local communities being self-sufficient in the event of a disaster (Daly, Becker, Parkes, Johnston, & Paton, 2009).

However according interviewees in this research, particularly I027 (an emergency manager involved in DRR programmes and the Canterbury response) still have concerns that too top-down an approach was conveyed in the media. Along with the use of the term 'Civil Defence' in New Zealand this was thought to be influencing a perception that authorities were responsible for, and taking care of all aspects of DRR except the household preparedness that has been the focus of Ministry of Civil Defence and Emergency Management media campaigns over the last decades.

This was likely because the Civil Defence Controller himself saw value in a 'command post' in response:

> *Because of my military background, I apply a military approach to it, rightly or wrongly. I think it's right in the urgency of the response, but that approach doesn't work in the recovery side of things.*
>
> "Many lessons learned says quake boss" (Heather, 2011b)

The discussion above shows that while attitude may have shifted authorities' views about and approaches to responsibility for DRR vary. Since there are such disparate views about the emphasis that should be given to individual and authorities' actions the default recommendation is to suggest a balanced representation of individual and institutional responsibility for DRR.

### 7.2.7 Portrayal of individual and government responsibility was relatively balanced in the New Zealand media

Recent media content analyses found high levels of government responsibility framing (Barnes et al., 2008; Fu et al., 2012; Pasquarè & Oppizzi, 2012).

Review of New Zealand media stories after the Canterbury earthquakes did not mirror this finding. Instead this study found that the framing of government and individual (citizen) responsibility was in some respects relatively even (for example in respect of portrayal of responsibility for DRR actions in all of the four phases of DRR through action emphasised in headline story types actions - as presented in Table 7.2.

**Table 7.2: Attribution of responsibility in NZ DRR-solution media story types**
The left hand column indicates whether the attribution of responsibility portrayed by the media story headline is A=authorities, I-individuals, B = Business or Mx- a mix of both. Story types in the New Zealand mass media that emphasise DRR solutions are shown in the second column from left. The story types relate to the phase of the DRR cycle shown in the third column (DRR solutions are discussed in section 7.6.3). The right hand column indicates the number of ODT articles published for each of the story types in the period 04 April 2008 to 03 January 2012.

| Attribution of Responsibility | DRR-solution story types | Phase of DRR cycle | No. ODT articles |
|---|---|---|---|
| A | Closure | Reduction | 13 |
| A | Code Compliance | Reduction | 3 |
| A | Codes Standards & Policies | Reduction | 28 |
| A | Construction Methods or Materials | Reduction | 17 |
| A | Development Hearings | Reduction | 3 |
| Mx | Drills (only one Emergency Medical Treatment) | Readiness | 11 |
| Mx | Future Insurance/reinsurance (range of article types) | Readiness | 103 |
| Mx | Heritage Building Matters | Readiness | 41 |
| A | Infrastructure Upgrade | Reduction | 3 |
| A | Land Use | Readiness | 4 |
| A | Monitoring or Warning Systems | Readiness | 7 |
| A | Government Assistance | Response | 37 |
| Mx | Insurance Claim Process or Repairs | Response | 14 |
| I | Fundraising/Donations by NZers (one Aid in Recovery – sports) | Response | 266 |
| IB | Businesses Helping Out | Response | 20 |
| I | Celebrity Involvement | Response | 12 |
| I | Celebrity Visit | Response | 9 |
| A | Leader Condolences | Response | 16 |
| A | Leader Visit | Response | 26 |
| Mx | Cleaning up | Response | 7 |
| A | International Aid | Response | 15 |
| I/IB | Accommodation/Break Away | Response | 24 |
| IB | Business Initiatives in Recovery | Recovery | 39 |
| A | Government Recovery Initiatives | Recovery | 50 |
| Mx | Commemoration or Memorial | Recovery | 44 |
| Mx | Recovery Milestones - Events in Recovery | Recovery | 21 |
| Mx | Return to Normal | Recovery | 59 |
| I | Citizens in Recovery (choices/actions in recovery) | Recovery | 10 |
| A | Political in Recovery | Recovery | 137 |
| I | (decision to) Stay or Go | Recovery | 63 |
| A | Environmental Rehabilitation | Recovery | 0 |
| I | Injury Rehabilitation | Recovery | 1 |
| Mx | Rebuild Plans & Vision & Logistics/Progressing & Skills Shortage | Recovery | 23 |
| Mx | Land Decisions (and Heritage Building Matters) – both | Recovery | 22 |
| Mx | Recycling or Not | Recovery | 1 |

Analysis showed that the media emphasised aspects of authorities actions that have only infrequently been discussed in detail in disaster media research. Mention is made in the literature of media functions in the areas of response leadership, and coordination. However the discussion has not emphasized the value of leaders or authorities raising awareness of issues that become important in response, such as staying away off the roads to reduce congestion, or speed restrictions due to the effect of vibrations on damaged buildings. However these topics of citizen concern and interest were not discussed in the media, nor were they researched in any detail. (The topics were known to be of interest or concern as the media, who had been surveying its reader panel specifically about Canterbury earthquake coverage (Futurescape-Global-Ltd, 2012) reported on those topics).

The New Zealand media after each major earthquake event dedicated much broadcast time and many press articles to response advice in the form of *Authorities Update* headline story types (see Chapter 5). These stories contained a range of authorities' raising of awareness of secondary and tertiary risks, and associated advice regarding possible response mitigation actions. These stories had as their sources, police, fire, and Civil Defence personnel, officials from various government Ministries, and local and Regional Council staff. The stories relate to infrastructure risks, the provision of aid (e.g. location of welfare centres or government grants). There were also messages from organizations such as Federated Farmers to check grain silos in case rain has leaked in and started spoiling grain, and from Irrigation New Zealand about electrocution risk to farmers and the need to turn power supplies off before heading into wet fields. A subset of this story type related to health advice to prevent disease, and included information such as the need to boil water for pets also.

There was however a tendency for authorities to announce decisions in the media without disclosing the evidence basis to the satisfaction of citizens (for example as noted in section 6.8.4) so that citizens felt their knowledge and views had not been considered.

There was also no portrayal of citizen involvement in, or information about the basis of earthquake-DRR-related policies. Survey respondents made no mention of their involvement in the development of DRR-related policy and legislation. It may be that this is a function of media portrayal.

Individuals, policy and legislation

More specifically Wilkins (1986, p. 7) observed that *"individuals, even in democracies, are portrayed as having relatively little control in establishing the policy agenda"*.

Mileti and Sorenson (1987, p. 191) took the view that the most effective risk reduction measures *"are not ones taken by individuals but those legislated or adopted by communities and by nations".* This was a view echoed by interviewees in this research, in particular those who were involved in policy and decision-making. Citizen involvement in DRR-related legislation was either too cumbersome from a 'consultative' point of view, citizens had no time or interest in being involved, or citizens did not have the knowledge to be involved. As Canterbury Medical Officer of Health (Interviewee I008) stated:

> *We've discussed this question at the World Health Organization, and my answer is always that the basis for a good emergency response is robust legislation – that's where you've got to start – you need to have legislation that gives organisations the mandate to respond in an organised way.*

As per the discussion about building code development in section 7.1.4 not all interviewees though share the view that citizens do not want to be involved in DRR-related decision-making. While Dr Humphrey (I008)'s approach is not consistent with contemporary practices relating to citizen participation it is important to note that citizens indicated in previous surveys, and again in this research, that they want and expect authorities' advice in response. The richer responses as to what needs to be communicated indicate that this advice should be provided along with the evidence-basis on which is the advice is being made.

Mentions of DRR by scientists and officials in the New Zealand media often referred to political actions being taken by policy- and decision-makers without mentioning mitigation measures individuals might undertake. Opportunities for non-expert individuals to influence policy or legislation were also missing. For example citizens were not involved in establishing acceptable risk thresholds for building codes set after the Canterbury earthquakes (cf. section 7.7). While there were references to and quotes from leaders of emergent recovery-related non-governmental organisations, there was little portrayal of the influence (if indeed there was any) of the NGOs on policy. This generates the following recommendation:

**Recommendation 36 (responsibility and motivation):** All - Broaden portrayal of individual empowerment (from preparation, through involvement in emergent groups, to involvement in policy agenda).

Leadership in the New Zealand media

The value and role of governance and leadership in DRR (in response and recovery and on into reduction was rarely discussed in the research literature let alone the media (as discussed in sections 2.5.6 and 6.11, and in glossary group 2 (Appendix 1). Political leadership is vital for DRR (de Jesus, 1995; UNISDR, 2015), particularly in relation to recovery (as was discussed in chapter 2).

In the natural hazard media research leadership has been analysed by a few typically in relation to image and image repair (Benoit, 1997; Benoit & Henson, 2009; Low et al., 2011), but also in terms of 'restorative rhetoric' (Griffin-Padgett & Allison, 2010).

Story types that emphasise leadership include *Leaders & Aid, Leader Condolences and Leader Visits.* Leaders also feature in *Latest Updates, Government Recovery Initiatives, Political in Recovery and Recovery Decisions* story types as well as *in Commemoration* or *Memorial, Remembering, Awards & Commemorations and Thanks for Relief* story types. (Leaders are also are the topic of criticism in *Citizen in Recovery* and other human-interest stories).

Analysis of the content of the aforementioned story types showed that leaders highlighted evidence of and the importance of solidarity, rallying together, community spirit and the positive as the quotes in Table 7.3 show. There were some who did not appreciate these types of comments from leaders for reasons discussed in section 7.6.10. Leaders also made comments about the role of science, as discussed in section 5.5.10. Quotations elsewhere in this thesis that highlight aspects of leadership are presented in sections 6.5.6 and 6.10 (see also Interviewee I029's comments in Appendix 10).

An overall recommendation for portrayal of responsibility for DRR

Reflecting on the discussion in this section, previous academic studies portray actions as *either* the responsibility of government, or citizens. Responsibility of businesses, or mixed responsibility (as shown in Table 7.2) does not appear to have been previously examined. The post-Canterbury reality would appear to be partnerships.

**Table 7.3: Leader's rallying comments during the Canterbury earthquakes**
These are quotes taking from Stuff articles, the first related to the Darfield earthquake, the second and third comments were made after the Port Hills earthquake and the fourth after the large June 13 2011 aftershocks.

> *Agriculture Minister David Carter said many farms remained without electricity, and that situation could last several days. "In true Kiwi spirit many of these farmers are not only dealing with damage to their own properties, but they're also helping out their neighbours," he said.*
>
> "Christchurch earthquake-latest updates" (NZPA, 2010i)

> *If there is anything positive to come out of this it is the prospect of having a better, brighter city than we had before. ..."He [Minister Gerry Brownlee] urged people to "find that Crusader spirit", saying: "We can come out of this really well if we do it right.*
>
> "Quake bill may reach $4b" (NZPA, 2010j)

> *There are those people who say this city is permanently munted and will never rise again. That is absolute bollocks," [Mayor] Mr Parker said.*
>
> "'People will die of this'" (Goodwin, 2011)

> *It [the June 13 aftershock) does not lessen our resolve to rebuild. People of Christchurch should know that all New Zealanders are thinking of them and will continue to support and standby them at this very difficult time. ... However he [the Prime Minister] said they were stoic people who would regroup.*
>
> "Key - NZers feel Christchurch's pain" (NZPA, 2011f)

As Interviewee I011 suggested:

> *The media should be getting us to question our value priority – do we want safer buildings in our country, for ourselves, for our families, for people in other cities in New Zealand? They should be reminding us that if so we should be demanding that our Governments think about DRR long-term well past electoral cycles, and we should be prepared to pay for them [safer buildings].*

Notwithstanding the other recommendations about the importance of emphasising individual responsibility this leads to the recommendation:

**Recommendation 37 (responsibility and motivation):** All - Frame DRR as a shared issue and responsibility; the responsibility of all of society - show DRR as being about individual and community participation, as well as an official institutional or government responsibility - a partnership in equal proportions where both individuals and officials can positively affect DRR.

## 7.3 DRR: overall portrayal, 4Rs, 12 DRR-topics, and environments

### 7.3.1 Overall representation of the 4Rs was unbalanced

All four phases of the DRR cycle should be represented for a full understanding of DRR (Chapter 2). This research has shown that academic interest in media, earthquake-research and the media all show similar patterns in respect of attention to the 4Rs (Table 7.4).

**Table 7.4: 4R focus of the various datasets**

Results of analysis of the focus on the four phases of the DRR cycle in various datasets as described in Tables 3.5 and 3.6, compared with the results from previous research by(Turner, 1982-year8). A visual representation of some of these results is presented in Figure 7.4.

| Data set | Readiness | Response | Recovery | Reduction |
|---|---|---|---|---|
| 20-earthquake—related research | 9.8 | 36.4 | 5.3 | 48.5 |
| Natural hazard media research | 18 | 55.3 | 12 | 14.7 |
| Survey Respondents/Interviewees Q2 and Q3 | 35.8 | 44.7 | 1 | 18.5 |
| Survey Respondents/Interviewees Q3 - better | 40.2 | 41.2 | 1.4 | 17.2 |
| TV1 all items before Darfield earthquake | 12.9 | 68.3 | 2.9 | 15.9 |
| ODT all items before Darfield earthquake | 15.1 | 65.1 | 4.1 | 15.6 |
| ODT all articles after Darfield earthquake | 7.8 | 51.9 | 34 | 6.3 |
| ODT only brief mentions after Darfield earthquake | 10 | 59.8 | 22.6 | 7.6 |
| TV1 all items after Darfield earthquake | 5.8 | 58.6 | 30 | 5.7 |
| 1000-STUFF articles selected for likely science content | 14.3 | 31.5 | 34.4 | 19.8 |
| TV1 all 2008-2011 | 6.3 | 59.2 | 28.2 | 6.3 |
| ODT all 2008-2011 | 8.8 | 54.1 | 29.6 | 7.6 |
| TV Turner, 1982) | 1.6 | 78.0 | 14.0 | 1.2 |
| Print news (Turner, 1982) | 2.9 | 80.0 | 9.0 | 2.4 |

Key observations from Table 7.4 are:

- earthquake research was reduction- and response-focused; none of the other datasets emphasised reduction to the degree researched
- while proportions of reduction articles are not high they are significantly more than for recovery when there has not been an earthquake event
- natural-hazard media research was response-focused

- historical US print media articles and television items analysed by Turner (1982) were less-balanced across each of the 4Rs than articles and items analysed in this research
- New Zealand television and distal print media (ODT) showed similar proportions before and after the Darfield earthquakes
- proportions of recovery-related media articles or items increased after the Darfield earthquake in both the ODT and on TV1
- proportions of readiness-related media articles or items decreased after the Darfield earthquake in both the ODT and television
- local Stuff articles provided a relatively balanced coverage in terms of the 4Rs
- New Zealand survey and interview respondents emphasised the importance of readiness
- survey and interview respondents' mention of a recovery topic was proportionately low (only 4% of Aucklanders mentioned recovery, whilst from regions closer to Canterbury 20-32% mentioned recovery); and
- respondent attention to recovery and reduction broadly mirrored that of pre-Darfield TV1 and ODT coverage.

Recent media content analyses have begun to include analysis for coverage across the 4Rs (Barnes et al., 2008; Houston et al., 2012; O'Brien et al., 2010; Steelman & McCaffrey, 2013). Some researchers have remarked on the fact that the focus of research into DRR communication itself has been on a limited range of DRR actions in the preparatory readiness phase (e.g. Steelman & McCaffrey, 2013). This they acknowledge as having less than desirable implications for societal understanding of the possibilities in risk management in other phases, such as response. However a few, including Steelman and McCaffrey have extended their analysis or discussion into long-term recovery or beyond into long-term inter-disaster reduction. This research showed that recovery-related media content analyses account for less than 15% of all media content analyses in the last 40 years. This imbalance is however, being increasingly addressed. All but five of the only twenty-five recovery-related articles relating to the analyses (out of a total 164 articles) were published recently, that is since 2005 - see Appendix 6.

Previous content analysts referred to a narrow focus by the media on the 'warning and impact phases of disaster' (e.g. Larson, 1980). The event and the response stages were said to generate most interest with longer term recovery, mitigation and preparedness generating considerably less media interest, if any (Fischer, 1994; O'Brien et al., 2010). Where quantitative results with respect to media attention could be found, they were remarkably similar to those from other research. For example Wilkins (1985) found 68% of media coverage related to impact and immediate post-disaster response. Results from this research were within a few percentage points of this for both television and print media for pre-Darfield coverage (Table 7.4).

Before the Darfield earthquake media coverage of recovery (mostly relating to international disasters - Chapter 5) was limited (Figure 7.1 a). However for the Darfield event recovery coverage increased as a proportion of the total coverage in both local and national media (Figure 7.1b, c and Table 7.4).

**Recommendation 38 (DRR topics 1, 3, 10, 11, 12):** Media and DRR advocates - More recovery and reduction media story frames need to be used to achieve a better balance of attention before, during and after disasters occur (balancing 4Rs).

For example the article “Pain, fear, despair and dehydration” (Chug, 2011b) emphasised negative consequences when in fact the body text of the article contained science comment about ways of coping, which might have been portrayed simply by adding the word ‘Avoid’ or ‘conquer’ to the headline.

Comment about coverage of the four phases follows in section 7.3.3, after a summary of citizen comment about the communication of DRR topics.

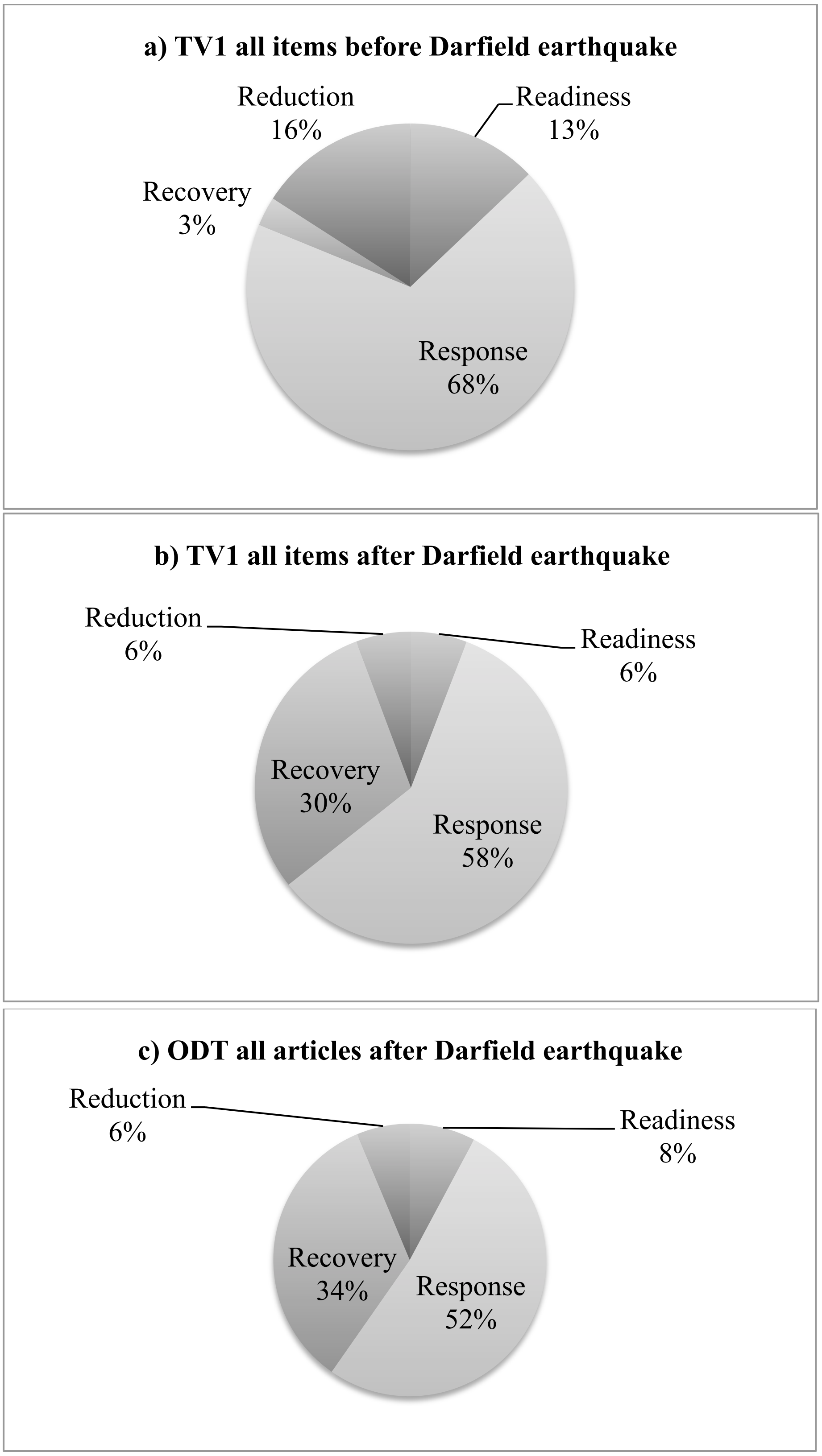



**Figure 7.1: Visual representation of 4R focus of selected datasets – this research**
Visual representation of the four phases of the DRR cycle (4R) focus in online television and print media items a) before the Darfield earthquake, b) after the Darfield earthquake and c) in the ODT after the Darfield earthquake. The 4Rs are as decribed in sections 2.5.3-2.5.6.

### 7.3.2 Interviewees provided a wide range of comments about DRR information in the media

Interviewees made comments as summarised below about the communication of DRR (as it related to communication regarding the Canterbury earthquakes). A series of narratives in Appendix 10 provide a précis of the interviewee comments on DRR information.

In terms of background information (DRR topic 1) some suggested there should be less detail about scientific topics, and in particular about geology. Many interviewees commented that citizens needed to know about the range of hazards including hazards secondary to earthquakes such as liquefaction and tsunamis, and that aftershocks may continue for years. One interviewee suggested earthquake precursors and cycles and patterns of earthquakes rather than single or 'unusual events', and another that it is important to understand that damaging earthquakes can occur away from a major plate boundary. The need for more communication of engineering topics was also a general theme. A number of interviewees suggested that building codes was a topic that had been particularly poorly communicated.

Knowledge about possible consequences was a topic (DRR 7 or 10) raised in some form by nearly all interviewees. The need for more knowledge about possible economic consequences, both the direct and indirect costs of earthquakes, was raised by a third of interviewees. Other comments ranged from *"this is what your city will look like (not if, but when) an earthquake occurs"* (I002), to a need to understand that aftershocks can cause considerable, cumulative damage, the need to better understand that infrastructure damage may mean that residents in a disaster area will need to survive independently for weeks not only a few days, and possible long-term psychological effects of disasters.

Some Cantabrian interviewees thought it would be useful for citizens to know how difficult and long recovery could be, others thought there should be more positive stories about recovery and lessons learnt elsewhere about recovery.

There was only one comment (from interviewee I015) about the need to know about the cause (topic 4) of disaster *"people need to know that people make a disaster not the hazard"*.

Many comments were about how warnings could be considerably improved (primarily topic 2). Interviewee I019 suggested that there should be messaging that *"earthquake (or natural hazard) risk is ever present and therefore that there is an urgent need for risk* *reduction"*, and I012 *"that there is risk in every region and you pick your risk depending on where you live"*.

Other suggestions included:

- better aftershock forecasting and more information about tsunami risk
- emphasising that there is no reliable short-term earthquake prediction
- avoiding hazard maps with red and green as these do not give a clear understanding that low risk does not equal no risk; earthquakes can happen anywhere in New Zealand
- recognising that probabilistic statements are often misinterpreted
- not labelling media articles and items that raise risk awareness items as alarmist; and
- the possible value of a weekly earthquake forecast to 'normalise' the topic of earthquake risk.

Over half the interviewees mentioned the importance of communicating about the vulnerability of the built environment in some way. There should be more information about likely building and infrastructure performance. The term *'earthquake–proof buildings'* should be avoided as there is no such thing. A scientist suggested that the interface between seismic hazard models and the building code should be better communicated.

Most interviewees mentioned the need for all citizens to know some pragmatic measures or the range of possible solutions and steps that can be taken to reduce risk. Most commonly mentioned mitigation topics to be communicated or better communicated were insurance, land use planning and land mitigation, building codes, materials and design options.

The importance and value of innovation (particularly innovative New Zealand design), social connectivity, flexibility and adaptation and 'connected self-reliance' in response and recovery; that preparation is about people, not only earthquake kits was emphasised by all DRR advocates and Canterbury recovery leaders.

The need to take personal responsibility for DRR was a theme. Some interviewees suggested that information about household preparations 'suitable actions on event' be expanded on. For example not to focus on 'Drop, Cover and Hold', and instead be prided with suggestions for what to do if in different locations (e.g. in a car, as a pedestrian, in a rural environment, etc.). Examples given of ways to expand on ‘preparation by stocking a survival kit’ were preparing through knowledge of first-aid and about hygiene, getting to know neighbours, and planning to support the vulnerable in response.

Open communication of practical logistical matters from authorities in response (topics 7-9) was an expectation, including better communication of who to contact about which issues and where to get help. Interviewees thought that post-earthquake assessments of all types could be explained better, including stickering and explanation of the reasons for evacuations and cordons.

Interviewees, as did survey respondents, often mentioned the need for simple evidence-based information to inform individual decision-making (particularly in recovery) or about authorities’ risk reduction decision-making (e.g. the choices that authorities make on citizens’ behalf about infrastructure).

Unity between different organizations in providing collective answers and comment about issues was sought, as was transparency of the costs of risk management options (including with respect to heritage buildings and rebuild options).

I013 and I019 stressed that it is particularly important to know that the additional costs to achieve mitigation are not always high. In particular the cost of securing contents is not high. I027 thought a discussion should be introduced about the things that prevent people from preparing (e.g. most leases prevent people from securing things to walls).

The need to communicate the implications of not mitigating risk, and various aspects of the pros and cons of the various options in DRR were also frequently mentioned (risk assessment topics 2, 5, 8 and 11). Interview respondents (and survey respondents) indicated they would like more discussion about acceptable risk, risk tolerance and liability in risk management. Experts indicated that they thought there needed to be more communication about risk balancing - the trade-off between accepting some exposure to risk, and reminding people about the residual risk that was accepted when a disaster happens.

Only one respondent (I022) mentioned DRR in a sustainability context.

### 7.3.3 Research- and media-attention to the 12 DRR topics was not balanced

The discussion in this section presumes attention to the various topics in DRR would ideally be evenly distributed (equating to approximately 8% for each of the 12 DRR topics).

Relative attention to the 12 DRR topics for the various datasets analysed in this research is presented in Table 7.4. Figure 7.2 provides a visual representation of the attention to the topics in the print news before the Darfield earthquake and television after the Darfield earthquake.

The science article data set showed the most even proportions of attention to the 12 topics

Of all the datasets natural hazard media research and the 1000-Stuff science article dataset showed the most even proportions of the DRR topics. That said natural hazard media research has not often looked at how background information about earth science is communicated (4%), compared with the predominantly hazard-related research output of 25.6%.

Both media research and academic earthquake research outputs after earthquake events were high for topic 7 (consequences of event). Greatest emphasis on a topic in the media was for topic 7 before the Darfield earthquake. Survey respondents and interviewees placed most attention on topic 7 also. Proportions of portrayal of topic 7 were similar to portrayal in all media after the Darfield earthquake. Note that on television topics 3, 4, 8 and 11 (mitigation, cause and response and recovery assessments) were not mentioned in pre-Darfield coverage. Communication about cause of disaster and even cause of earthquake (topic 4) remained negligible after the Darfield earthquake on television and in all print media.

The ODT stood out in terms of its coverage of long-term consequences (Table 7.5). The ODT's coverage of consequences in the recovery period (topic 10) was even higher than on the STUFF website which was dominated by news from the local Christchurch Press.

The number of articles and items for each of the DRR topics increased many-fold after the Darfield earthquake (for example see Table 7.6 for television item numbers before and after the Darfield earthquake). All story topics except topic 4 (cause) increased significantly in broadcast coverage after the Darfield earthquake. So the earthquake event brought to people's attention warnings and mitigation stories, although the percentage increase of those story types was not as great as response and recovery stories.

Table 7.4 and Figure 7.2b show that science topics were reported in Stuff relatively evenly across the twelve DRR topics (particularly in comparison with the ODT). Structural mitigation - design, technology and construction (topic 3), cause (topic 4) and preparation (topic 6) and needs assessments (topic 8), were however under-represented.

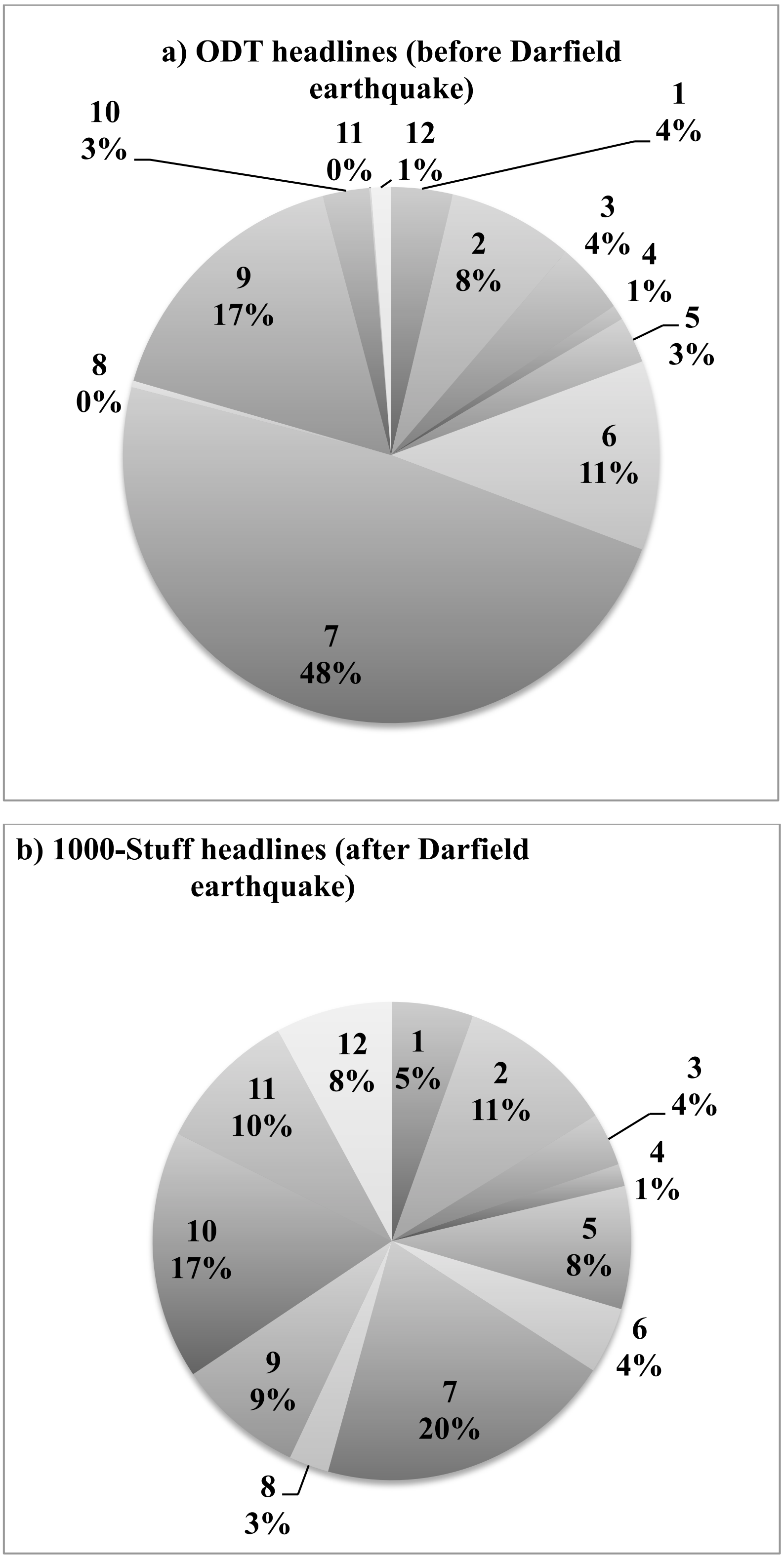



**Figure 7.2: DRR topics in the New Zealand media**

Visual representation of the DRR topic focus in online print media headlines a) in the ODT before the Darfield earthquake, and b) in Stuff headlines after the Darfield earthquake (as per Table 7.2). The twelve topics are as depicted in Figure 3.5. For descriptions of the twelve topics see Table 3.20 and 3.21.

### Table 7.5: DRR topics in the New Zealand media

For each of various datasets shown in the left hand column, columns to the right showpercentage attention to each of the 12 DRR-topics (Figure 3.7; Table 3.18). Note that in this study the percentage attention is not purely the number of articles/items or responses but a weighting of up to three topic codes per article headline (see Table 7.5). Where proportions are approximately 8% they are around the expected proportion (100/12 topics); less and the topic is under-represented. See Figure 7.1 for visual representation of some of the data in this table.

| | DRR topic code (% attention to) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dataset** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Natural hazard media research articles | 4 | 7.1 | 3.6 | 6.3 | 4.4 | 7.3 | 21.6 | 13.7 | 20 | 4.4 | 3 | 4.6 |
| Earthquake-related academic research titles | 26.4 | 11.6 | 10.5 | 1 | 4.1 | 4.7 | 25.1 | 0.8 | 10.5 | 3 | 1.1 | 1.3 |
| TV1 items before Darfield earthquake | 3.9 | 12 | 0 | 0 | 6.1 | 6.8 | 48.9 | 0 | 19.4 | 1.9 | 0 | 1 |
| ODT headlines before Darfield earthquake | 3.7 | 7.6 | 4.3 | 0.9 | 2.8 | 11.4 | 48.3 | 0.4 | 16.4 | 2.8 | 0.1 | 1.2 |
| ODT headlines after Darfield earthquake | 1.7 | 2.7 | 1.9 | 0.8 | 2.8 | 4.2 | 29.9 | 1.7 | 20.3 | 24.8 | 1.7 | 7.5 |
| ODT headlines after Darfield earthquake (no brief mentions) | 2 | 3.6 | 2 | 0.9 | 3.9 | 5.2 | 32.3 | 2.6 | 24.9 | 9.3 | 2.4 | 10.9 |
| TV1 items after Darfield earthquake | 1.7 | 2.8 | 1.2 | 0.2 | 3.7 | 1.9 | 26.5 | 3.4 | 28.7 | 8 | 6.2 | 15.8 |
| 1000-Stuff articles (after Darfield earthquake) | 5.5 | 10.7 | 3.6 | 1.5 | 8.3 | 4.5 | 20.2 | 2.7 | 8.6 | 16.8 | 9.7 | 7.9 |
| Barnes (2008) – after Hurricane Katrina | - | - | 1.4-3.1 | - | - | 4.6-10.4 | - | - | - | - | - | - |
| Women's magazine articles – NZWW (2008-2011) | 7.6 | 0 | 0 | 0 | 0 | 1.3 | 40.6 | 0 | 32.1 | 0.9 | 0 | 17.4 |
| Women's magazine articles – NEXT (2008-1011) | 11.8 | 0 | 0 | 0 | 0 | 13.2 | 25.0 | 0 | 27.9 | 13.2 | 0 | 8.8 |
| TV1 all items (2008-2011) | 1.8 | 3.4 | 1.1 | 0.2 | 3.9 | 2.2 | 27.9 | 3.2 | 28.1 | 7.6 | 5.8 | 14.8 |
| ODT all articles (2008-2011 | 1.9 | 3.4 | 2.3 | 0.7 | 2.8 | 5.3 | 32.7 | 1.6 | 19.8 | 21.5 | 1.5 | 6.6 |
| Survey/interview responses (both Questions 2 & 3) | 2 | 9.25 | 7.4 | 4.8 | 5.6 | 28.35 | 34.3 | 1 | 6.25 | 0.5 | 0.15 | 0.4 |
| Survey/interview responses (better – Question 3 only) | 3.1 | 10.2 | 7.4 | 4.5 | 2.7 | 31.2 | 32.8 | 0.5 | 6.6 | 0.4 | 0.2 | 0.4 |

**Table 7.6: Number of television items for each primary DRR topic**

The number of television (TV1) items for each DRR code (Figure 3.7; Table 3.18) is shown separately before and after Darfield earthquake. When comparing with Table 7.4 although the percentage of overall items may have reduced after the Darfield earthquake the number of items has still increased (e.g. topic 6).

| DRR topic | Number of TV1 items | |
|---|---|---|
| | before Darfield | after Darfield |
| 1 | 4 | 22 |
| 2 | 11 | 37 |
| 3 | 0 | 16 |
| 4 | 0 | 3 |
| 5 | 6 | 49 |
| 6 | 6 | 25 |
| 7 | 43 | 348 |
| 8 | 0 | 45 |
| 9 | 18 | 378 |
| 10 | 2 | 105 |
| 11 | 0 | 82 |
| 12 | 1 | 208 |
| All | 90 | 1317 |

Conclusions from the analysis of New Zealand media are likely to apply elsewhere

It has been difficult to find data from previous research to compare with the results of this research (Table 7.5). This is because historically researchers have used different coding criteria. Wilkins (1986) wrote that only 4% of stories analysed were stories of pre-disaster hazard mitigation (topic 3 this study) and preparedness (topic 6 this study) or pre-disaster hazard prediction. This is similar to the overall TV1 coverage in this study (1.1% for topic 3 and 2.2% for topic 6 – total 3.3%). Proportions of coverage also broadly match those recorded by Barnes et al. (2008). Barnes et al. and Wilkins' results show that at least some of the findings in this research are comparable to overseas media content analyses. This means that conclusions and recommendations made here on the basis of the analysis of New Zealand media in relation to DRR topic frames are likely to be relevant to media in other countries.

Attention to risk management topics varied between different media

Proportionally both television and print media representation of preparation (topic 6) dropped significantly after the Darfield earthquake. However before the Darfield earthquake print media ODT dedicated 11.4% of its earthquake-related articles to preparation topics, and 4.3% to structural mitigation (this was twice the proportion of stories identified by Barnes (2008) whose results for these two topics combined was 8.5%).

Before the Darfield earthquake though the percentages for the two topics combined (topics 3 and 6) were considerably higher (6.8% for television and 15.7% for the ODT - see results rows 4 and 5 in Table 7.4).

Television placed considerably less attention than print media on the two risk management solutions topics both before and after the Darfield earthquake. On TV1 before the Canterbury earthquakes attention to topic 3 was 0% and topic 6 6.8%. This was even less after the Canterbury earthquakes (1.2% and 1.9% respectively). Of the media examined television was the medium where citizens are likely to have learnt more about DRR solutions in response and recovery. Online print news communicated more about DRR solutions in reduction and response.

If one compares overall results on-line print news and television are remarkably similar except in relation to the attention to response actions (topic 9 - higher for television) and recovery consequences (topic 10 - higher for the ODT). Comparing only the post-Darfield television and Stuff results for topics 9 and 10 one sees the same proportional variation.

Women's magazines provided many stories about preparation

Both women's magazines showed quite similar results to each other except that NEXT included more stories about preparation (topic 6). Women's magazines do not provide even medium- to long-term risk or warning stories, and thus do not meet citizen needs in that respect.

Reduction and readiness-related articles increased in number after the Darfield earthquake

In both television and print media proportionate coverage of reduction topics decreased after the Darfield earthquake (sum of topics 1-3 in television items down from 15.9% before to 5.7%). This was also the case for readiness topics (sum of topics 4-6 in television items down from 14.9% to 5.8% after the Darfield earthquake). Note however that there were almost 15 times as many television items about earthquakes in the same time frame after the Darfield earthquake, as there were before. This meant that while the percentage of coverage of a topic was proportionately low, there were still many more items that might have been viewed about DRR after an earthquake-related disaster than before the Darfield earthquake occurred.

Figure 7.2a shows that headlines in online print media articles before the Darfield earthquake were strongly consequence- and response-action-focused (topics 7 and 9 respectively).

Attention was primarily on DRR actions in response

Headline framing in New Zealand media articles emphasised actions in response (topic 9). Television, women's magazine and ODT datasets alike, both before and during the Canterbury earthquakes all paid between 20 and 30% of headline attention to actions in response (Table 7.3) This was typically only slightly less than the attention to response consequences. The only exception was ODT headlines before the Darfield earthquake at 16.4%. Response topics would benefit from representation of response assessments that drive the actions (as these are poorly represented in all datasets – see 7.7.21).

Note that while it is correct that natural hazard media research article headlines suggested consideration of response-needs topics there was very little analysis or comment relating to representation of the assessments. This is also true for assessments in other phases of the DRR cycle.

Recovery was poorly covered in the media prior to the Darfield earthquake

*"Recovery is about more than restoring physical infrastructure."* (Spee, 2008).

The conclusion that media don't cover recovery issues to the fullest made by Caldwell et al. (1979) held in respect of New Zealand media coverage prior to the Darfield earthquakes.

In this research the body text of the 'Recovery Assessments & Initiatives' group of stories published after the Darfield earthquake was found to cover the full range of recovery topics from consequences (topic 10) through to assessments (topic 11) and descriptions of the recovery initiatives themselves (topic 12). (This is rather than the story headline focusing on one of these topics). Similar to response coverage recovery needs assessments were mentioned but little detail was given (section 7.7.21).

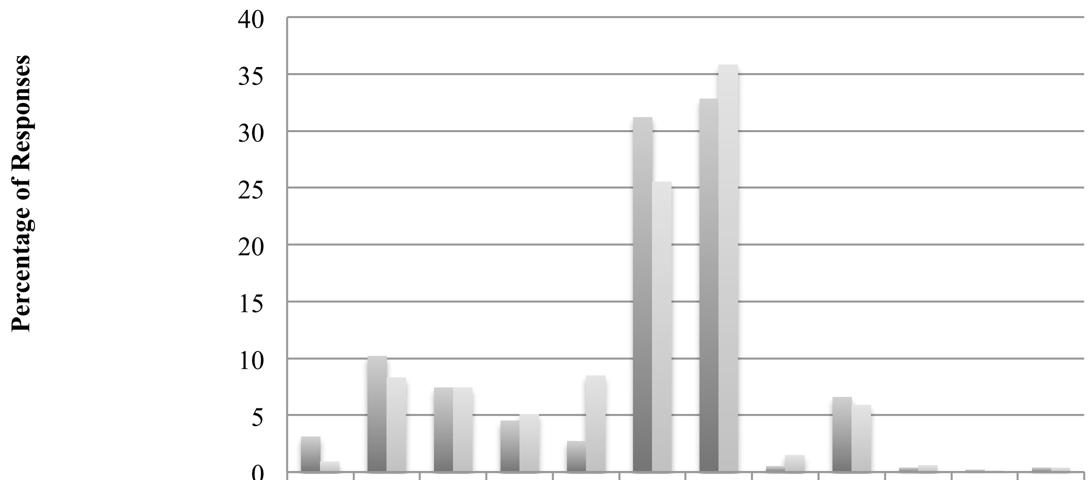
Specific recommendations relating to the observations made in this section were developed and are presented in later sections.

### 7.3.4 Survey and interview respondent attention to the 12 DRR topics was response focused

Survey and interview respondents' answers to Questions 2 and 3 showed a generally similar focus on what should be communicated and to which topics should have, in their view, been *better* communicated (Figure 7.3).

Background knowledge (topic 1) did not need to be better communicated (note that this was typically in respect to earth science as this was what most respondents appeared to consider that earthquake-related science is). Warnings (topic 2) and preparation (topic 6) were also topics that respondents mentioned less in terms of better communication than they did in answer to Question 2 (what needed to be communicated).

Of all topics mentioned by respondents as needing to be communicated it was audits, reviews and lessons learnt (topic 5) that needed to be much better communicated, three times as many respondents thought aspects of topic 5 should be better communicated than it was. Respondents also indicated a particular need for more, or better information about consequences (topic 7) than was provided before the Darfield earthquake.




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WHAT should be better communicated (Q2) | 3.1 | 10.2 | 7.4 | 4.5 | 2.7 | 31.2 | 32.8 | 0.5 | 6.6 | 0.4 | 0.2 | 0.4 |
| What should be BETTER communicated (Q3) | 0.9 | 8.3 | 7.4 | 5.1 | 8.5 | 25.5 | 35.8 | 1.5 | 5.9 | 0.6 | 0.1 | 0.4 |

**Figure 7.3: Respondent views about communication of DRR topics**

Visual representation of, and data table showing, the focus of responses to Questions 2 and 3 of the survey and interview of New Zealanders (methodology section 3.3). The number of respondents was 470. Respondents were primarily Cantabrians who had experienced an earthquake-related disaster and Aucklanders who have not experienced a damaging earthquake.

Most respondents, and particularly the Aucklanders who have never experienced an earthquake emphasised the importance of individual preparedness (part of topic 6), and knowing what might happen (potential consequences) and has happened in response (topic 7). This is what the media have also focused on (see Table 7.4 and Figure 7.3). Respondents clearly had in mind the need for preparedness, regardless of whether they were acting on this or not (cf. survey results reported in the media, such as in television item “Most Kiwis ill-prepared for major shake” (TV1, 2009-04-08)).

Half of the respondents who indicated that cause (either of earthquakes or of disasters) needed to be better communicated were DRR researchers or earth scientists. Presumably the other respondents considered that cause was well known and did not require explanation (analysis also showed there were few media articles dedicated to topic 4). This is interesting given the complexities of causal framing uncovered in this research as discussed in detail in section 7.4.

Respondents overall did not mention needing to know about recovery (topics, 10, 11 and 12). This reflects what was in the media before the Canterbury earthquakes rather than afterward. This has been interpreted as a case of media content framing particular topics as important, and, not knowing what citizens take as being important. Supporting this also is that 23% of Cantabrian respondents specifically asked for better communication of long-term consequences (topic 10) whereas those with less experience of recovery and its importance do not suggest any of the recovery topics should be better communicated.

Of all of the DRR analysis or evaluation topics (2,5,8,11) respondents primarily focused on wanting pre-event warnings (topic 2).

Of all of the DRR solutions topics (3,6,9,12) respondents indicated individual preparation (part of topic 6) needed to be communicated, however fewer gave examples of how it needed to be better communicated.

Survey respondents and interviewees wanted to know about the actions that all the different characters in DRR are undertaking, with perhaps the exception of the media (Table 7.7). DRR activities by businesses and corporates were emphasised by interviewee I004 (CEO of the Canterbury Chamber of Commerce) but otherwise rarely mentioned. Respondents were particularly interested in the actions that they as individuals might or should undertake. They expected both warnings (and associated advice) and explanations to be provided by scientists. Respondents only rarely mentioned collective community actions.

Summing references to emergency management by central, local and regional government and other authorities shows that respondents evenly mentioned authorities' (22.4%) and individual (21%) actions in DRR. Note though that the individual actions mentioned were typically limited to household preparations and survival actions on event (section 7.6). Survey respondents indicated that advice is expected and needed from scientists. However they ask for information and advice that goes beyond preparing an earthquake kit (section 7.6.6).

**Table 7.7: Survey respondent mentions of characters in DRR**

These are mentions in response to open questions 2 and 3. These are not responses to specific questions about who is responsible for DRR, or communicating it.

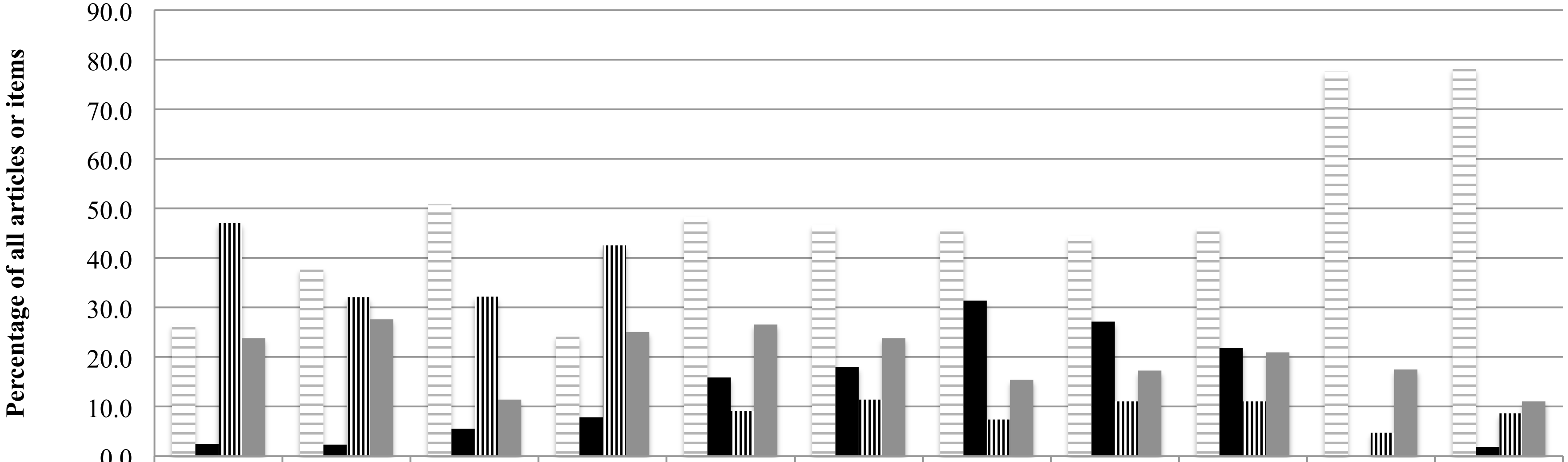
| Stakeholder group | Q2 | % total Q2 | Q3 | % total Q3 |
|---|---|---|---|---|
| Individuals | 153 | 21.0 | 346 | 32.3 |
| Central government | 30 | 4.1 | 23 | 2.1 |
| Local/regional government | 14 | 1.9 | 17 | 1.6 |
| Scientists warning | 186 | 25.5 | 233 | 21.8 |
| Scientists explaining | 49 | 6.7 | 43 | 4.0 |
| Emergency management | 47 | 6.4 | 68 | 6.3 |
| Other authorities | 73 | 10.0 | 126 | 11.8 |
| Business | 35 | 4.8 | 22 | 2.1 |
| Community | 15 | 2.1 | 29 | 2.7 |
| Media | 6 | 0.8 | 1 | 0.1 |
| Unspecified | 122 | 16.7 | 163 | 15.2 |

### 7.3.5 Portrayal of natural, social, built and economic environments

Two previous studies one of natural hazard- the other of disaster-media reporting suggested that the political-, economic and human-related implications of natural disasters are ‘amplified’ (Pasquarè & Pozzetti, 2007) or that the *“the built, human and social capital components of hurricane vulnerability and risk [were] emphasized over the natural capital components”* (Miles & Morse, 2007, p. 372).

Physical scientists Pasquarè and Pozzetti observed that environmental journalists often tend to shape their reports in such a way as to *“amplify political-, economic- and human-related implications of natural disasters”* (Pasquarè & Pozzetti, 2007, p. 166) While Pasquarè and Pozzetti stopped short of discussing any implications, one is left with the impression that this ‘amplification’ was considered unwarranted or unwelcome. Here, it is argued that this should not be in light of many concerns about the effect of emphasizing the ‘natural’ in ‘natural disaster’ (section 7.4.12).

In this study both academic earthquake-related research and earthquake-related media content may appear to be high in natural capital (Figure 7.4). However, when one removes earth science research or media articles or items about the secondary effects of earthquakes, this is no longer the case. Only 7.2% of the 47.1% of natural capital in the 20-earthquake research dataset related to environmental science (as opposed to earth and planetary science about earthquakes as a hazard or their effects). As was noted in section 6.7 little research or media attention was given to warnings about the effects of earthquakes on the environment (Figure 6.3), actual effects (consequences) of earthquake on the environment, or recovery of the natural environment.




| | Earthquake Research | ODT before Darfield | TV1 before Darfield | Stuff Science | TV1 all items after Darfield | ODT full items after Darfield (no brief mentions) | ODT all articles after Darfield | ODT before and after Darfiled | TV1 before and after Darfield | Next magazine | NZ Women's Weekly |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Social | 26.6 | 37.9 | 50.8 | 24.5 | 48.4 | 46.7 | 45.7 | 44.6 | 46.1 | 77.7 | 78.4 |
| Economic | 2.5 | 2.4 | 5.5 | 7.9 | 15.9 | 18.0 | 31.5 | 27.1 | 21.9 | 0.0 | 1.9 |
| Natural | 47.1 | 32.1 | 32.2 | 42.5 | 9.2 | 11.4 | 7.4 | 11.1 | 11.0 | 4.8 | 8.6 |
| Built | 23.8 | 27.6 | 11.4 | 25.1 | 26.6 | 23.9 | 15.4 | 17.2 | 21.0 | 17.5 | 11.1 |

**Figure 7.4: Comparison of attention to the four environments – this research**

Comparison of attention in the 20-earthquake-research and media datasets before and after the Darfield earthquake to the social, economic, natural and built environments.

For all datasets analysed in this research the focus was on the social environment. As might be expected women's magazines paid the greatest attention to social aspects of earthquakes (and by implication social aspects of DRR). Natural aspects do not feature at all in women's magazines, and of the two magazines analysed only Next magazine mentioned the economic environment. The ODT discussed economic aspects more than any other media after the Darfield earthquake (Figure 7.4). Coverage was more balanced in both ODT and TV1 after the Darfield earthquake. Results for the 1000-Stuff dataset reflect the disciplinary contribution discussed in chapter 6.

Miles and Morse (2007) identified what they termed an 'underweighting' of attention on natural capital. They observed that this mirrored the fact that natural capital is, as found by Costanza et al. (1997) often at the periphery in policy-making, which tends to focus on the economic. Miles and Morse (2007) suggested a move was needed from socio-economic framing to ecological economics. Research is only beginning to explore inter-relationships between the various environments, for example about economic costs of poor mental health in the wake of disasters (Zahran et al., 2001). As such it is unsurprising that such information is not being reported in mass media.

The results shown in this section, particularly when combined with the discussion in sections 6.6 and 6.5 on media portrayal of environmental sciences and economics suggested that while a socio-economic framing is stronger than for natural capital, there is no depth to the media coverage of economic aspects of disaster. The recommendation that arises from the above observations is as follows:

**Recommendation 39 (environments):** Scientists and DRR advocates - Natural and economic aspects of disaster need to be researched and the findings communicated more in the media (to better balance with attention to built and social aspects of disasters).

See also recommendation 52 (section 7.5.6) that suggests more attention be focused on natural and social consequences of earthquakes, not only damage to built and economic environments, and recommendation 79 (section 7.7.7) regarding the need to recognise vulnerability and communicate warnings relating to all environments.

## 7.4 Communicating the cause of earthquake disasters (topic 4)

*People need to know that people make a disaster not the hazard*.

Interviewee I015, Affected citizen – Canterbury University student

### 7.4.1 Introducing the communication of cause of earthquake-related disasters

Causal framing is fundamental to DRR success. This is clear from the title of the UNISDR publication on DRR-communication "Disaster through a difference lens; behind every effect there is a cause" (UNISDR, 2011a). Notions as to the cause of disasters direct attention to considering possibilities in risk reduction, and affect associated behaviours and actions. Causal notions affect those working in natural hazards and disaster research and DRR practice, and people within society generally (D.A. McEntire, 2001, 2011; Stefanovic, 2003). Causal framing while studied in 6.3% of natural hazard media has however been one of the least studied aspects of natural-hazard- and disaster-media.

One researcher who has studied causal framing Scanlon (1980) stated that media do not adequately define all the causes of disaster. This research shows that academics rarely define the range of causes of disaster either. Those scholars have explored the topic of the cause of earthquakes and attributions of responsibility for causing disasters have done so in a variety of ways. None of the research has however developed a code framing for all identified disaster causes, or has identified all of the DRR-characters portrayed in the media as responsible for DRR actions.

A curious mix of causal frames has been identified in the few relevant previous natural-hazard and disaster-media content analyses, and again in this research (section 7.4.13). Many of the frames prevalent in media coverage do not fit with modern scientific understanding of disaster cause. Useful framing that emphasises social causes is absent. The consequent misunderstandings of the cause of disasters limit DRR success.

The key issues that have been identified (discussed in detail below) are that:

- fatalistic framing and anthropomorphism are unhelpful for DRR
- pseudo-scientific causes debate that detracts from DRR, and that
- framing of disasters as natural appears to be common to avoid blame, however
- avoiding blame means social aspects that contribute to disasters are either absent from media coverage, or quickly 'buried'; and
- discussing only one or two frame sets means the range of possibilities in DRR are not fully recognised.

A variety of recommendations are needed to counter the different unhelpful causal frame types. The reasons for making these recommendations are discussed briefly in the following sections. To break with the hazards-focused tradition, the discussion in this thesis is about communication of earthquake disaster cause not only cause of earthquake. This in itself is a significant framing that has spawned the recommendation:

**Recommendation 40 (DRR topic 4):** All - The cause of disasters should be carefully distinguished from the cause (trigger) of earthquakes.

### 7.4.2 The cause of disaster, not only the cause of the hazard needs to be understood

It is more important to understand the causes of disaster than the cause of earthquakes (Burton et al., 1978; Ploughman, 1995) and discussion in section was 2.3.7. Yet scholars themselves have been unclear whether they were referring to cause solely in terms of the cause of the hazard event (e.g. *the cause of earthquakes*), the *cause of certain consequences* (such as damage, injury, death or suffering), the *cause of vulnerability,* the *cause of the disaster(s)* or a combination of these different types of cause. Where the literature is clear it has tended to focus on the cause of the triggering physical hazard event.

An academic article that considered public understanding of earthquake cause is (Jacobi, Bergeron, & Malvesy, 1996). However in keeping with the comments above the attention was on the popularization of plate tectonics – an earth science theory.

Media articles and comments on those articles analysed in this study showed this lack of clarity to prevail in public sphere discussions. Survey comment also mirrored the attention on earthquake cause, rather than disaster cause. Respondents who mentioned communication of cause tended to do so in the context of sense-making when an event has occurred. For example respondent W022 stated *"I think a basic understanding of how earthquakes are caused is important because it helps people understand what is happening and why."*

Only a few respondents indicated that the focus of DRR communication efforts should be on addressing the most significant contributory factors to disasters. With disaster causes not having been the headline focus of many mass media articles (Table 7.5) and with the emphasis on the communication of earth science (Chapter 5) and a consequent emphasis on the cause of earthquake, rather than cause of disaster citizens have not been given the first building block of what is important to know of disasters. In conclusion it would be useful that any discussion about the cause of an earthquake-related disaster focuses on more than the cause of earthquake.

### 7.4.3 DRR-research, media and survey respondents gave similar attention to the topic of cause

Whatever type of cause was being considered, the cause of earthquake or disaster was not a topic that the media in New Zealand, the global earthquake research, or the natural hazard-media research community have addressed. Nor was cause a topic that survey or interview respondents frequently volunteered as being of concern (Table 7.5).

There were four story types in the New Zealand media dedicated to the topic of disaster cause *Reflecting on History, Fatalistic Beliefs, Liability Litigation or Inquiry*, and *Inquest/Cause of Injury* (Table 5.15).

There were also stories about disaster causes that relate to exacerbation of disaster rather than to primary causes. These are stories that review specific DRR measures and report these as a particular criticism finding related to DRR communication (topic 5) or whatever other phase of the DRR cycle the finding relates to – e.g. *(Un) prepared citizens* stories related to readiness, and *Aid Issues* stories relate to response and recovery. However framing of the cause of disaster is not limited to media stories or academic articles dedicated to the topic. Body text mentions of an issue include frames that build societal understanding of disaster cause. Collecting these from both academic and media articles showed just how complex the topic and communication of earthquake-related disaster cause really is.

### 7.4.4 This is the first study to compile earthquake-triggered disaster-related causal hypotheses in academic and media articles

This is the first study to have compiled, discussed and begun to explore the prevalence of the full range of earthquake-triggered disaster-related causal attributions in both scholarly literature and in the media.

In this research over 45 causal hypotheses relating to earthquakes and associated disasters have been identified from academic and media articles (Table 7.8). These causal hypotheses affect DRR; some in ways that have been empirically confirmed by previous researchers, other effects are implied only. An example of at least one of each of the 45 hypotheses (with the exception of cause 6g, deliberate act) was found in both in the academic literature and in New Zealand media between 2008 and the end of 2011. Some of the examples are presented in Table 7.8. The mix of frames in the New Zealand media is discussed later (section 7.4.15).

In compiling Table 7.8 it was noted that studies of media portrayal of the cause of earthquake-related disasters rarely cover more than a few of the topics at once. Different disciplines framed concerns with causal framing in very different ways.

#### 7.4.5 Scholars have typically considered only particular sets of causal frames

Literature review shows that most of the comparatively limited research into causal framing of natural hazards and disasters has considered one frame set against another. Scholars in a particular discipline typically emphasise one, or a set of these causal dichotomies that relate to their disciplinary approach, but no one has collated the various framings. The 'causal framing contests' or 'causal dichotomies' identified through literature review are shown in Table 7.10. This research has shown that the media report on similar sets of frames (see following sections.)

#### 7.4.6 Fatalistic beliefs, anthropomorphism, active verbs and responsibility for DRR

Most attention to causal attributions in media content analyses has been on fatalistic attributions (see Appendix 4). Earthquake- or disaster-related fatalistic beliefs are that earthquakes are caused by mythical creatures, are somehow supernatural (whether due to the wrath of a displeased deity for example because of immoral behaviour, an Act of God, or are otherwise miraculous), are purely a matter of luck, or that humans are powerless in the face of earthquakes.

Fatalism is defined as a way of being or state of mind where people judge outcomes as uncontrollable and their actions as useless (Weiner, 1986). Considerable research has linked fatalism regarding the cause of earthquake damage and other effects (consequences) with a passive attitude to DRR or a failure to prepare for earthquakes (Duval & Mulilis, 1999; Grothmann & Reusswig, 2006; Lindell, Arlikatti, & Prater, 2009; McClure, Allen, & Walkey, 2001; McClure, Sutton, & Sibley, 2007; McClure, Sutton, & Wilson, 2007; K. Smith, 1993; Turner et al., 1986). Individuals or societal groups who ascribe to fatalistic beliefs have been shown to believe that there is little that can be done to influence earthquake disaster outcomes.

**Table 7.8: Causal hypotheses for disasters**

Eight groups of earthquake disaster and associated death and damage causal 'hypotheses' identified from review of cross-disciplinary academic literature and analysis of media articles. Most groups are spilt into subgroups. *Characters are shown in italics.* Note that the eight sub-group headings 1-8 in the table are presented in a generalised time sequence of their appearance in society over time. However the time sequencing does not apply to the subgroups within them.

The causal frames were identified from review of the wide range of literature shown in Figure 1.1 and as per the bibliography.

While it was simple to categorise academic and media discussions into the groups this was not always the case for subgroups. Sometimes it is not particularly clear which subgroup might be mentioned. For example the statement by a citizen in an article written by the New Zealand Herald published on the ODT website "*this am's shake was a gentle, rolling reminder that THAT is still hanging around. I hadn't felt anything more than a wee wobble in ages*." (Unattributed, 2011d). Cause 4b) was chosen in this instance.

Selected examples of some of the causal attributions identified from analysis of New Zealand media are presented in Table 7.9.

With deletion of a few earthquake-specific elements this coding framework would be equally applicable to a study of any disaster.

1. **Movement of *mythological creatures*** (e.g. giant animal forms)
2. **Supernatural**
a) Act of *God*
b) includes all forms of *divine* retribution
c) work of *Satan*
d) *miracle*
***3. Chance, luck or fate***
**4. Hazard-related Act of *Nature***
a) wrath of *nature (*nature part of man versus *nature*)
b) *Earth* or *earthquakes* attributed with human characteristics (anthropomorphism) in some way, including *earthquake as villain* (hazard-related anthropomorphism)
c) natural – tectonic, including earthquakes triggering earthquakes on other *faults*, or *volcan*ic activity
d) meteorological cause - *lunar or planetary* influence
e) framing natural hazards or effects as unusual or unprecedented
f) historical beliefs about the cause of earthquakes (e.g. underground gas explosions)
**5. Technological or testing mishap or omission**
a) *scientists* did not know about the hazard
b) *engineering* design (damage and death toll function of structural design - *buildings*)
c) (limitations of) *design* codes (combination of science and governance)
d) over-reliance on *technology* (design and construction science not knowing all, *man* vs nature)
e) *reservoir*-induced seismicity
f) *frack*ing
g) *military/scientific* testing
**6. Act of *individuals***
a) failure to consider risk (optimistic bias/discounting risk/lethargy- or 5a)
b) failure to consider DRR (cost – 6f or 7a, or unaware 6d)
c) failure to understand individual as having agency in DRR
d) act of uninformed populations/plea of ignorance (unaware)/anti-science
e) act of barbaric populations given to anarchy (racial prejudice)
f) insufficient resources- includes greed (construction failure or poor planning decision-making due to) – see also 7a
g) deliberate act (e.g. arson-fire)
h) immoral behaviour (associated with 2b)
7. **Act of Society - politics and governance** (*politicians/governments*)
a) (in)sufficient resources at city/region/country level (e.g. retrofitting *public buildings*)
b) policies and practices
  i) nature of leadership (leaders preference to be seen to respond well to disasters)
  ii) short-term election cycles making long-term DRR activities low priority
  iii) particular policies such as neoliberalism and/or development
  iv) risk (or safe) society
  v) planning practices including lack of enforcement
  vi) perpetuation of vulnerabilities
  vii) failure to understand effectiveness of DRR practices in achieving resilience
c) *scientists/officials/policy- or decision-makers*
  i) blaming those previously in power
  ii) all to blame
  iii) blame others up and down hierarchy
  iv) plea of ignorance
  v) context or assumptions (typically cost was prohibitive, insufficient resources at individual level (6c) or slow economy (7a)
d) risk or DRR (in)sufficiently communicated
8. **Interaction of nature and society** (some combination of a range of failing from engineering through social systems and governance – *Multiple characters*)

**Table 7.9: Examples of earthquake-disaster-related causal attributions in the New Zealand media**

The table presents selected examples, rather than an exhaustive list, of quotes from the New Zealand media 04 April 2008-03 January 2012 that illustrate causal attributions made about earthquake-related disasters.

| **Cause type (see Table 6.7) followed by referenced quote.** |
|---|
| **Act of God (cause 2a)** *"Natural disasters and other acts of God simply come along every so often"* in "Counting the political aftershocks"(Editorial, 2011). 'Faith and Reason' articles (e.g. "It's a miracle nobody was killed" (Crosson, 2010) and "Acts of God ours to effect" (Bernhardt, 2011)) after all international and local events framed the divine as being evidenced by caring for others in society particularly during, and potentially before disasters. |
| **Fatalistic (cause 2b)** - Late in May, 2008 after the Sichuan earthquake in China Stuff published the article "China angry over Sharon Stone's karma remark" (Reuters, 2008c) that French fashion house Christian Dior dropped Sharon Stone from its Chinese advertisements and released a statement from the actress apologizing for saying the devastating earthquake that struck China may have been "karma" for its treatment of Tibet. |
| **Luck (cause 2c)** – *""I think we've been extremely lucky as a nation," Mr Carter told NZPA"* – in "NZ 'blessed' no one died: Civil Defence Minister" (NZPA, 2010f) |
| **Miracle (cause 2d)** – *"it's a miracle nobody was killed"* (Crosson, 2010) |
| **Anthropomorphic (cause 4b)** - an example of anthropomorphism is in the poem "Twenty-two Two 2011" by celebrity New Zealander Gary McCormick, broadcast on 23 February 2011 on TV1 Close-up programme<br>*"You miserable low-life bastard. We saw you on the fourth of September calling into town on your spineless spine, giving us a flick and looking us over. ... I saw you the other day run up a blind alley full of hatred and dark breath ... You held us down on the jagged ground. You shook the streets and the city buildings. You tore the spire from the cathedral."* |
| Other examples of anthropomorphism were:<br>*"It's 6.51am and we just had an aftershock that made three-year-old Finn say "Mr Shakey is back, we've got to go home now." I said that naughty Mr Shakey sat on our roof so we need somewhere else to stay. The only thing that can stop Mr Shakey is getting under a table. Soon Finn was giggling and pretending to be a turtle. Take that Mr Shakey."* Journalist Vicki Anderson in "Fight or Flight" (Vicki Anderson, 2011a)<br>*"An easy way to explain earthquakes to children was to say it was the Earth farting, [psychologist Nigel] Latta said. "It's got pressure that it needs to let out and everything rattles. It's because it's eating too many beans," he said. "It explains liquefaction. Sometimes we think it's a fart, but it's not and it does smell a bit, too."* in "No excuses for bad behaviour" (Law, 2011).<br>*"Shakeland and Big-Fart the Lombridragon, written by a group of young Italian architects, is a story about a town damaged when the ground shakes not because of a quake but because of a bean-eating, farting dragon." In "Big-fart book translates into city kids' fun"* (Law, 2012). |
| **Failure to consider risk (cause 6a)** – *"despite the continuous education given, we were ignorant. Coming to the assumption that if there were to be an earthquake, it would never happen to us, to our community, in our lifetime. The earthquake-damaged roadway on the South Brighton bridge approach attracts the curious after the earthquake in Christchurch. It was always just some future event learnt only for theoretical case studies in NCEA. Thus, when the quake shook early on September 4, it left us all wishing we'd paid that little bit extra attention."* from "Geography's relevance hits home surely" (Little, 2010). |
| **Meteorological (cause 4d)** – Any of articles relating to the "Moon Man". A brief mention in a 'Lifestyle" opinion piece in the ODT on 20 October 2011 *"I'll admit that it's [rain] basically my least favourite weather pattern, right behind earthquakes"* (K. Kenny, 2011). |
| **Historical belief (cause 4f), gas explosion** *"Dawson's comments on the quake's cause were also reported. He, along with a "Mr Gordon of the Mines Department", concluded the earthquake was caused by underground gas explosions. Dawson said it was possible for an underground section to fill with gas that would result in an explosion". "Early quake forecast faulted" (Lynch, 2011b).* |
| **Building design (cause 5b), construction and laws (cause 5c)** meant no fatalities "Why so few casualties in Canterbury quake / Why we're not Haiti" (NZPA, 2010g) |
| **Design failure (scientists/experts – cause 5b)** – relating to collapse of CTV building in Christchurch on 22 February 2011 causing many fatalities in "Question over CTV Building Construction" (M. Wright, 2011c) or blame quote in Table 5.73. |
| **Fracking (cause 5f)** – "Fracking – yes or no?"(Vicki Anderson, 2011b) |
| **Military/scientific testing (cause 5g)** – *"I continue to receive the odd email about the connections between earthquakes and military-sponsored scientific investigations, such as the HAARP [High Frequency Active Auroral Research Program]. Some people are concerned that military organisations may be triggering these earthquakes, which is absolute nonsense."* Dr Mark Quigley in "The year the earth shook" (Dudding, 2011) |
| **Scientists did not know about the hazard (cause 5a and 4c)** – as a consequence of the article "Canterbury quake may have been on 'new' fault line" (NZPA, 2010e) on-line commentary suggested this was of concern |
| **Greed (cause 6f)** – framing of L'Aquila earthquake cause being builders who avoided building to required codes |
| **Vulnerability – generally an Act of Society (cause 7)** – Prof. Warwick Murray emphasized when discussing the Chilean Concepcion earthquake of 2010 on television (TV1, 2010-02-28) that the event was not a natural disaster, and had arisen due to underlying vulnerability. |
| **Act of Society (cause 7)** – *"Haiti -- one of the poorest nations in the world -- had virtually non-existent building standards, or at least, few that were systematically enforced"* - Paul Caruso, a geophysicist at the US Geological Survey in "Why we're not Haiti" (NZPA, 2010g). "Professor Warwick Murray profiles Haiti" (TV1, 2010-01-14). Also political factors slowing recovery – *"A multibillion-dollar reconstruction effort has been slow to start in part because of the chaos from the first round of the presidential election and political uncertainty."* (Associated Press, 2011b). |
| **Planning decisions (8b)** – regarding subdivision consents that led to homes being built on lands prone to liquefaction "Quake-hit residents may sue Council" (Wall, 2010) |
| **Variety of causes** – *"Most of us would regard the L'Aquila earthquake as a tragic act of nature, or of God or of fate. For a group of L'Aquila residents, however, it was the fault of civil protection officials for not warning local people to evacuate after a series of smaller tremors. .... it's time we accepted that earthquakes are among the forces we cannot control. ..... There are many earthquake-prone cities that, thanks to poverty and corruption, are full of buildings likely to collapse and crush people to death in a major tremor."* from "The earthquake blame game" (Boniface, 2010) |
| In NZPA (2010g) and TV1 (2010-01-14) there were a variety of causes portrayed; old technology (URM buildings) + insufficient resources for retrofit + business individuals failure to consider DRR + governments (cost as reason to not legislate or enforce). |

**Table 7.10: Causal framing contests in academic research and the media**
Causal dichotomies identified from 1) scholarship on previous natural hazard risk and disaster media and 2) from risk- and risk communication literature in general (whether common or causal framings noted as being of concern but rarely discussed in the scholarly literature).

| ID | Previous Scholarship – risk-related media | Cause as per Table 7.8 |
|---|---|---|
| 1 | Science versus pseudo-science | 4c vs 1-3 |
| 2 | Fatalistic or religious beliefs versus science and DRR | 1-3 vs 4c or 8 |
| 3 | Over-reliance on technical solutions | 5d |
| 4 | Blaming technological practices | 5b, c, e, f, g |
| 5 | Natural cause versus technocracy | 4 vs 5 |
| 6 | Nature versus bureaucracy (social) | 4 vs 7 |
| 7 | Benign nature, inherently dangerous world & risk society | 4 vs 7bii) |
| | **Previous Scholarship – general risk scholarship** | |
| 8 | Individual perceptions vs expert perceptions | 6 vs 4 or 8 |
| 9 | Innocent victim/human act (individual or social) | innocent 6d) vs 7 |
| 10 | Complex or insoluble social problems versus simple and effective engineering solutions | 8 vs 5b or 5c |
| | **Emphasising hazard-related causal framing – identified in this study** | |
| 11 | Identified versus unidentified faults (scientists did not know about the hazard) | 5a) |
| 12 | Large fault versus small fault, fault triggering and volcanoes | 5a) |
| 13 | Any article emphasizing earth science or natural cause | 1-4 |

Possibilities to tailor mass media content to counter fatalism suggested by the above scholars include:

- presenting a range of causes, and ones that are not fatalistic
- avoiding fatalistic attributions of cause including anthropomorphism of earthquakes including using alternatives to active verbs
- being clear about outcomes if DRR possibilities are implemented; and
- emphasizing controllable structural factors and the political and social factors that contribute to disasters.

Act of God framing in the New Zealand media

Interpreting disasters as acts of God (as is prevalent in religious discourse) and acts of nature (as is prevalent in physical science discourse) is considered inappropriate as social and economic and political factors are ignored (T. Steinberg, 2000, 2001).

There were many references in the New Zealand media to ‘luck’ or Acts of God. Only rarely were these comments tagged with further explanation that there was a degree of serendipity as to the time of day that the Darfield event occurred, or that many aspects of good risk management such as New Zealand’s building code and construction methods had also converged to reduce the death toll. The Prime Minister and other officials made some of the references to luck. Even geoscientists mentioned 'luck' or made other fatalistic comments in the media (for example "We keep our fingers crossed that we don't have any more large earthquakes" - Kelvin Berryman, seismologist GNS in TV1, 2011-07-13). Leaders have been observed making fatalistic attributions to disasters in other countries (e.g. Gros, 2011)

**Recommendation 41 (DRR topics 4, 3, 6, 9, and 12):** All - Fatalistic frames should be avoided as they are unhelpful for DRR (avoid referring to luck or blessings); when others use fatalistic frames respond by show-casing positive outcomes that occur when DRR is implemented.

Fatalism in relation to human nature

An aspect of fatalism not discussed often in the literature reviewed is fatalism attributable to human nature, such as a lack of social trust in governments, institutions and business elites that can affect the priority people place on DRR or their willingness to engage in auditing or improving their risk management practices. A suggested solution is that communicated content provide examples of successful advocacy for DRR by all, in order to increase both social trust and citizen participation in DRR.

**Recommendation 42:** All - Providing examples of successful advocacy for DRR would increase social trust and citizen participation in DRR, and decrease fatalism or cynicism with respect to human nature (DRR topic 4).

References to animal movements and acts of the supernatural unhelpful

Attributing human or animal characteristics (anthropomorphism) to earthquakes is a fatalistic framing, obscuring, as discussed previously, that DRR actions are possible. Anthropomorphism in the media may relate to direct comments, or imply nature has human-like emotions or behaviours. Verb use is significant for the latter. For example verbs such as 'hit' or 'struck' imply a wrath of nature framing (4a), which is fatalistic. Knobloch-Westerwick (2008) suggested using a passive rather than active voice in relation to a causal agent unless it is specifically intended to have a particular causal agent attributed as the cause of an event. Note that powerful verbs are apparently preferred by editors over more moderate ones (Fioravanti & Velho, 2010).

Anthropomorphism is a strong framing in the New Zealand mass media (Table 7.8). However mention of deities with human form that are part of Maori legends about earthquakes were all but absent from the media analysed.

This study has identified extensive use of similies, metaphors and active verbs in the New Zealand media before during and after the Canterbury earthquakes that are suggestive of a wrath of nature framing (4a), that is not beneficial to DRR. In particular over 70% of *Felt Occurrence* story type headlines included active verbs such as ‘rattled’, ‘shook’ or ‘shaken’, ‘woke’, ‘rocked’, or even more violently ‘hit’ or ‘struck’.

After the Canterbury earthquakes psychologists, counsellors and parents shared advice in the mass media about how to reduce the psychosocial distress experienced by children. Some of this advice perpetuated a type of causal framing not previously referred to in media analyses, but which has been identified in this research as ‘hazard related-anthropomorphic’. These causal explanations being given to children in relation to earthquakes were clearly similar after both the Canterbury, and Italian (L’Aquila) earthquakes (see Table 7.8). How constructions of earthquake cause, supposedly for children’s benefit, such as those recounted above (or for that matter any other earthquake or DRR-topic) impact on children’s perceptions of DRR, or on their later constructions of cause and what that means for DRR would be a valuable topic of future investigation.

**Recommendation 43 (DRR topic 4):** All - Where possible avoid references to animal movements and acts of the supernatural, or verbs that suggest earthquakes or nature have human attributes.

### 7.4.7 Meteorological links (considered pseudo-scientific attributions) were prevalent in the New Zealand media

In this research it was identified that almost 20% of scholarly earth science articles (5% of all articles in the 20-earthquake DRR research dataset) relate to the topic of atmospheric precursors to earthquakes. The New Zealand earth science research focus does not mirror the international attention to these topics. The prevalence of scholarly interest in other countries is considered at least in part to explain the public fascination with the possibility of meteorological or planetary causal links. It also explains why in interview Ken Ring (Interviewee I025) mentioned wanting to work with New Zealand scientists to explore a topic that is researched overseas (see Table 3.3 and Appendix 8). On reflection the debate was more one about communication of science versus 'non-science' and scientist credibility, than one that directly affects DRR negatively. In fact the reverse may be true.

As will be discussed in section 7.4.11, the attention by scientists and pseudo-scientists alike on *cause of earthquakes* and in section 7.7 on 'possible timing of future earthquakes' takes attention from causal framing that is more beneficial to DRR. Emphasising the likelihood of a certain timing of an earthquake masks the possibility that individuals and societies may benefit from framing the need to have employed as many DRR possibilities as possible in the event an earthquake occurs in the next 5 minutes (section 7.7.4). The rationale for recommendations stemming from the above observations is developed further in sections 7.7.3 and 7.7.4.

A further contributing factor to the perception of earthquakes as having meteorological cause (cause 4d Table 7.8) may be that many of the media stories of the international *Disaster Occurrence* or *Felt Occurrence* story types referred to the meteorological bureaus that government earth scientists cited about earthquake occurrences often belong to. For example the Taiwan Central Weather Bureau is cited in article "Moderate earthquake off eastern Taiwan" (Associated Press, 2010b) as having recorded a magnitude 5.3 earthquake. There is no recommendation relating to this observation as the likely most effective solution relies on renaming the institutions involved. (An alternative would be a caveat that earthquakes are not related to the weather whenever meteorological bureaus are mentioned).

### 7.4.8 There is a need to separate tectonic and volcanic earthquake cause

This study identified that portrayal of the cause of earthquakes in the media is New Zealand is confusing. Both tectonic and volcanic causes of earthquakes are mentioned in the media.

*Volcanic eruption* story types are both an earthquake-cause and earthquake-risk story type that there is no formal discussion of in the literature. These stories mention earthquakes in conjunction with volcanic alerts, or volcanic eruptions, or in a New Zealand example published in the period analysed, were stories about landslips caused by earthquakes associated with magma body movement (e.g. "More quakes hit evacuated Waihi village" Watson, 2009). The risk aspect of the stories is discussed in section 7.7.2 (alarm reassurance). Such stories associate earthquakes with volcanic activity. In the five years of New Zealand media articles relating to earthquakes analysed there was no explanation of the differences between tectonic and volcanic earthquakes made by scientist sources.

This is the likely reason for confusion as to the association between earthquakes and volcanoes noted in some of the survey responses in this study. The confusion may be reinforced by having volcanologists commenting on seismic risk (for example Gill Jolly in ODT article “Aftershocks raise risk of big quake” NZPA, 2011g)..

Citizens will not be able to distinguish between tectonic and volcanic earthquake cause if this has not been explained to them. This could be relatively easily remedied with an acknowledgement that volcanic eruptions can cause earthquakes. Earth scientists might consider adding a sentence to their responses to media regarding the distinction between tectonic and volcanic earthquakes when either occurs.

**Recommendation 44 (DRR topics 1 and 4):** Scientists - Reduce citizen confusion by briefly explaining the similarities and differences between tectonic and volcanic earthquakes.

### 7.4.9 Media articles attribute accountability for DRR more than blaming

There are many scholarly references to there being too much blame and emphasis on error, defects, villains and scapegoats in disaster media (e.g. Barnes et al., 2008; Drabeck & Quarantelli, 1967; A. Hall, 2011; McKay, 1983; Rogers & Sood, 1980). A. Hall (2011) referred to a ‘rhetoric of blame and recreancy’ (lack of duty of care). CARMA (2006) found that 15% of US articles analysed regarding the Kashmir earthquake included accusations of blame (the main culprit cited was God).

That said McKay (1983) found for multiple hazards (as was found in this study for earthquakes) that attributions of responsibility for prevention were more prevalent than those attributing blame. A crude but effective way to illustrate this is to use Tables 5.15-5.20 to compare the nature and number of ‘DRR Options’ story group and the references to individuals and authorities undertaking DRR activities in the ‘What’s Happened?/Being Done’ and ‘Road to Recovery’ story groups, compared with the ‘Disaster Cause/Review’ group. Note also that some of the ‘Disaster Cause/Review’ group stories such as *Awards, Commendations and Thanks* are not framed as blame. Singer (1994) suggested that this was partly because there is often no blame attributed for natural hazards (cf. section 7.4.11).

There is consequently no recommendation relating directly to the volume of blame in the media. The recommendations that follow the discussion in the three following sections relate to the importance of blame and accountability framing (because that framing portrays social and political causes and associated vulnerability).

At this point it is pertinent to note that New Zealand has a culture of 'no-fault' insurance. The terms of engagement of the Royal Commission of Inquiry into building collapses also specifically avoided questions of liability (Royal Commission, 2012b). A. Hall (2011) noted such a tendency in the UK to avoid lawsuits and litigation in relation to natural disasters, and instead focus on policy changes, mitigation investment, and occasionally changes in governance.

### 7.4.10 There is individual and political difficulty with blame and accountability

It has been said that media are attracted to blame, controversy and conflict stories particularly if these are about officials, institutions or governments, rather than ordinary citizens (Kitzinger, 1999; Sandman et al., 1987). Those concerned with blame appear not to recognise blame as a relatively rational and necessary part of the risk management audit process (Drabeck & Quarantelli, 1967). This research showed that there was little blame framing or discussion of blame and liability in academic articles. An example of an exception is an article discussing the legal paths available to recover damages in Chile's 2010 earthquake by (Talciani, 2010). It would seem that academia leaves these discussions if they occur at all, to officials; the consequence will be that such work is not peer-reviewed.

Framing a disaster as being the result of human acts or omissions is said to be unsettling, provokes dissonance, blame attribution, and guilt as it puts the spotlight on resource inequities, dependency, and vulnerability (Ploughman, 1995). Some of the research community is clearly uncomfortable with holding individuals, officials, organisations or governments to account over disasters (e.g. Goltz, 1984; S. Miller, 1997). While disaster researchers generally acknowledge that human systems such as governance play a large part in disasters there is also a reticence and discomfort expressed by disaster researchers regarding saying so in the media (RADIX, 2013-2016).

Moeller (2006) argued that apolitical disasters are appealing. Hughes (2007) inferred that attribution of responsibility in the media (for failures) to organizations who were at fault was undesirable. However why this is not beneficial for DRR was not stated.

While decades ago Alexander (1980) considered that the degree of responsibility placed on governance in the media was excessive, nowadays Alexander emphasises the importance of accountability and governance (Alexander, 2013, 2015).

The United States media have been found to examine political factors in terms of foreign disasters but not their own (Ploughman, 1995). Incompetent government was implicated twice as often as God in analysis of US media representations of the cause of the disaster surrounding Hurricane Katrina (CARMA, 2006).

Prior to the Canterbury earthquakes the New Zealand media raised political causes in relation to the Haiti, Sichuan and L'Aquila earthquakes. However after the Canterbury earthquakes causes associated with authorities, policies and decisions made that may have exacerbated the scale of disaster were raised in the media only once or twice then essentially set aside until the Royal Commission of Inquiry.

Local news was found by Rashid (2011) to provide richer causal contexts than in news produced further from where an event occurred. There were, however, no such striking differences identified between causal representation in local Christchurch Press articles (on stuff.co.nz) compared with articles from other regions on Stuff, in the ODT or on national television.

The discomfort with blame noted in natural-hazard-media research was echoed in survey and interview responses in this research. This is particularly interesting because blame framing in relation to the Canterbury earthquakes was limited. While having the media construct a disaster as 'natural' or as an 'act of God' may provide solace, emphasis on the value of social order, and to relieve guilt is not beneficial to DRR (Ploughman, 1995) as is explained further in the following section.

**Recommendation 45 (DRR topics 4 and 5):** All - Causal attributions even if involving blame should be recognised as valuable opportunities to improve DRR.

### 7.4.11 Framing disasters as 'natural' avoids understanding of social responsibility

There is too much emphasis on the naturalness of disasters in the media (Fluchter, 2011). Framing disasters as natural (causes 4a-4c) or attributing disasters to 'natural causes' denies the historical and social dimensions of disaster (Bankoff, 2003) and clouds the opportunities for societies to successfully address DRR (Harwell, 2000). This allows individuals and societies to forget that responsibility for disasters lies at least in part with those who influence social, political and economic systems. According to Bankoff (2003) this focuses attention onto predominantly technocratic solutions. This in turn, Bankoff suggested, establishes a conviction that societies can mitigate disasters either through technocracy or beaurocracy, so that disaster prevention becomes a matter of improving scientific prediction, engineering preparedness, and institutional management of hazard. (There is however no known research to empirically prove this is what people take from natural attributions.)

Despite disaster researchers' understanding that there is more that contributes to earthquake disasters than the hazard event itself there are still some scientists (predominantly physical scientists but also others) who argue that discussions of cause and blame should be on aspects relating to the natural hazard rather than political or ideological (e.g. Pasquarè & Pozzetti, 2007). Cioccio and Michael (2007) thought it was sensationalist for the media to show mass devastation for what was a natural process. Moeller (2006) suggested that it was at least in part the seemingly apolitical, and 'natural' cause of the Indian Ocean Tsunami (IOT) that led to unprecedented levels of donation and aid to Muslim and dark-skinned disaster victims. There has been research into the volume of media coverage and links to aid (P. H. Brown & Minty, 2008; Potter & Van Belle, 2004, 2009; Rioux & Van Belle, 2005; Simon, 1997; Van Belle, 1999, 2000, 2003; Van Belle & Hook, 2000) however no study has been identified that quantitatively links natural- or apolitical-framing with the amount of aid provided.

According to Masel-Walters and Hornig (1993) and C. Su (2012) scientists of all types made naturistic attributions in the media. This was also a finding of this research. Scientists also make similar attributions in scholarly articles. For example Lamontagne et al. (1992, p. 584) stated *"only Mother nature knows"* in their article giving recommendations for post-quake communication by seismologists. Moeller (2006, p. 176) stated *"the [Indian Ocean] tsunami, an unprecedented natural disaster that could not be blamed on human action or inaction and affected rich and poorer countries alike."*

Analysis of the New Zealand media identified no headlines that emphasised natural causes. However there were many body-text references to natural causes, leading to the recommendation (46) that follows at the end of the next section.

### 7.4.12 A focus on social, political and economic factors contributing to disaster is needed

The social, political and economic circumstances that cause vulnerability need to be communicated (Anbarci, Escaleras, & Register, 2005; Cox, Long, Jones, & Handler, 2008; Freudenberg, Gramling, Laska, & Erikson, 2008; Freudenburg et al., 1996; Freudenburg, Frickel, & Gramling, 1995; Kodrich & Laituri, 2005). These causes are those listed in group 7. While they are not the sole cause of any disaster they are always an integral part of them (cause 8). Ignoring social causation leads to absence of socially based DRR solutions.

Kodrich and Laituri (2005, p. 253) noted that *"the media often ignore the conditions that exacerbated the disaster in the first place: poverty, social stratification, inequality and global politics"*. Previous research (including Spencer & Triche, 1994) showed causes most typically identified in the media were natural and physical rather than social or technological despite *"clear evidence of their hybrid, natural-human origins"* (Ploughman, 1995, p. 308). Spencer and Triche suggested that this is particularly so in media reports soon after disasters, which are more prominent (and read more widely). While later reports may introduce additional interpretations these may not be as widely received. There were few investigative or analytical pieces (Lan, 2009; Wilkins, 1985).

It is reasonable to expect that institutional representatives will avoid defining 'their' institutions as major causal agents (Douglas, 1985). This may account for leaders' fatalistic framing. Stallings (1990) suggested social, political and economic causes were not present in the media because of the absence of sociologist, anthropologist and economist sources. The analysis presented in Chapter 5 also showed the absence of these types of sources in the New Zealand media over 4 years.

Vulnerability was not a topic discussed in the New Zealand media about the Canterbury earthquake. There was also very little discussion of social, political, organisation or economic causes in the New Zealand mass media.

It was only those with academic knowledge of the importance of social causes who mentioned the need to communicate social causes.

**Recommendation 46 (responsibility and DRR topics 4, 3 and 6):** All - Avoid emphasising nature as the cause of disaster so that social responsibility in causing disasters is understood. Show that disasters are caused by a combination of social and natural factors that contribute to disasters, however as earthquakes can't be prevented it is only the social causes that we can currently mitigate against (e.g. choice of buildings, policies etc.).

#### 7.4.13 Consider the effects of framing technology as beneficial or detrimental to DRR

Kitzinger and Reilly (1997) was concerned that representing technology as 'progress' may mean that threats to human health are overlooked. A pro-technology bias in the media associated with a narrative of progress was claimed by Fleetwood (2006) and William R. Freudenburg et al. (1996). However Fleetwood has found evidence that technological failures are an increasingly used framing for the cause of disasters. This is apparently a switch from framing technology as 'good' because of a historic over-reliance on technological solutions.

Technological innovation is a significant part of the success of mitigation measures (DRR topic 3). New Zealand has been at the forefront of some of this innovation (Appendix 4).

This research showed the New Zealand media included both 'good' and 'bad' framing of technology. It is noted that when framed as 'good' there was no reference to the limitations of the technology.

There was a tendency for scientists to be dismissive rather than taking even a sentence to explain the evidence-basis when technology was framed as 'bad'. Two instances of this occurred when military testing was mentioned in the media as a possible cause for earthquakes in a Stuff article with the headline "When the earth shook" by Dudding (2011) - see quote in Table 7.8 . No explanation of why the suggestion was nonsense was given, nor was an explanation given when nuclear testing in North Korea in 2009 was referred to in the Otago Daily Times as a possible cause of an M4.7 earthquake ("N. Korea runs nuclear test" by Associated Press, 2009).

In New Zealand the linking of geology with nuclear sciences in the full name of GNS, in *Felt Occurrence* reporting could fuel conspiracies relating to military testing (cause 5g), but does not appear to have done so.

**Recommendation 47 (DRR topics 4 and 3):** All - Technology is beneficial to DRR; although it does have limitations and when it fails it may also create or contribute to disasters.

A recommendation relating to the need to address false claims is recommendation 72 in section 7.7.3.

Framing of failure of old design, materials or construction methods is a way of drawing attention to possible and successful alternatives. This will also apply to technologies for remediating liquefaction-prone sediments. Since McClure, Sutton, and Wilson (2007) found that attribution of the cause of damage to poor engineering design of buildings is more powerful than attribution of lack of damage to good engineering design a further recommendation is:

**Recommendation 48 (DRR topics 7, 4, 3 and 6):** All - Any damage should be portrayed as selective; provide comparisons that show that different structures or different land areas perform differently depending on mitigation methods applied.

### 7.4.14 Causal attributions by New Zealand survey respondents

Most survey respondents focussed on cause of earthquake or tsunami (Table 7.10). Few referred to the cause of disaster. Some mentioned earthquake signs, or symptoms (e.g. face to face respondents F028 and F196). One Auckland respondent mentioned an association between volcanic eruptions and earthquakes. There were six references to earthquakes or disasters just being 'natural' (e.g. as F073 stated *"It's natural; it just happens").* The 'other' category includes a reference to earthquake disasters being caused by climate change. Another was Interviewee I025's suggestion that international research was needed to understand earthquake cause and statement that *"[tectonic] plates only go down 10km – but earthquakes go 300km down - it's just theories and other people have other theories").* This latter is a specific matter that earth scientists could clarify whenever there are deep earthquakes.

W091 said that there was no need to know why an earthquake happened. Others stated that earthquakes can't be stopped or controlled (e.g. F02 and F050). Web respondent W193 considered that the duration of consequences is the cause of disasters. Interviewee I025 stated that *"The earthquake was not the issue, it was the shonkiness of construction".*

The only respondent who referred to social and political agency in causing disasters, and the fact that it is not only earthquakes that are part of the cause, but also land use decisions and construction methods was a multi-disciplinary DRR researcher from Canterbury.

Understanding of the cause of earthquake-related disasters in the general populace is clearly at odds with contemporary disaster researcher understanding, which focuses on the social causes of disasters, which can be mitigated. This is likely because of the confusing mix of causal frames presented to citizens in the media, as the following section briefly discusses.

**Table 7.11: Causal attributions of New Zealand survey respondents**
This table presents a summary of mentions of the cause of earthquakes or cause of disaster by survey respondents in answers to Questions 2 and 3 of the survey described in Chapter 3.

| Explanations needed or needed to be better explained in the media | No. mentions |
|---|---|
| God or deity is the cause of earthquakes | 0 |
| That can't stop earthquakes, or control them | 4 |
| About earthquakes - why earthquakes happen and where, and the reasons that some areas more at risk, why earthquakes occurred in Christchurch and why there were so many earthquakes | 48 |
| How fracking does/doesn’t cause disasters | 6 |
| Other | 4 |
| About the cause of disaster | 19 |
| That disasters occur at the intersection of hazard and human communities or that the depth and distance of an earthquake in relation to a population affects disaster outcomes | 3 |
| Poor beaurocracy/governance cause disasters | 3 |
| The causes of tsunami | 3 |
| Respondents who made multiple references to various causes | 8 |

### 7.4.15 A curious mix of causal frames co-exist in the media worldwide

Causal interpretations for earthquakes and disasters presented in the New Zealand media in the period 2008-2012 lurched from one framing to another (see Table 7.8). New Zealanders’ causal attributions as reported in the New Zealand mass media variously attribute exposure to seismicity to geophysical, religious and metaphysical causes with the level of impact controlled by a curious combination of God, fate and engineering. The emphasis of initial causal framing was on luck and or the existence of structural mitigation and technological innovation for having reduced the death toll. Other frames entered the media without pattern. As these are media reports whether these fatalistic beliefs are ‘real’, or merely ‘figures of speech’ is unknown. Regardless, having been represented in the media these frames will influence readers/viewers.

The variety of causal frames identified in this research is a similar mix to that observed by Halvorson and Hamilton (2010) in interviews after the Kashmir earthquake of 2005. A similar range of causal attributions had also been identified by Alexander (1980). Schlehe (2010, p. 113) referred to a *"tangled web of co-existing interpretations and associated coping strategies"*. There were no media articles analysed in this study that acknowledge the causal complexity, let alone begin to simplify this for the reader/viewer.

### 7.4.16 Some causal framing exists outside the media

There are reasons for the perpetuation of some frames that lie outside the media. For example insurance legislation in New Zealand refers to earthquakes as 'Acts of God'. In fact the insurance industry world-wide widely uses the Act of God defence to limit the potential attribution of blame (Fasoyiro, 2009). However discussion of the degree of influence this might have on causal attributions has been all but absent in the literature on media and disaster cause. Burgess (2012) is a recent exception.

### 7.4.17 A wider range of causal frames need to be represented

> *If journalists intend to convey the 'truth' of disasters rather than merely 'signalize an event' they must be cognizant of the fact that disasters occur within a socio-political context and scrutinize disasters for evidence of human precipitation and exacerbation and present these fundamental findings in lead paragraphs rather than merely focusing on the physical phenomena which appear to trigger disasters*
>
> (Ploughman, 1995, p. 320).

It is important that useful causal frames are presented in the media. Yet very few of the media articles analysed in this study mentioned multiple causes of earthquake disaster. An exception was the Stuff article entitled "The earthquake blame game" (by Boniface, 2010). However, the causal framing presented was essentially unhelpful for DRR in emphasising natural or fatalistic causal framing and the uncontrollable nature of earthquakes, although there was later reference to poverty and corruption contributing to building collapse 'elsewhere' (see quote in Table 7.8).

Causation is narrowly represented both in academic research, and in the New Zealand mass media. A focus on the triggering hazard (in this case earthquake) and fatalistic causes also prevail. This is not beneficial for DRR for reasons explained in the previous sections.

Many scholars note that media create risk-related frameworks that are typically mono-causal or with limited rather than complex networks (McKay, 1996; Spencer & Triche, 1994; Stallings, 1990) and references therein. This is despite the fact that causation is increasingly viewed in academic circles as non-linear and complex (Jasanoff, 1998) and earthquake-related disasters are known to arise due to a complex interplay (interaction) of factors (see Chapter 2). This research showed that complexity in identifying that there are over 45 factors that academics, the media and citizens frame as contributing factors to earthquake-related disasters. However, according to (Lundy, 2011) sources in the media are not given time to articulate complexity. Hornig Priest et al. (2006) suggested that where causal factors were identified in the media those articles should call for change.

**Recommendation 49 (DRR topics 4, 3, 6, 9 and 12):** All - When discussing causal factors call for change.

### 7.4.18 Summary of causal framing

In summary causal information, even blame, is valuable.

The key recommendation made in relation to communication of cause is to represent cause as interplay of factors with an emphasis on the controllable social aspects of DRR and call for change. That key recommendation, which summarises all the recommendations relating to communicating cause presented in this section is key recommendation made in the concluding chapter (Table 8.1).

## 7.5 Risk identification: communicating characteristics and consequences

### 7.5.1 Introducing risk identification topics

The cause, characteristics, and short- and long-term consequences of disaster relate to the first part of the risk management cycle shown in Figure 2.2; risk identification. This section discusses risk identification topics 1, 7 and 10; how characteristics and consequences have been, and could be better communicated in the mass media. (Cause or attribution of responsibility for disaster (topic 4) was discussed in the previous section (6.4)).

### 7.5.2 Characteristics - provision of background information (topic 1)

There is disciplinary bias in the provision of background science information in New Zealand media that broadly mirrors the overall DRR disciplinary bias discussed in Chapter 5.

The background science needed to understand DRR comes from multiple disciplines (as established in Chapters 1, 2 and 5). A holistic understanding of the background characteristics of all consequences whether built, social and particularly natural and economic (which were not communicated often in the New Zealand media), all characters who are causes or are part of solutions to DRR and the background science to those solutions is required. This is to avoid perpetuating the hazards-tradition bias and the limitations it places on DRR as was introduced in section 2.5.7.

The importance of indirect experience created by media reports relating to earthquakes regarding DRR was established in Chapter 2. Not only citizens, but also experts and decision-makers need to understand the background to DRR science in aspects of DRR and disciplines other than those they are knowledgeable in. Experts and officials alike will benefit from knowing what has happened in other earthquakes. Analogy, historical precedent and local context should be used to make explanations so that experience is contextualised (Plough & Krimsky, 1987). Until 2010 New Zealand had not experienced major social disruption or serious economic setback due to an earthquake (or in fact any geological hazard) since the period in 1929-1942 when a series of large shallow earthquakes occurred repeatedly in different parts of New Zealand (H. Cowan et al., 2009). Consequently citizens would need to draw from historical events to understand the issues and solutions surrounding earthquake events.

This study has shown that the supplemental or background information provided in the media about earthquakes, disasters or risk reduction to citizens was focused on earth-science and that this is a DRR research bias that is mirrored in the media (see Chapter 5).

For example one might expect a focus on background science information in story types in the 'Research & Findings' story group. Although potentially from any of the 4Rs and any disciplines, stories from the 'Research & Findings' story group focussed on earth science and hazards (Chapter 5).

Thus a key recommendation in relation to communicating background is to ensure that scientists from a range of disciplines provide background evidence bases. For reasons of brevity, given the need to be concise (section 4.2.15) background information may be provided in the form of a link to some other information site or source (e.g. the link to a video about the risk of Port Hills rock falls in "40-tonne boulder exploded off hillside" Fairfax NZ News, 2011f).

<u>Background information derived from research about multiple earthquakes is needed</u>
Tierney challenged researchers to *"overcome the tendency to build up knowledge one disaster at a time and focus more on what disasters ... of all types have in common with respect to origins, dynamics, and outcomes."* (Tierney, 2007, p. 520). This is the type of knowledge that all citizens require. This research showed that only 0.8% of ODT articles and no television articles were 'pegged' on historic disaster events (Table 5.2), and (Table 7.12) that fewer than 2% of ODT articles and less than half a per cent of television items were about historic earthquakes on event or story types of the 'Anniversary' subgroup, and they very rarely covered multiple events.

Of all sources in these story types economics experts (from banks) made most reference to other disasters and provided some history, but rarely provided their information source. Only a few of the New Zealand media articles analysed reported earthquake-related academic findings published by New Zealand researchers.

New Zealand earthquake disaster histories or summaries in any form - tables, stories, or link to background information - in the two and a half years prior to the September 4 2010 event were rare. It was only after major international events such as the Chile and Haiti earthquakes that tables of major earthquakes were published. Such *Historic Event Lists* were typically published on the day of a large event.

**Table 7.12: Proportions of story types relating to background science**

This table shows the proportions of print (ODT) and televised (TV1) items published or broadcast in the New Zealand mass media between April 2008 and January 2012 that had 'Research & Findings' group heading story types (listed in the middle column).

| Story SUBGROUP | MEDIA HEADLINE STORY TYPE | % ODT | % TV1 |
|---|---|---|---|
| About any of 4Rs | Background/Expectations | 0.6 | 0.5 |
| | Research Plans | 0.2 | 0.2 |
| | Researchers/Researching | 0.3 | 0.6 |
| | Research Findings (event or future) | 0.3 | 0.4 |
| | Historic (Earthquake) Events | 1.5 | 0.0 |
| | Historic Event Lists | 0.0 | 0.1 |
| Anniversary | This Day in History | 0.1 | 0.0 |
| | Historic Commemoration | 0.1 | 0.0 |
| | End of Year | 0.1 | 0.3 |

*Historic Event List* articles typically referred only to the ten deadliest earthquakes or earthquakes of largest magnitude. The information provided (which is essentially framing 'the most important information to be known of historical earthquakes') was location, date magnitude and number of deaths. This framing is perpetuated in research literature and in this thesis (Tables 3.7 and 3.8). This is because there is no compilation or grouping of other key factors or 2-3 sentence descriptions of key response and recovery issues or disaster cause, or data tables to draw from.

The tendency was to only consider earthquakes in the past century or at most last few hundred years. In terms of geologic timescales this means that the re-occurrence of the largest earthquakes over a long time period was largely unaddressed in the mass media. A citizen would have to have read a *Research Findings* article about Alpine Fault research into return periods to understand this. Occasionally more detailed discussions were provided in *Historic Events* stories published when another event occurred or on 6-monthly or yearly anniversaries of the historic events.

After the Darfield earthquake the mentions of, let alone articles dedicated to, understanding what occurred, and the response to, and recovery from previous New Zealand disasters was limited; mostly to mentions of the Napier earthquake (e.g. "Christchurch economy might boom like Napier" A. Wood, 2011). From what was present in the media one might have thought nothing was learnt from the Gisborne earthquake of 2007 that had any application to Canterbury. After the Darfield earthquake a few articles mentioned Canterbury's history of damaging earthquakes briefly. Only one article "Big earthquake due to rock

Marlborough" (Wardle, 2010a), mentioned Gisborne; *"A quake measuring 6.8 on the Richter scale caused massive tank damage to hundreds of tanks at the company's Gisborne winery 21/2 years ago which were still being fixed"*.

Just that one sentence, which is unlikely to have been read by many as it was published by the in the Marlborough Times, provides a rare description of the consequences related to the wine industry, and an indication that a 'return to normal' does not occur quickly. Even in articles about the largest international events there were only a few references to past events. For example in the ODT the 1995 Kobe earthquake was mentioned (not featured) a few times in the two weeks after the Tohoku earthquake, but not after end of March 2011.

The value of disaster summaries, either within the body text of, or as stand-alone articles in providing context appears to be forgotten. That context relates to more than providing a sense of probability of recurrence (repetitive events affecting successive communities). Context is required not only for threat appraisal but also for understanding of consequences and successful DRR measures including recovery actions. With today's powerful data aggregation, tabulation and info-graphic-generation capabilities the commonly presented information could be significantly extended.

The following section includes the observation that consequences of earthquake are often framed as unusual, which frames society as not or less accountable for those consequences (see also section 7.5.10). One way of countering this framing of a 'natural cause' for disaster is to provide more information about a range of historical earthquakes. That type of information is however not currently readily available.

The following recommendation (50) combines the above discussion (including that more information about and derived from research relating to multiple earthquakes needs to be provided) with the various recommendations in Chapter 5 that relate to broadening the information provided, and Recommendation 49 (to provide causal links).

**Recommendation 50 (all DRR topics through topic 1):** Scientists - Prepare information about previous earthquakes; this background evidence basis include facts about each of the environments, should broaden disaster statistics and include a summary of key causes of disaster for multiple earthquakes (the information may be provided via a link).

Further recommendations relating specifically to 'characteristics' story types are not provided here. The discussion in chapter 6 for each of the disciplines provides indications of topic areas where sources might develop concise messaging for use in the media.

### 7.5.3 Eleven concerns about communicating consequences (DRR topics 7 and 10) were identified in previous research

Consequence-related communication issues and conclusions about the issues have been identified through a combination of literature review about media utility and failures in DRR, recommendations for science risk and DRR communication, survey and interview responses, and reflection on all of these are discussed in the following sections.

The following list of concerns and implicit associated recommendations relating to the communication of consequences of earthquakes has been compiled from previous academic research.

One of the concerns is a lack of awareness of, and the relevance of possible consequences.

1. Lack of attention to severity (consequences).

This is at the same time as media 'sensationalism' is the primary criticism or concern with media communication of both risk and disaster. Most of the observations that the media are 'sensationalist' fall into one of the six following categories, all of which are relevant to the discussion in this chapter;

2. Blame-associated sensationalism (human causes of disaster).
3. Sensationalism associated with luck, acts of God or Satan (cause of disaster).
4. Use of superlatives and other exaggeration about severity of consequences, including emphasis on damage and loss of life (Fischer, 1994), harms and horror (Nimmo & Coombs, 1985).
5. Sensationalizing disagreements between scientists (arguing about background knowledge, characteristics such as magnitude, or consequences).
6. Sensationalising the unusual or unexpected (consequences)
7. Too much emphasis on consequences (Burkhart, 1987; Masel-Walters & Hornig, 1993)
8. Emphasis on loss (e.g. imbalance in reporting of economic loss versus economic opportunities.

Despite the fact that some researchers (e.g. William R. Freudenburg et al., 1996) have found “surprisingly little evidence of blatant sensationalism” (Turner, 1982, p. S19), other researchers refer to sensationalism or bias even in recent studies (e.g. Souza & Martínez, 2011). As will be discussed in following sections dismissing media coverage as sensational may in itself be harmful to DRR if people discount risk consequences or risk warnings because of this.

Other concerns that have been raised by researchers (typically referred to media biases) are:

9. Geographic biases – the implications of certain locations not being named (where consequences have occurred) as this affects aid (as discussed in Chapter 5) and recovery timeframes.
10. Ignoring/denying/forgetting/hiding possible consequences.
11. Differing hazard types creating different injuries and therefore different health needs; for example earthquakes break bones while volcanic eruptions result in respiratory issues and burns (Bolduc, 1987).
12. Socio-economic and racial bias by the media rather than considerately representing these groups. Such bias is thought to cement perceptions of impersonal impact, or otherwise justifies inaction and is therefore detrimental to DRR (Bellegarde-Smith, 2011; Goltz, 1984; J. E. King, 2011; Rovai & Rodrigue, 1998; Voorhees et al., 2007). Examples of bias are representation of damage or disaster occurring in certain areas, and racial stereotypes relating to maladaptive and criminal behaviours. Note however that others argue that it is important to show socio-economic differences as these highlight vulnerabilities.

The above concerns have been translated below into a set of recommendations about how consequences might better be communicated. Behavioural consequences are discussed in section 7.6, which related to DRR actions.

### 7.5.4 Is emphasising harms necessarily communicating consequences?

*There’s got to be meaningful draw on comparable experience elsewhere …and by crikey someone’s got to do it. It’s not alarmist to talk about possible consequences.*

Interviewee I001

There would be no disaster if losses were the same or outweighed the benefits. Disasters are, by definition conditions that involve loss (Chapter 2). Yet the media are criticised for emphasising harms when reporting disasters.

Many academics refer to a focus of media attention on the worst and most exceptional forms of the negative consequences of disasters, which they variously refer to as damage, harms, severity and loss (e.g. Kodrich & Laituri, 2005; S. Robinson, 2009b; Rogers, 1990; Singer & Endreny, 1994; Stevens, 1993; Vergara, 2010). There is said to be an emphasis on property loss and lives lost (Anzur, 2000) not other aspects of consequences. Accusations that media are sensationalist in this way by no means apply only to modern news media. Deresiewicz (1982) referred to an emphasis on damage and fear in sixteenth century German broadsheets of earthquakes Deputy Mayor Ngaire Button – Interviewee I020 stated:

> *Mass media in the initial stages just wanted to see rubble, and they wanted to sensationalise the story. Whenever they interviewed me they wanted me standing in front of something broken.*

Yet for all the claims that the media 'play up' the consequences of disaster in Western countries (e.g. Moeller, 2006), there is reference to down-playing of disaster in some countries; for example in India and China (Caldwell et al., 1979; D. Liu, 2010).

The media has been charged with distortion of the degree of damage and presenting the atypical as if typical (Kueneman & Wright, 1975; Wenger, 1980).

(This focus on negative consequences may be deliberate to assist newsworthiness (Spencer & Triche, 1994), or by NGOs for foreign aid (Driessens, Joye, & Biltereyst). At the same time others are concerned when harms are not covered in the media. For example:

> *The actual aftermath of the earthquake and tsunami seemed to have been pushed off the front pages while a nuclear "disaster" that hadn't actually affected any members of the public took centre stage instead.*
>
> (McCartney, 2011, p. 1845)

or;

> *[Civil Defence Minister] said the way the quake had been portrayed to the public did not reflect the true severity of it. "Although nobody died and serious injuries were few, it seems to have taken away some of the publicity that this is by world standards a very large event.*
>
> " "NZ blessed – no-one died" Civil Defence minister" (NZPA, 2010f)

Also an individual's earthquake preparation is known to relate to the perception that earthquakes are likely to have significant consequences for oneself (McClure, 2006).

A growing body of research has suggested that using emotive framing of consequence over a rational frame may help the public better comprehend a potential risk (Choi & Lin, 2008). According to Rojecki (2009, p. 970) consequences should be represented in the media as a *"motive for a plan for recovery or prevention of future disaster".* Weichselgartner and Kasperson (2010, p. 276) referred to the need to "*facilitate social memory and learning by providing a reservoir of experience*". Given comments by a journalist in Moeller (2006) that there is no exciting video in reconstruction as there is in response, there may also be value in covering the harms (with dramatic pictures) as an introduction to coverage of recovery.

<u>Reporting of death toll was reasonably accurate and used by officials</u>

Whereas historically media have been charged with exaggerating death tolls, evidence has been found in this research to suggest that nowadays a cautious approach to death tolls is generally taken in early reports.

Opinions about the reporting of death toll are mixed. Some have asserted that media reporting of death tolls creates disaster misconceptions because the figures reported are not an accurate or reliable statistic (Bolduc, 1987; D. Jones, 1993; Mitchell et al., 2000; Scanlon, 2011). Kondo et al. (2012) has expressed concern that emphasis on damage, and numbers dead or affected may contribute to societal dysfunction, although the evidence basis for this was not presented. Others suggest that media reporting of human loss is mostly accurate (Wenger et al., 1975; Wenger & Friedman, 1986; Wenger, Sebok, et al., 1980).

X. Yang, Wu, and Li (2011) and Zhao, Wu, and Li (2008) showed that media reporting can be used to extrapolate final death tolls. Estimations of death toll are required for planning response and recovery (as are injury counts, and numbers of affected properties or persons).

Where there was over-estimation of death toll in the media, for example of the Concepcion earthquake death toll in 2010, the over-estimation was attributed by the media in the media to double-counting among government agencies (Associated Press, 2010a). Death toll statistics reported in the New Zealand media relating to the Canterbury earthquakes were clearly the result of government release, and were typically cautious estimates derived from missing persons lists, or numbers of identified dead, rather than total body counts. Also, as discussed in section 5.3.6 unless reporting a foreign event the *Death Toll/Injured* headline frame is not prevalent. As such they cannot be reasonably described as having been 'sensational'.

### 7.5.5 Survey respondents impressions of the communication of consequences

The issues with the portrayal of long term consequences in the mass media previously identified in citizen surveys that were part of natural hazards media research may be summarised as there being a:

- comparative absence of information about long-term consequences
- focus on psychosocial trauma, and a
- focus on the negative, not the opportunity.

Many survey respondents emphasised the importance of communicating the harshness of consequences, so that the severity is understood, the risk is not discounted and there is no psychological surprise. A few respondents commented on their surprise that reality and Hollywood could be so close. This suggests media have not been overly sensationalist and adds weight to later arguments that authorities should not err too heavily on the side of 'reassurance' (section 7.7.2).

From the above discussion the so-called focus on harms can be seen as rather more nuanced than is typically portrayed. In New Zealand media the number of media headline story types in the 'Event Effects' group is far fewer than in the 'What's Happened/What's Being Done' group. It would make little sense to tell a story about 'what is being done' without giving the context of what has occurred. A pragmatic approach to coverage of harms seems warranted.

**Recommendation 51 (DRR topics 7 and 10):** All - Dismissing media coverage as sensational may be harmful to DRR: there is a need to communicate consequences (harms).

Survey and interview respondents also noted the comparative absence of information about long-term consequences and expressed specific needs to know:

a) that aftershocks occur, potentially for a long time, and that they can contribute to cumulative damage (see Table 6.10)
b) how long recovery consequences endure (damage and disruption, both infrastructural and cultural)

c) the ‘normal’ range of long-term psychosocial response; and
d) respondents also noted that a balance needed to be struck when illustrating post-disaster resilience, coping, adaptation and opportunity (sections 7.6.9 and 7.6.10).

### 7.5.6 There was little coverage of long term consequences (topic 10)

There was little attention to recovery consequences (long term individual and community effects) in the mass media (Table 7.4 and Wenger & Friedman, 1986). The number of consequence-related media headline story types in recovery is also limited compared with response story types (Table 7.13).

Loss of culture and heritage, amenity, arts and other aspects affect social fabric were rarely discussed in the media analysed in either an specific, or collective or comparative way with the experience of other cities.

Academic discussion of how the media portrays communities affected by disaster in the long term is not nearly so common as other DRR topics. Nor has there been much earthquake-related research to support this type of communication. A rare example of a summary of the literature regarding the long-term consequences of natural disasters relates to economic consequences (that is a paper by Noy & duPont, 2016). Similarly as discussed in chapter 5 there was not much coverage of environmental or distal consequences. Interviewee I013 suggested *“what would be useful is to benchmark where [communities] are with other places who have been through similar events”*.

**Recommendation 52 (DRR topic 10):** All - Communicate a wider range of consequences; social losses, long-term as well as short-term consequences far from, not only close to the epicentre (damage, disruption and their likely duration for all four environments).

The following recommendation draws from survey and interviewee comment summarised in Table 6.10 and Appendix 10 and extends recommendation 10.

**Recommendation 53 (DRR topics 1 and 10):** All - Acknowledge that aftershocks can occur, can contribute to cumulative damage, may occur for months to years, and that a damaging earthquake might be a foreshock.

**Table 7.13: Long-term consequences emphasized by media headline story types**

Table showing both the media story types that focussed on long-term consequences (centre column) and those headline story types that implied consequences (right hand column). Consequences shown in the left-hand column are grouped according to the four environments or capitals.

| Consequence | Headline story types focused on consequence | Implied long-term consequence story headlines |
|---|---|---|
| **BUILT** | Rebuilding | |
| | Rebuild Plans & Visions | |
| | | Recycling Earthquake Waste |
| **SOCIAL/HUMAN** | | |
| General social/cultural effects | | |
| | Citizens in Recovery | |
| | Change in Luck | |
| | Double Disaster | |
| | Political in Recovery | |
| Long term effects of injury | | Injury Rehabilitation |
| Psychosocial | Stressed, Scared, Struggling | Ways to Feel Better |
| General public health | Long term overall health | |
| Behaviour | | |
| Migration | Staying/Going | |
| | Students Staying/Going | |
| Maladaptive behaviour | Antisocial Behaviour & Law Enforcement | |
| | Aid in recovery | |
| | Leader Visits | |
| On-going pro-social | Celebrity Visits | |
| | Commemoration or Memorial | |
| | | Recovery-related 'DRR options' stories |
| Adaptations/resilience including planning visioning for future | Rebuild Plans & Visions | |
| | Return to Normal/Resilience | |
| Audits-reflections, inquests, litigation and inquiries | | All in ‘Contributing Factors’ subgroup published in recovery period |
| | | All in ‘Reviewing DRR Measures’ subgroup published in recovery period |
| **ECONOMIC** | Business Recovery | |
| | Economy in Recovery | |
| | | Business Recovery Initiatives |
| | | Government Recovery Initiatives |
| **NATURAL** | | |
| | | Weather Worries |
| On-going flooding/rockfall | | Making the Natural Environment Safer |
| Other environmental effects | | Environmental Rehabilitation |

### 7.5.7 Recovery timeframes are decades and need to be communicated

*"The recovery process is more years to decades*."
Prof Johnston in Stuff article "Post-quake fear a missed opportunity" (Fea, 2011)

There was almost nothing in the three years of coverage prior to the Darfield earthquake to acquaint citizens with, or remind them of likely disaster recovery consequences or timeframes; that recovery may take decades.

New Zealand focus group participants (G. Gregory et al., 1997) and survey and interview respondents in this research indicated that they wanted more information about long-term consequences. The fact that survey respondents two decades later in this study also asked for more information about long-term consequences is understandable given that there were no ODT articles, only one television item "Slow progress in Gisborne quake repairs" (TV1, 2008-12-20) and two examples of long-term recovery consequence story types (in three articles) in Stuff prior to the Canterbury earthquake. All three Stuff articles related to Haiti, which in other earthquake-related stories was consistently being framed as an undeveloped country. So while the articles were recent they were likely to have been considered as not being representative of what New Zealanders might expect in disaster recovery. Furthermore there has been little written or broadcast about recovery to events such as the 2007 Gisborne, or 2009 Fiordland earthquake.

While an article had been published in the New Zealand media ten days after the Tohoku earthquake "Japan earthquake recovery to take years" (Associated Press, 2011a) it was only in July 2011 (nearly a year after the Darfield earthquake and six months after the Port Hills earthquake) that an article with the headline "City rebuild will take 15-20 years" was published (Gates, 2011a). Yet this is not unique to media articles; titles of research journal articles rarely hint at the longevity of consequences being discussed.

**Recommendation 54 (DRR topics 10-12):** All - Tell it like it is: recovery may take decades.

### 7.5.8 Better communicating long-term psychosocial consequences

*The mental trauma far outweighs any physical loss that any of us has suffered… We're not prepared as a country to deal with the emotional fall-out from a disaster like this…. And I think we'll do it really hard.*
Canterbury-based recovery advocate, Interviewee I029

The long-term consequence that gained most media attention was psychosocial well-being, or lack thereof. Psychosocial consequences are very real and relevant to the affected citizens (Siegrist & Gutscher, 2008). As Spee noted:

> *Recognition has to be given to psychosocial aspects of an event. Improved information dissemination about 'normal' responses and reactions following a disaster enables people to deal with the psychological and social impacts, and this then places them in a better position to deal with economic and other impacts.*
>
> (Spee, 2008).

Survey respondents in this research also note this. Despite the significant research interest in the topic there was a lack of commentary about experiences specific to earthquakes; the experiences of other communities in disaster, the things that exacerbated psychological distress, how individuals coped in disaster and what officials and governments could learn from this and apply when developing their practices (Chapter 5).

Vasterman et al. (2005) referred to the media as creating new syndromes. Furedi (2007) and authors cited there-in argued that there was a contemporary framing focus on emotional aspects of problems including disasters, and an increasing tendency to incite people individually to illness and powerlessness causing an increase in mass psychogenic illness. Accordingly frames of stoicism, 'resilience' and a sense of unity and common purpose were said to be less common than they were in disaster reporting decades ago (Furedi, 2007). Black and McLean (2011) also suggested that there was a mistaken and harmful focus on trauma in the New Zealand media, leading to self-diagnosis.

Recommendation 16 related to the need to acknowledge the possibility of on-going psychological distress and communicate ways of coping. Framing of a 'return to normal,' a focus on resilience, and rallying by leaders was not always appreciated by citizens (as is discussed in section 7.6.10 – see recommendation 71). The above discussion suggests a need to find a balance between the open acknowledgement that long-term psychological effects are a consequence of earthquake-related disasters (as citizens have asked) and other framing that avoids this becoming a self-fulfilling prophecy; to communicate that psychological distress is a likely consequence, but one that can be mastered.

### 7.5.9 Doom and gloom, or boom? Communicate opportunity not only harms

> *To me from a communications perspective it's about turning around that negative mind-set. It's about turning around "We're all in this bloody awful liquefied on-going seismic activity and we all have to stand to one side while it's being rebuilt",*

*to "Yeah ok we accept we're in a seismic event but we can get on despite that and we can positively engage in recreating Christchurch" ... I want people to understand that this has been a huge disaster but with it comes with huge opportunity – the opportunity to do things differently.*

CEO of the Canterbury Chamber of Commerce - Interviewee I004

Doom and gloom about the negative consequences of disasters should be offset with some acknowledgement that disasters are 'windows of opportunity', including economic 'boom' well as for DRR itself (Iwan et al., 1999; Noy, 2009). The 'correct' balance is a matter of opinion. A rough calculation of the 1000 articles in Stuff dataset shows a harms-to-benefits ratio of approximately 10:1. There were articles in the New Zealand media that explained opportunities and benefits of disaster (e.g. 'Christchurch economy might boom like Napier' A. Wood, 2011); some were criticised (section 7.6.9).

Communicating economic gain, or boom after disasters is considered crass by some and a clear example of 'disaster capitalism' (cf. Klein, 2007). Recall that some people consider a focus on negative consequences biased or sensationalist in order to assist newsworthiness (Spencer & Triche, 1994). Some stress the importance of framing and focusing on opportunity in the aftermath of disasters as a way of lifting individual spirits, giving hope and encouraging adaptation and resilience (section 7.6.9). Others consider the reputational consequences on a city or regional scale, and impacts on tourism and other business (cf. discussion in section 5.2.14).

Earthquakes are a window of opportunity for change when problems, potential policies and political conditions come together (Lan, 2009). An example of this opportunity framing in Stuff is:

*Former mayor Garry Moore said Christchurch had an opportunity to build an "environmentally sound, fantastically state-of-the-art, 21st-century place that will attract the brains and the thinkers of the world. We lost a lot of our beauty and that has to be rebuilt, in a modern way."*

"Christchurch earthquake impact 'bigger than Katrina')" (AAP, 2011)

That article also illustrates sustainability goals and pro-technology framing.

**Recommendation 55 (DRR topics 10 and 12):** All - Showcase opportunity in disaster, not only doom and gloom.

### 7.5.10 Communicate the unusual or unexpected with caution

There were many examples where earthquakes or their effects were framed as 'unusual' 'enigmatic', 'abnormal', a 'surprise', or 'unpredictable', by the media, by expert sources in the mass media, as well as in the headings and body text of academic publications (e.g. "'Exceptional' shaking caused PGC collapse" Fairfax NZ News, 2011o). Often, however, there is historical precedent for what was framed as unusual or surprising (e.g. Stein & Okal, 2011).

A Canterbury-related example is that while it is correct that liquefaction experienced in Christchurch was significant on a percentage of the city-affected basis, to suggest that it was the greatest ever experienced in a city is not. In the Niigata earthquake of 1964 a third of the city sank up to 6 feet (Brumbaugh, 2010). However it is likely that, as was stated in Stuff article "Orange zone puts futures on hold" (D. Williams, 2011b) *"No city has been liquefied four times before, he [Mike Jacka principal and geotechnical engineer at the Earthquake Commission] says. "It really is unparalleled," Williams says."*

Similarly the aftershock sequence experience in Christchurch was not necessarily unprecedented. It was an example of a large population base experiencing multiple aftershocks, and it was one of the best-recorded aftershock sequences in the world with multiple seismographs installed around the city.

Other Canterbury-related examples of 'unusual or 'unexpected' framing include a) the framing of the Darfield earthquake a being 'unusual' in having resulted in no deaths despite its large magnitude (some did point out that factors such as building codes, seismic retrofitting and the time of day had contributed to the nil death toll); and b) any earthquake at Darfield being a 'surprise' as the fault there was unknown (this despite the fact that, as stated by GNS in a media release printed by the New Zealand Herald in February 2011;

> *"If you strip away the sediment and gravels of Christchurch and the Canterbury Plains you would see the bedrock looking like broken glass from millions of years of earthquake activity," Dr Berryman said.*
>
> "Christchurch earthquake: Radar points to rupturing of single fault" (Johnston, 2011)

Also, many recent earthquakes have occurred on faults that were previously unknown; including the well-known 2003 Bam earthquake(Fielding, Lundgren, Bürgmann, & Funning, 2009), 2008 Wenchuan earthquake (Liu-Zeng et al., 2010), Haiti earthquake (Calais et al., 2010).

Clearly there is a need for all involved in DRR to take responsibility for framing such as described above that may result in citizens not realising social accountability for disasters.

**Recommendation 56 (DRR topics 7, 10, 4 and 5):** All – Be cautious when framing aspects of a disaster as unusual or unprecedented; is there really evidence for this – does framing this way avoid or diminish social accountability?

Collating and providing a range of summary information about historical earthquakes (recommendation 50, section 7.5.2) would be a way of illustrating to media and citizens alike those experiences are not so unusual.

## 7.6 Communicating risk solutions

*It's [Canterbury earthquake-related science comment in the media] been very much driven … by seismologist-oriented communication [rather] than by engineer-oriented communication, which would be… we are living on earth, earthquakes are part of the deal… it's not about when the next one is going to be, can I go out of the house? Or trying to see the future… it's all about solutions more than problems.*

Geotechnical expert - Interviewee I012

### 7.6.1 Why it's important to communicate risk solutions

This section discusses the communication of DRR solutions, and the actions that may be taken to implement DRR in all phases of the DRR cycle.

Not only do solutions, the options in DRR, need to be communicated, but also a focus on solutions is required to balance a focus on hazard or threat information (Anbarci et al., 2005; Atterstam, 1995; Burkhart, 1987; McCarthy et al., 2008; McClure, 2006).

Citizens need to know and understand the potential for reduction in damage by implementing DRR measures (Paton, Bajek, et al., 2010; Spittal et al., 2008). In particular information is needed that emphasises actions that will make a difference on the outcome for themselves and the community at large (Turner, 1993). This is because beliefs that specific risk reduction behaviours are effective, positively impact on the degree to which those behaviours are acted upon (Martin et al., 2009). Belief that DRR can be achieved is a better predictor of preparedness than beliefs about the seriousness of threat (Lindell & Perry, 2000; Mulilis & Duval, 1995; Paton et al., 2003).

Denial of vulnerability may be countered by showing that risks can be mitigated (Crozier et al., 2006).

Exposing citizens to lists of possible preparatory actions has been shown as successful in reducing optimistic bias (Weinstein, 1980). Telling stories about actions that others have carried out has been shown as successful in reducing optimistic bias (Weinstein, 1980). A general lack of knowledge about 'suitable' seismic adjustments (Lindell & Perry, 2000) may be remedied through media communication; the following sub-sections combine what has been written about the communication of risk solutions in previous research (which is very little) with some observations from analysis conducted as part of this research.

### 7.6.2 DRR-solution story types and subtopics in the New Zealand media

The topics shown in Table 7.14 are the risk management or 'risk solutions topics' explored in this research and discussed in this and following subsections. The DRR-solutions-related story types (story types of the 'DRR Options' group) identified in the New Zealand media are shown in Table 5.16. See also Table 7.2 for examples of some of these story types.

In this research all 'earthquake' article titles were assessed for mentions of DRR actions. This yielded a set of keywords associated with DRR (see Appendix 9.3). Using these keywords would assist in future automation of analysis of content for reference to DRR-solutions. The keywords also give an impression of the way DRR-solutions were framed in New Zealand in the period 2008-2012.

**Table 7.14: Risk management (solutions) topics**

The relationship of the DRR topic codes, to the four phases of the DRR cycle and the various DRR-activity groups (Reduction Equation 6, p. 57).

| DRR Topic Code | Which of 4Rs | DRR Topic Description using elements of Reduction Equation 6 | |
|---|---|---|---|
| 3 | Reduction | (Infra)structural mitigation, | Education/ |
| 6 | Readiness | Legislation, Preparation, Integration | Communication/ Participation/ |
| 9 | Response | Response Actions/Adaptation | Leadership/ |
| 12 | Recovery | Recovery Adaptation | Adaptation |

'DRR Options' group of story types (Table 5.16) generally discuss reactions to hazard as opposed to reactions to vulnerability. There were headline story types for environment (sustainability) and for cost (economic) though typically framed as the latter and only in a few articles (Appendix 12). There were no story headlines for citizens to understand the importance of the life-safety post-event functionality debate on decisions about the built environment (buildings or on infrastructure), or even a decision whether to implement the earthquake early warning systems that Japan has, and New Zealand does not.

### 7.6.3 Risk solutions; the range should be broadened to match with citizen needs

There should be an increase in information relating to DRR solutions (Martin et al., 2009; McClure, 2006) and in particular to broaden the relatively narrow range of choice prevalent in hazard adjustment decision making (Needham & Nelson, 1977).

Survey responses showed that citizens think only of a very narrow range of activities as reducing disaster risks. They often listed detail in respect of stocking emergency food supply and get-away kits, but rarely mentioned such things as recovery actions, insurance or commemoration.

Literature analysis in this research showed that the focus of research into DRR communication has related to a similarly limited range of DRR actions in the preparatory readiness phase. In the research literature there was often an unstated presumption of what suitable adjustments are, without stating the evidence basis for the contribution to DRR in terms of particular goals or citizen needs. Similarly although media showed that there were a wide range of DRR actions portrayed in the New Zealand media in all phases of the DRR cycle (Table 7.15) the focus was on a limited range of individual preparatory actions within Topic 6. These findings are supported by Perez-Lugo (2001), Houston et al. (2012) and Steelman and McCaffrey (2013).

This suggests it is important to link advice about DRR options with outcomes and goals, to shift the attention as per earlier sections 6.1.3 and 6.1.4 and to underpin all advice with a brief mention of the evidence basis (this is incorporated in Recommendation 50 on p424).

**Recommendation 57 (DRR topics 3, 6, 9, 12 and responsibility):** All – Broaden the range of DRR actions mentioned in the mass media particularly those that citizens can engage in.

A further recommendation derives from recent New Zealand social psychology literature as follows. Research by Paton, Bajek, et al. (2010) showed that social context, community participation, collective efficacy and empowerment play a very important role in facilitating hazard preparedness in New Zealand's individualistic culture (introduced in Chapter 2). Thus a further recommendation relating to portrayal of risk solutions in general is that communication of risk management strategies should be shown as being dovetailed with other community development activities, and thus offering immediate benefits by facilitating development of social capital in ways that are useful in everyday life not only for rare disasters; that *"show a return on investment in everyday life"* (Paton, Bajek, et al., 2010, p. 779).

**Recommendation 58 (DRR topics, 3, 6, 9, 12):** All - Show how risk management strategies can be part of everyday life and community development activities.

**Table 7.15: DRR actions portrayed in the New Zealand media**

This table summarises DRR actions specific to DRR solutions topics, 3, 6, 9 and 12 as portrayed in the New Zealand media in the period April 2008 to January 2012. Generic actions such as scientific research, evaluations or communication are not shown.

<table>
<tr><th>Topic 3</th><th>Topic 6</th><th>Topic 9</th><th>Topic 12</th></tr>
<tr><td>Building design and construction and remediation technique development</td><td rowspan="2">Building code/ legislation and Land zonation and compliance</td><td>Closures/evacuation during event (medical officer, councils)</td><td>Demolition</td></tr>
<tr><td>Implementation of land-use planning and closures and evacuation prior to event</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Leader/Dignitary visits</td><td></td></tr>
<tr><td>Contents securing</td><td>Community building/community participation and supply stocking for self-sufficiency/getaway kits</td><td>Mutual aid - solidarity, Volunteerism and Logistics for government initiatives including policing, military assistance in clean-up</td><td>Rehabilitation/ Clean-up</td></tr>
<tr><td></td><td>Training (first aid and professional) and other preparation e.g. ‘Drop, Cover Hold’ message and drills</td><td>Emergency Medicine/Vet/ Public Health</td><td>Rehabilitation - Physical & Psychosocial</td></tr>
<tr><td></td><td></td><td>Donations - individual, corporate and government grants</td><td>Government funding of recovery</td></tr>
<tr><td></td><td></td><td>Victim ID</td><td rowspan="2">Commemoration</td></tr>
<tr><td></td><td>Commemoration</td><td>Memorial</td></tr>
<tr><td></td><td>Insurance</td><td>Aftershock classification</td><td>Insurance pay-outs</td></tr>
<tr><td>Land Remediation technique development</td><td></td><td>Survey - boundary changes</td><td>Land remediation (tamping liquefiable land and removing boulders)</td></tr>
<tr><td></td><td></td><td></td><td>Rezoning/permanent evacuation</td></tr>
<tr><td></td><td></td><td></td><td>Reconstruction</td></tr>
<tr><td></td><td></td><td>Praise (leader/media)</td><td>Inquest/Commission of Inquiry</td></tr>
<tr><td colspan="4">Incentives</td></tr>
</table>

### 7.6.4 DRR-topic code 3 and 6 story types have ambiguous and unexciting headlines

Headlines from the ODT presented in Table 7.16 show the nature of DRR-solutions articles and the DRR topics they represent before the Darfield earthquake. The number of headlines in each topic type reflects previously mentioned emphasis on response in pre- or inter-earthquake media coverage.

What is noticeable about these articles is the nature of the headlines for topics 3 and 6. Whether in television or print media, published before or after the Canterbury earthquakes these are rarely 'captivating'; for example "Taranaki buildings solid and safe – architect" (Fairfax NZ News, 2010d) may appeal predominantly to those interested in construction. There were no headlines that suggested controversy that might have been used to illustrate options and different outcomes.

The one story of the 1000-Stuff dataset relating to preparation was a human interest article with an ambiguous headline "Turtles Christchurch earthquake |Spreydon school" (Carville, 2011b) was more suggestive of an article about turtle survival.

Similarly, in the ODT dataset most of the 11 articles with headlines that were unclear relate to a DRR topic. The articles covered decentralisation, heritage buildings, preparedness (kit preparation), database of elderly, mutual aid, and Royal Commission topics, along with lessons learnt from Japan and the formation of a bridge lobby group in Canterbury. It is concluded that:

**Recommendation 59 (DRR solutions topics):** Media, media scholars and DRR advocates - Explore headlines that better reflect DRR messages and in particular how mitigation and preparation topic headlines might be made more interesting.

The framing of DRR solutions after the Darfield earthquakes was heavily weighted to strengthening and policy relating to heritage buildings (Figure 7.6). The ODT carried stories relevant to both Christchurch and Dunedin. Owners were urged to heed building codes and other rules. Earthquake Recovery Minister Brownlee was a featured character. Also frequently mentioned were the CTV building (which collapsed in the 22 February Christchurch earthquake) and funds required for quake strengthening.

There is no such singular framing if the headlines of the 1000 Stuff articles with topic 3, 6, 9 or 12 headlines are put into wordle, except that the words Christchurch quake and

**Table 7.16: Pre-Darfield earthquake DRR solutions headlines from the ODT**

Headlines from the Otago Daily Times before the Darfield earthquake emphasised DRR solutions in different phases of the DRR cycle (right hand column). Note that there were only two articles with DRR topic 12-related headlines.

| Headline | DRR Topic Code |
|---|---|
| Shelterbox recruits NZ volunteers | 3 |
| Major upgrade for basilica considered | 3 |
| Historic buildings may be demolished | 3 |
| Restorer of building frustrated by zoning | 3 |
| Red Cross seeks more volunteers | 6 |
| Civil emergency exercise to be held | 6 |
| Team for a crisis put to the test | 6 |
| Tsunami meetings planned | 6 |
| Emergency planning DVD for deaf/hearing impaired | 6 |
| NZ Super investing in catastrophe bonds | 6 |
| Disaster awareness of paramount importance | 6 |
| Civil defence pushes for preparedness | 6 |
| Southlanders urged to prepare for emergency | 6 |
| Civil Defence urges emergency preparation | 6 |
| Samoa calls for tourists | 9 |
| Rippon to give Samoa contribution | 9 |
| Shakira meets Haitian earthquake survivors | 9 |
| Tibetan monks ordered out of China's quake zone | 9 |
| Twitter no timewaster when other line of communication fail | 9 |
| NZ donations for tsunami relief reaches $350,000 | 9 |
| NZers rally round to help tsunami victims | 9 |
| Samoa appeal raises $1m | 9 |
| Boys run for Haiti quake victims | 9 |
| World nations rush rescue, relief workers to Haiti | 9 |
| Key, McCully to visit Samoa | 9 |
| Dalai Lama wants to visit China quake site | 9 |
| Turia calls on NZers to dip deep | 9 |
| Hercules due in Samoa with aid supplies | 9 |
| Defence Force aid team to leave Samoa | 9 |
| US forces scale back Haiti relief role | 9 |
| Rotary gives shelter to victims | 9 |
| Aid agencies gearing up | 9 |
| NZ ready to help Samoa, says McCully | 9 |
| NZ to step up aid efforts in Samoa | 9 |
| NZ vows extra aid after tsunami | 9 |
| NZ pledges aid; Key to fly to Samoa | 9 |
| Vital NZ aid continues to arrive in Samoa | 9 |
| NZ ship brings aid to Samoa | 9 |
| Millions pledged internationally for Haiti quake relief | 9 |
| UK boy (7) raises $NZ221,500 for Haiti | 9 |
| China unease halts Japan's military offer | 9 |
| NZ medical services gearing up to help | 9 |
| NZ medical staff stood down from flying to Samoa | 9 |
| DOC checks on trampers after big quake | 9 |
| Volunteers needed for Samoa rebuilding | 12 |
| Plan for activities and physio school in Haiti revealed | 12 |


**Figure 7.5: Prevalence of keywords in seismic risk management-related headlines**

Wordle generated from the headlines of all risk management topic headlines (DRR solutions topics 3, 6, 9 & 12) published in the ODT between 04 September 2010- to 31 December 2011 (after the Darfield earthquake.) The headlines were entered into wordle.net

earthquake stand out. Wordles for some of the topic headlines in Stuff show that for topic 12 the emphasis is on reopening, waterways and removing rocks. The word ‘officials’ stands out (Figure 7.8).

Residents feature more than officials in relation to actions in response (topic 9). The words ‘water’, ‘medical’, ‘victims’ and ‘lifted’ (the latter two in relation to identification of victims and to the lifting of boil water notices and removal of cordons, respectively).

For topic 6 the word ‘prepared’ stands out. ‘Wellington’, ‘warning’ ‘fear and ‘new’ also feature as do, to a lesser degree ‘consents’, ‘code’ and ‘reinsurance’ and ‘exercise’.

### 7.6.5 Mitigation positively affects outcomes – topic 3

*“The emergency kit is important but [building] structure is 90 per cent of it.”*
(Prof John McClure in “ ‘Unrealistic optimism bounces back” Sharpe, 2010)

Buildings are the number one cause of death in earthquakes and the greatest contributor to financial loss. Damage to buildings inhibits post-event functionality. Infrastructure is highly important to the functioning of cities and smaller communities alike. As discussed in section 6.3 there is a wide range of materials, design, technological and construction innovations that contribute to DRR success in relation to buildings, infrastructure and the land on which they are sited. These are all part of DRR communication topic 3 and Recommendation 9.

It is a myth that mass devastation from earthquakes is inevitable (J. Cowan et al., 2002); while earthquakes themselves are not controllable, damage is. Buildings designed to modern building codes withstand earthquakes well. It is vital that people understand that earthquake damage is controllable through engineering design and construction.

People who consider earthquake damage as a function of poor engineering design are more likely to engage in preparedness actions of their own (McClure et al., 2001; McClure, Sutton, & Wilson, 2007; McClure et al., 1999). Media should therefore present descriptions or comparisons that show that different building structures perform differently in earthquakes (McClure et al., 2001). Damage, loss and suffering should be portrayed as selective, attributable to controllable causes and therefore preventable (J. Cowan et al., 2002; McClure, Sutton, & Wilson, 2007). Since attribution of the cause of damage to poor engineering design of buildings is more powerful than attribution of lack of damage to good engineering design (McClure et al 2007a) it makes sense to show damage. Communications should however also show the success of building design in preventing damage (McClure, Sutton, & Sibley, 2007).

A survey respondent who considered that damage was portrayed without reference to the success of DRR solutions had the following to say;

> *The focus has largely been on what went wrong, rather than what went right. The fact that the vast majority of buildings (commercial and residential) fulfilled their design criteria of 'life-safety' has rarely been communicated while the CTV building collapse witch hunt has gained continuous attention. The fact that no-one was killed in their home has never been mentioned.*
>
> (Web survey respondent W216)

While there are a number of pre-existing recommendations for communication relating to engineering design and construction (as summarised above and in chapter 5) this is not the case for other aspects of mitigation (topic 3). For example, early warning systems are needed (de Jesus, 1995). However the absence of mention of early warning systems by the media has not been discussed before. New Zealand does not have early warning systems. Early warning systems were rarely mentioned in the New Zealand mass media. Possibilities in land remediation for liquefaction-prone lands, stabilising boulders and cliffs, or implementing other aspects of land-use planning were only cursorily mentioned.

> *The reasoning for engineering requirements should be explained clearly, like "a building in zone B should withstand an earthquake creating accelerations of 4ms-2, which generally requires heavy steel reinforcing of concrete or stonework".*
>
> Survey respondent W010

Innovation and success should be celebrated. For example as per Dr Andy Buchanan's statement as quote in section 6.3.4 which framed innovative mitigation in a sustainability paradigm without onerous costs, and

> *There is no reason why Christchurch cannot become a world leader in innovative, medium-rise wooden commercial buildings. The timber construction industry says that the country has sufficient wood resources to supply whatever is needed, and we have among us the designers, architects, construction engineers and builders who could do the job.*
>
> Opinion piece by Jim Anderton, Wigram MP "Wood ideal material for rebuild (Anderton, 2011)

The 'lives lost' framing often prevalent in the media should be avoided (Borah, 2009). It is possible to communicate a 'lives saved' DRR success story in the response period. In warning this might be 'lives potentially saved'.

For the above reasons the recommendations in respect of Topic 3 are:

**Recommendation 60 (DRR topic 3):** Scientists and DRR advocates – Provide examples showing that damage is not inevitable if innovative mitigation solutions are applied (e.g. early warning systems and land remediation techniques).

**Recommendation 61 (DRR topics 3, 6, 9):** All - 'Lives saved' rather than 'lives lost' frames should be emphasised whenever disaster or risk are mentioned to underscore DRR achievements.

### 7.6.6 Readiness and preparation are not just about emergency kits and knowing how to survive (topic 6)

Preparation involves more than survival actions (Russell et al., 1995; Spittal et al., 2008). The following quote from an academic article about New Zealand media coverage of DRR actions summarises the issue discussed in this section (note that this was not a media-related research paper).

> *On the day after the September earthquake, the Dominion Post newspaper ran a big feature saying: "Have you got your emergency kit, etc." One author wrote a letter saying that this is good civic duty you are performing, but it would be useful to also remind people that they need to have a builder check their house. The newspaper duly printed the letter, but when the next earthquake happened on 22 February, the next day, the Dominion Post repeated the mantra "Have you got your emergency kit, etc." The lesson about the importance of actions to mitigate damage was not learned. There needs to be a shift to focus on prevention, not just survival.*
>
> (McClure, Wills, Johnston, & Recker, 2011, p. 10)

It is however, not only the media that focus on earthquake survival kits. On analysis of the New Zealand mass media relating to the Canterbury earthquake, scientist sources, typically earth scientists, but sometimes engineers also, repeat the ‘preparation’, ‘survival kit’ or ‘drop cover and hold’ mantras rather than providing other DRR options (e.g. “Earthquakes could strike anywhere at any time and people should be prepared with emergency kits, Dr Jolly said” in NZPA, 2010a).

An example of an article headlining preparation published in the ODT three weeks before the Darfield earthquake was "Emergency planning DVD for deaf/hearing impaired" (NZPA, 2010d).

Some of the headlines were dismissive, or fatalistic about DRR preparations (e.g. “We can never be adequately prepared for ‘the Big One’” by McLeod (2011)). Or there was a tendency for deficiencies in individual and household preparations to be framed humorously (e.g. as in “ Quake exposes household havoc” in Boniface, 2009).

A lesson from previous events mentioned by Interviewee I006 is that there should be higher insurance excesses/deductibles to encourage homeowners to reduce risk. Such, or other incentivisation was not a headline topic in the New Zealand mass media.

An Otago Girls High School student mentioned more preparation actions than any scientist source mentions of preparation actions in any media article analysed in the article “Geography’s relevance hits home surely” (Little, 2010) she wrote for the ODT.

While the media are to be lauded for the preparedness messaging they currently publish or broadcast this could be significantly improved as per the following recommendation:

**Recommendation 62 (DRR topic 6):** Media – Discuss a variety of forms of preparation (e.g. insurance and recovery planning) not only household preparedness and survival positively; avoid publishing headlines that are fatalistic about DRR achievement, or including humorous anecdotes about the lack of preparation.

### 7.6.7 Previous scholars identified six issues with response solutions (topic 9)

Scholars have previously identified the following framings, misconceptions or myths they consider have a detrimental effect on DRR actions in response. The issues range from the general to the very specific.

1. Search and rescue by individuals or volunteers is not often reported in the media, yet most rescues are by people known to the victim (see later this section).
2. Misconceptions about types of aid/donations required (see overleaf and section 7.7.15).
3. An emphasis on authorities' actions and individual helplessness rather than on individual and community efficacy (Scanlon, 2006).
4. Misconceptions about disease and required health actions in response.
5. A need for relocation from disaster-ridden areas is automatically implied.
6. Too much attention on maladaptive behaviours and little attention to mass care (Wenger & Friedman, 1986) necessitates a need to emphasise mutual aid (section 7.6.9).

Discussion about these topics, including portrayal in the New Zealand media occurs in the sections indicated after each point. This study identified further issues from survey and interview (points 7-9) discussed in this section.

7. Survey respondents asked for more details about actions on event beyond 'Drop, Cover and Hold'.
8. Survey respondents requested details about building assessments, post-assessment stickers, the use of cordons and the need for evacuation.
9. Survey respondents sought more information about what to expect of authorities in response including communication channels that would be used.

<u>Specialised search and rescue, volunteer and community efforts</u>

Specialised search and rescue is not necessarily needed as most people are rescued by friends, neighbours or passers-by (Cohen et al., 2002; Haberland, Heyer, & Schulz, 2010; Rojecki, 2009). The New Zealand media emphasised the importance of individual citizen rescue and volunteer and community efforts, not just those of authorities. USAR search and rescue was reported on frequently, as were individual non-specialist 'rescuers'. The latter were reported on as active at the site of collapsed buildings in the city centre as well as away from the city centre. Perhaps most pertinent in terms of DRR is the later criticism in the New Zealand media coverage of inquests at not having open channels for information, and not integrating 'local knowledge'.

Search and rescue personnel portrayed in the New Zealand media were a mix of paid professional first responders, through trained volunteers (fire and ambulance) and untrained and unpaid responders, and giving assistance in recovery. The bias in depiction of volunteers in terms of more frequent depiction of white volunteers or on student volunteerism noted by Phillips (1986) has not been examined in this research.

Media coverage of aid

Articles publicising fundraising events and other aspects of aid were a significant part of the New Zealand media's coverage in response (see Appendix 10). Another popular media story type in response identified in this study but not discussed in previous research literature are those that give *Thanks for Relief*. These stories publicise acknowledgement of, and gratitude for fundraising efforts, and gestures of solidarity, from individual through to international. Yet few research articles considered media portrayal of fundraising events. Exceptions were Gist and Stolz (1982) who studied advertising of community gatherings in immediate aftermath of earthquake Ho and Hallahan's (2004) study of corporate advertising and Driessens et al. (2012) article about a television fundraising event.

**Recommendation 63 (DRR topic 9 – aid specific):** Media - Stories that mention aid activities should portray the spectrum of specialist search and rescue, first responders, individual and community volunteers and corporate efforts and the importance of utilising local knowledge.

The many story types in the 'Aid, Volunteers or Solidarity' subgroup or *Aid Projects in Recovery* or *Aid Issues* story types, including articles of self-congratulation by nations as to their level of donation in an event (discussed in Chapter 5) could be used to highlight what aid is most important (cf. Recommendation 96).

Appropriate relief donations

The needs for every disaster are not the same. Differing populations, geographies and hazard types create different needs. Bolduc (1987) suggested that the media needed to note the following: 1) Mass hunger is not inevitable and medicine is not necessarily needed, 2) An overabundance of response relief goods may interfere with relief effort, and may also lead to a lack of financing for recovery (rehabilitation and reconstruction) 3) A little time taken to properly assess needs avoids waste through inappropriate items being donated and distributed. It is, for example, not essential to fly in food and clothing, 4) that there is a general framing of giving that cash demonstrates that the donor does not know what to give and 5) that filming a cheque may not be considered spectacular by media. However cash is often better as it puts cash into the local economy, and no transport costs are involved.

CARMA (2006) considered that relief donations feed Western self-interest. A challenge identified by Barakat and Ward (1995) is that it is easier to obtain funds in disaster than for prevention.

The second part of the following recommendation follows from the discussion in sections 5.2.9 and 5.2.16.

**Recommendation 64 (DRR topics 9, 12, 3 – aid specific):** Media - When reporting about aid refer to the fact that cash donations support the local economy, and no transport costs are involved. (If possible emphasise that aid is required in recovery not only in immediate response, and money contributed to reduction will reduce to the need for future aid).

Misconceptions about required health actions in response

In terms of health needs there are two areas previously referred to in terms of media content, albeit the first is infrequently referred to: 1) Epidemics do not occur suddenly after a disaster. Misperceptions about disease, epidemics and plagues have sometimes led both the population at large and aid agencies to demand immediate vaccination. The key to preventing and controlling disease is to improve sanitary conditions and educate survivors in public health procedures (Barakat & Ward, 1995) and 2) Dead bodies or carcasses do not cause disease so that there is often little need for either spread of disinfectants or quick mass burials (Bolduc, 1987).

**Recommendation 65 (DRR topic 9): All -** Advise that the key to preventing and controlling disease is to improve sanitary conditions. Dead bodies do not cause disease so there is little need for disinfectants or quick burials.

Relocation from disaster areas may not be necessary

Relocating disaster victims in temporary settlements is often seen as the best alternative, yet economically and emotionally it costs much less to remain close to home than to be relocated far away from pre-earthquake neighbourhoods (Barakat & Ward, 1995; Bolduc, 1987; Quarantelli, 1991, 1999; Stefanovic, 2003). The New Zealand media did not cover shelter or temporary housing topics with any reference to science or other developed country's experience.

**Recommendation 66 (DRR topics 9 and 12):** All – Comment about shelter and relocation should be supported by evidence; for example relocation far away should not be portrayed as necessary, but as acceptable personal choice.

<u>Respondents requested more detail about survival actions</u>

Although much of the pre-event warning and preparedness media campaign attention has been focused on survival actions in response there are few studies that have assessed media influence on citizen response behaviours or citizen satisfaction with information about survival actions.

Some survey respondents made more general comments. For example respondent F063 wanted *"more information in general what to do. I don't know enough"*. Many linked response behaviours with outcomes. For example *"what can and needs to be done to make [earthquake] effects when they do happen, less painful to humans"* (Web respondent W239).

Face-to-face survey respondent F067's statement *"If disaster strikes practical advice is needed not science"* illustrates that advice in the media is perceived as not necessarily being as being underpinned by science. Many wanted to know about how to 'survive independently' after an earthquake. The need to consider footwear; at home, at work, by the bed, and being prepared to walk home, were oft-listed response actions that should be better communicated. Some specifically mentioned the need for preparations to be for weeks of self-sufficiency, not days as authorities had promoted prior to the Darfield earthquake (e.g. respondent W080, and I005 who said in interview *"What could have been better explained was that people would need to be self-reliant for such a long time."*).

Other survey respondents expressed a need for more information as to appropriate response actions beyond 'Drop, Cover and Hold' messaging. Respondent W108 wanted information about how to exit from a house when it is surrounded by liquefaction as people got sucked into holes and this 'totally dismissed an exit plan from the house'. A few (e.g. respondent W079) specifically mentioned knowing appropriate response to aftershocks (see Table 6.10). W135 referred to the airing of an American television show that in their view gave advice inappropriate for New Zealand houses.

Some questioned the effectiveness of 'Drop Cover Hold' as the individual survival action at the onset of a seismic event as recommended by New Zealand authorities, and there was confusion relating to 'Triangle of Life' advice circulated in emails at various times before and after the Canterbury earthquakes (see Appendix 13).

There were also very few *Drills* stories in the New Zealand media (Appendix 12) leading to the following recommendation

**Recommendation 67 (DRR topic 6):** All - Extend suggested survival actions beyond 'Drop, Cover and Hold'; give examples of how to respond when in different places, and in relation to different hazards (e.g. rockfall or liquefaction), and promote practicing these through drills.

<u>Requests to communicate about building assessments and associated decisions</u>

The value in the media communicating about the need for evacuations after seismic events (due to unstable buildings, slope failure including rockfall) is not a topic that has been considered in previous studies. Nor has there been explicit mention of the media function in explaining the rationale for post-event assessment stickers, cordons, or the need for further engineering assessments.

*Building Assessment & Decisions* stories in the New Zealand media did not provide information about the basis of the assessments, explanations of what the different types of stickers was rare, nor was the rationale for stickering, decisions to cordon off certain areas made clear. (This is also the case for *Closure* stories outside of the response period.)

Survey respondents specifically asked for information about the assessment processes and the basis for stickering of buildings. Interviewee I003 thought that there could have been better explanation of the necessity for cordons and evacuation in case of building collapse, and the fact that these saved lives. For example as Mayor Parker stated in "Powerful earthquakes rock Christchurch" (The Press & Stuff, 2011) *"Thank God we had evacuated the red zone." (though a less fatalistic start to the sentence may have been even more useful to underscore the value of DRR – see section 6.4)*

<u>Respondents asked what to expect from authorities</u>

Respondents also wrote of the need to be informed of what to expect of authorities in response. There were requests for more clarity about how information will be communicated in the response period. A framing remains that citizens should wait for official advice regarding evacuation in case of tsunami, rather than self-evacuating to high ground if there is shaking that lasts over 30 seconds. W074 thought expectations relating to government financial support should be better communicated.

Many survey respondents suggested a response action they required more information about was provision of information about aftershocks (Table 6.10). There has been some, albeit limited research about the provision of short-term warnings in the response phase (e.g. research about aftershock warnings by Mileti and O'Brien (1992) and Noda (2000)). Warnings are discussed further in section 7.7.

### 7.6.8 Recovery solutions (topic 12); more stories are needed

Much has already been said about communication of topic 12 in previous sections. The proportion of research, media attention was shown in Figure 7.3, survey respondent comment on the topic was discussed in section 7.3.4, the prevalence of story types is shown Table 7.2, a summary of the actions portrayed in the media is given in Table 7.15, and pre-Darfield headline types were presented Table 7.16.

This study identified that there are some story types that give a very clear idea of actions taken in recovery (for example *Leader Visit, Celebrity Visit, Return to Normal/Resilience, Commemoration or Memorial* and *Political in Recovery* stories (topic 12) that are part of the 'Events in Recovery' subgroups of stories). As found by S. Robinson (2009b) the rebuild was emphasised in more local coverage, than in other national or regional coverage. Headline story types show that communication of recovery was more solutions focused, than consequence-focused compared with response.

Recovery-action-related articles in the New Zealand media in the period September 2010 to January 2012 were almost without exception about the Canterbury earthquakes. The headlines were dominated by the terms 'officially', 'reopen' and 'waterways' and the focus was overwhelmingly 'Christchurch'-centred. The attention, following from the attention to these consequences, was on businesses 're-opening', and recovery from land damage (caused by liquefaction, land subsidence and rock-fall). Official appointments and announcements (mostly by Minister Brownlee or CERA head Roger Sutton) occurred along with EQC insurance payouts. Public meetings were reported on. The focus was on making 'safe' and 'Cantabrians' 'spirit'. Due to Court schedules and time frames (which in Canterbury were also disrupted by the earthquakes) and everyday media attention to sentencing, earthquake-related crimes were reported on from time to time during recovery (whenever sentencing occurred).

Aid was not so prevalent in recovery articles relating to Canterbury. This was unlike the rare instances in the media where there was mention of recovery related to international disasters the overwhelming focus was on aid.  Other topics not often reported were disability and health-related rehabilitation, recovery of the natural environment, about the information and decision-making processes relating to recovery. This may be related to the types of events (Chapter 5) that media are aware of and have personnel on ‘beats’ to report on.

There were few articles that focussed on individual or business recovery in-depth. Scientist sources were typically mentioned or quoted in articles relating to official announcements, or announcements of research findings. Recovery was rarely compared with recovery from other disasters elsewhere.

Anniversaries and other commemorative events which are themselves recovery actions are opportunities for media coverage of progress made and lessons learnt (or at least identified) that could, it is concluded be utilised more often. This recommendation is combined with another in section 7.7.27 about reporting of lessons. Recommendation 15, presented in section 6.8.10 relates to a suggested way to present coping strategies in the media.

A recommendation for this subsection about communication relating to topic 12 is:

**Recommendation 68 (DRR topic 12):** Media and DRR advocates - Events on which to peg stories about recovery actions should be sought.

A further recommendation (71) related to media reporting of leaders’ statements about affected residents’ resilience and a return to normal is provided in section 7.6.10).

There are few existing suggestions for improving media content relating to recovery because none of the 165 natural hazard media content analyses (Appendix 4) have studied the media as in-depth, or as far into recovery as this study. However recommendations about improvements to be made in recovery reporting could be taken from those in relation to response. For example coverage should:

1) Showcase opportunity not only doom and gloom (section 7.5.9).
2) Emphasise adaptive over maladaptive behaviours (section 7.6.9).

3) Report on individual actions as well as those of government (section 7.2, including for example the formation of emergent groups with those emphasizing political decision-making).

4) Frame decision-making as being 'on behalf of', and giving due consideration to the community in terms of participatory process (section 7.7.17).

5) Remember lessons (commemoration and audit/review) (section 7.7.27).

### 7.6.9 Response and recovery behaviours are both adaptive and maladaptive

*If you look at the individual human response to this it is absolutely extraordinary. We have been given the opportunity to tap into a far greater part of our potential.*

Interviewee I004

Many media content analyses have addressed some aspect of what is considered by disaster sociologists to be a myth, the myth that disasters bring out the worst in people.

Maladaptive behaviours have been the focus of much media and media research attention

Maladaptive behaviours were defined in Goltz (1984) as behaviours that block, delay, impede or fail to promote effective response. In this research the term 'maladaptive behaviour' has been used to refer to socially unacceptable, unwelcome to outright criminal behaviours. The behaviours that researchers have mentioned in this context include widespread panic, flight and massive evacuation (when evacuation is framed as irrational), scattered population, massive shelter utilization, psychological dependency (disaster shock), competition for necessities (including price-gouging by businesses, and looting), other heightened criminal behaviour, civil unrest and insurgency, anarchy and the consequential legitimization of the need for authoritarian government or military interventions or martial law to ensure post-disaster social order (Berger, 2009; Goltz, 1984; Jacob, Mawson, Payton, & Guignard, 2008; Quarantelli, 1975; Stock, 2007; Tierney et al., 2006; Voorhees et al., 2007; Wenger & Friedman, 1986).

Some researchers suggested that media portrayal of social behaviour post-disaster impact the distribution and delivery of food and water (Bellegarde-Smith, 2011; Mason, 2011), the level of relief funding and other aid contributions (Keen & Ryle, 1996; Simon, 1997) or on policy decisions (Quarantelli, Wenger, Mikami, & Hiroi, 1993). Some of these associations have been tested empirically others have not.

In the New Zealand media relating to international earthquake disaster event(s) there was typically only one to a few print media articles related some form of maladaptive behaviour, even if one adds in *Aid Issues* stories. However analysis of the ODT dataset shows that overall *Antisocial Behaviour & Law Enforcement* is one of the most common story types for the Canterbury earthquakes (Appendix 10). Forms of antisocial behaviour portrayed were burglary, theft (including from relief workers), increased drunken violence including drunks breaching cordon, impersonating EQC officials, bogus insurance assessors casing properties for burglary, and increased gambling and violence. Police found a P-lab and a meth-lab during post-quake door-to-door checks. There were also references to cyber-criminality in association with Japanese earthquake and tsunami and in New Zealand, and one Canterbury earthquake-related article about a Japanese media reporter jostling police. Some unusual forms of antisocial behaviour reported on ranged from resident's displeasure at rubberneckers, a person posing as an insurance assessor stealing a man's broken dentures and the use of excavator as a weapon during recovery work after the Darfield earthquake.

There were three articles that related to antisocial behaviour relating to DRR scientists; in 2009 a series of articles appeared in relation to a man throwing rocks in protest at helicopter used to survey a landside caused by earthquakes at Waihi Village, Taupo and his subsequent Court appearance.

<u>Police and military were portrayed as involved in delivery of aid not only dealing with maladaptive behaviour</u>

Balancing this, however, is a comparison not alluded to or assessed in previous DRR-media research. A significant proportion of the New Zealand reporting of police and military involvement in disasters illustrate the delivery of aid in both international and local events, and other forms of physical and psychological assistance and interventions. This occurred through body-text references to door-knocking to check on residents or through headlines such as *"Police keeping a close watch for flooding"* (NZPA, 2011b) or *"Canterbury Police urge stressed residents to seek help"* (NZPA, 2010k). (This links to attribution of responsibility for DRR discussed in section 7.2)

What citizens want of reporting of behaviours in disaster including crime, has not been ascertained in previous research

Survey and interview respondents in this study made little comment about media portrayal of post-earthquake behaviours. Whether this is because of the overall tendency for respondents not to comment on social science topics, or because they expect and want media reporting of crime has not been identified. Previous media analyses have either not identified or ignored in their discussions media reporting of a number of anti-social topics including price hiking, impersonating officials, non-qualified tradesmen, illegal dumping of waste, cordon breaches by business owners desperate to obtain items they require to continue business. Nor have they mentioned reporting of ‘normal acts’ that become illegal in disasters and are therefore policed. For example:

> *Canterbury health officials have indicated they would ask Civil Defence to use its powers to have police remove whitebaiters from contaminated rivers if the warnings continued to go unheeded. Failing to comply with a Civil Defence order could lead to a fine of up to $5000 or three months' jail.*
>
> (NZPA, 2010m)

<u>There is little research about maladaptive behaviours for media to draw from.</u>

The 20-earthquake-research dataset suggests there is very little published scientific knowledge available, or academic sources on the topic of maladaptive behaviours for media to draw from. Three exceptions are two articles about violence Chan and Zhang (2011) and Kolbe et al. (2010), and another Fortin and Pierre (2011) about police capacity subsequent to the Haiti earthquake. It is therefore unsurprising that most comments and statistics presented about antisocial behaviours came directly from police or unattributed comments in Court reporting. Looting and crime were reported both at the time of the incident and followed up at the time of sentencing. No study has been identified that has compared media representation of violence and looting generally, with that post-disaster and into recovery.

The only mention of crime science in the New Zealand media in the period analysed was in respect of training as part of a seminar for community patrollers (Porteous, 2011). There were no comments from persons whose science qualifications were provided beyond the above reference to health officials and references to family violence made by psychologists.

All this media attention does not reflect that while there will be examples of unwanted behaviours such as looting, or price-hiking, false invoicing in disaster response and recovery, the predominant behavioural tendency in disaster response is said to be mutual aid (Aldrich, 2011; Tierney et al., 2006; L. Yin & Wang, 2010).

Articles about aid are common; analysis of media framing of mutual aid is uncommon

None of the natural hazard media analyses (Appendix 4) focussed on the media framing of mutual aid. There is some mention in Barakat and Ward (1995) and Souza and Martínez (2011) of positive, pro-social behaviours such as solidarity, and Turner (1993) refers to the existence of 'therapeutic communities' in disaster. Phillips (1986) considered that the media focussed on *"altruistic behaviour from an unexpected source"*.

The lack of research attention to the framing of adaptive behaviours is surprising given the many media headline story types identified about mutual aid and solidarity in response e.g. *About or Assisting Animals, Accommodation/Break Away, Aid Projects in Recovery, Businesses Helping Out, Awards, Commendations or Thanks, Celebrity Involvement, Celebrity Visit, Cleaning Up, Commemoration or memorial, Fundraising/Donations by New Zealanders, Government Assistance, Leaders & Aid, Leader Condolences, Military or Police/Relief/Aid, NGOs & Aid, NZer Relief Volunteers, Outstanding, International Individuals, Pastoral care, Solidarity* or *Compassion & Community Spirit* stories. The stories included examples of individual, business, official and government, mutual aid, from local government workers transferring to assist in post-disaster organisation, farmers and students helping out with silt clearance, fundraising efforts by communities all over New Zealand and abroad, comprised over 10% of the pre-Darfield ODT headlines and 13% of the post-Darfield ODT headlines (Appendix 10). In contrast less than 3% of post-Darfield coverage were *Antisocial Behaviour & Law Enforcement* stories, and there was over ten times as much portrayal of mutual aid as there was maladaptive behaviours before the Darfield earthquake.

Consequently recognition by Court reporters and editors is needed that emphasising that an offence has occurred in association with a disaster event may give the impression that the antisocial behaviour has increased. To combat this impression, evidence-supported comment should be sought from credible sources as to how crime figures compare with pre-quake figures. An example of such a report is that from television "A new low in quake thefts" (TV1, 2011-07-08). Credible sources might be scientists within law enforcement agencies or academics.

**Recommendation 69 (DRR topics 7 and 10):** All - Emphasise adaptive over maladaptive behaviours in response and recovery; avoid framing adaptive behaviours as unexpected.

**Recommendation 70 (DRR topics 7, 9, 10, and 12 - cognitive and behavioural psychologists):** Scientists - Sociologist, psychologist or criminologist comment on post-earthquake behaviour, both maladaptive and adaptive behaviour would serve to balance any apparent biases.

#### 7.6.10 Simple recommendations for framing of return to normal, helplessness, and resilience versus aren't currently possible

Reflection on previous scholars' comment about portrayal of helplessness, resilience and a return to normal in the media suggests that different DRR goals preclude a simple recommendation about these aspects of DRR communication.

The examples below are also a reminder to note the distinction between recommendations based on subjective observations about media portrayal of DRR and research made on the basis of rigorous analysis. More research into framing of helplessness, resilience to disasters and return to normal is required.

<u>Portrayal of helplessness in the New Zealand earthquake-related media</u>

Previous researchers have emphasised that contrary to media headlines that portray people in disaster zones as helpless and panicky people have friends and relatives to assist them (Bolduc, 1987; Tierney et al., 2006). A Canterbury academic on the basis of their personal experience of the Canterbury earthquakes considered that the media had focused on helplessness and negative psychological health consequences (Fawcett, 2011). Fawcett suggested that the media should balance the helplessness and disastrous consequences by showing social resilience, a sense of unity and stoicism and organisational and cultural factors that promote coping after earthquake-related disasters. In short the media should show more action coping and adaptive behaviour in response and recovery. Other academic comment and a recommendation related to the need to portray coping rather than helplessness was presented as recommendation 34 in section 7.2.3.

Conversely however, it has been suggested that if framing of helplessness were reduced, this would affect aid contributions.

Portrayal of resilience in the New Zealand earthquake-related media

Previous researchers have identified a significant change from mid-20th century to contemporary portrayal of the human response to disaster, from community stoicism to individual psychological difficulties. This research identified an emphasis in academic research and media communication on individual psychological health and recognition that recovery takes a long time, rather than a focus on collective recovery and resilience.

There were only four ODT headlines included the word 'resilience'. However the word 'resilience' was often used in the body text of articles, typically in relation to individual coping as opposed to overall resilience to disasters.

Cantabrian survey and interview respondents expressed frustration at the many references to resilience and coping capacity in the media as they considered this to be as if the suffering was being swept under the carpet or ignored.

In *"Resilience puts city on a fast track back to solid ground"* (P. Wood, 2010) published four days after the Darfield earthquake Cantabrians were told that international evidence showed that what affects society most after a natural disaster is the rate at which it can recommence normal commerce. This article was an opinion piece by Peter Wood (president of the Society of Earthquake Engineers, an emergency management adviser with the Civil Defence and Emergency Management Ministry who was part of the Beehive team co-ordinating the response to the Canterbury earthquake). From this point on 'return to normal' and 'resilience' were two terms that were used, often synonymously to frame recovery stories.

Portrayal of a 'return to normal' in the New Zealand earthquake-related media

It is also pertinent that survey and interview respondents, and some making on-line comment about news articles indicated that Cantabrians did not appreciate references to a 'return to normal,' resilience and their 'coping'. Those for whom life was anything but normal, and would not be for years to come did not appreciate these mentions. There was a resistance to what was perceived as the lauding of economic recovery and business resilience, not only in Canterbury but in respect of recovery from international events (e.g. "Earthquake rattles consumer confidence" Weir, 2011) when the realities faced by citizens were weeks, months and for some even years of uncertainty and disruption.

Emphasizing that things will be 'back to normal' in a few weeks does not reflect the lengthy duration of recovery that citizens need to be prepared for (Barakat & Ward, 1995).

Other media studies that noted an emphasis on getting back to, or a return to normal or what Griffin-Padgett and Allison (2010) termed ‘restorative rhetoric’, include Cox et al. (2008), Hornig Priest et al. (2006), and Rojecki (2009). There was a sense that leaders invited a return after evacuation, or made references to a return to normal that were too early.

Similarly, in this study survey and interview respondents and the body text of some media articles criticised the number of references to a return to normal. Those for whom life was anything but normal, and would not be for years to come did not appreciate these.

Media analysis showed that references relating to a ‘return to normal’ started early after both the Darfield and Port Hills earthquake events (on September 6$^{th}$, and March 2$^{nd}$ respectively). However while authorities could have been clearer about the length of time recovery takes, on examination the comments that were made were cautious rather than overly optimistic. For example on September 6$^{th}$ (2 days after the Darfield earthquake Stuff reported *“[Mayor Parker saying] residents needed to understand things would not return to normal for "a significant amount of time"”* (The Press Dominion Post & NZPA, 2010). Later in the day it was reported that a *“return to normal could take months”*. On 14 March *“Civil Defence national controller John Hamilton yesterday said thousands of people could be preparing to return as schools reopened and life started to return to normal, causing concerns that would place pressure on the city's fragile infrastructure”* (M. Fox, 2011).

Background information and historical precedent about consequences and facts about recovery, if they were presented at all, were typically be buried at the end of articles (this follows from the discussion in section 7.5.2).

This is clearly an area of communication research that would benefit from further social psychological framing research to assess best ways of balancing the portrayal of vulnerable or disaster-stricken communities. A recommendation in the meantime is:

**Recommendation 71 (DRR topics 10-12):** All - Avoid early and frequent reference to a ‘return to normal’ and praise ‘resilience’ only when difficulties are fully acknowledged.

(See also recommendation 54, which suggests avoiding implying that recovery will be quick.)

## 7.7 Communicating the pros and cons - risk assessment

*What would have been helpful was a better understanding of the different type of risk analysis." What is the 'real' risk? (for example to Joe Bennett sitting in his house, of rock falling on him). So you had discussion in the community around what was acceptable risk, but there was no transparency around what was being applied. Was it risk of loss of human life, risk to the Council in mediating damage, was it the risk to EQC in increased claims, was it the risk to the private insurers? … A lot of different models, and a whole lot of different calculations, but somehow people's well-being and their mental health didn't come into that equation.*

Anonymous Interviewee I018

### 7.7.1 Risk assessments/evaluations in both earthquake research and the media are mostly related to DRR topic 2 rather than 5, 8 or 11

This section relates to communication of risk assessments in terms of the topics as shown in Table 7.17. As in all of this research the topic is considered from a variety of stakeholder perspectives.

Literature review has shown that the predominant framing of natural-hazard-media-research in this area has been predictions and forecasts of earthquakes. The topics in Table 7.17 are in effect all 'predictions', 'forecasts' or warnings, but not only of the hazard (earthquakes). Note that earth scientists in New Zealand tend to refer to medium or long-term 'forecasting' of earthquakes as opposed to predictions (Interviewees I024 and I028). While forecasting and long-term hazard assessment is the preserve of scientists the decision to issue a prediction/warning is typically made by officials (Alexander, 2007; Hough, 2005; Mileti & Beck, 1975).

**Table 7.17: Risk assessment topics in the New Zealand media**

This table describes (middle column) the DRR assessment topics as listed in the left hand column. The right hand column shows media headline attention to the four assessment topics (as presented in Table 7.3, section 7.3). Each per cent of ODT articles analysed represents 44 articles.

| DRR Topic Code | DRR Topic Description | % in print media (ODT) | % in women's magazines |
|---|---|---|---|
| 2 | Readiness – identification of risk or solutions, salience and warning | 3.4 | 0 |
| 8 | Response needs and delivery assessment | 2.8 | 0 |
| 11 | Recovery needs and delivery assessment | 1.6 | 0 |
| 5 | Reduction -lessons identified/learned/audit/risk management reviews | 1.5 | 0 |

Risk assessments are rarely discussed either in the academic literature (Table 7.5) or in the New Zealand media (Table 7.5 or two right hand columns of Table 7.17). For more details of the proportions of risk assessment topics presented in different New Zealand media before and after the Darfield earthquake see Table 7.3. Warnings and predictions in the New Zealand media in the period 2008-2011 were presented in Table 5.8.

The tendency has been to consider and discuss warnings of threat of earthquake occurrence (see Table 7.18).

**Table 7.18: Proportions of story types relating to warning topics**

This table shows the proportions of print (ODT) and televised (TV1) items with the warning heading story types listed in the middle column. The ODT articles or television items in the New Zealand mass media between April 2008 and January 2012. The total number of ODT articles 4836, television items is 1407.

The table shows that the proportions of natural environment warnings are much greater than proportions relating to economic, social and built environments or general risk. There were 29 articles in the ODT relating to tsunami warnings. The greater proportion of television items translated to 13 broadcast items relating to tsunami warnings.

| Story SUBGROUP | MEDIA HEADLINE STORY TYPE | % ODT | % TV1 |
|---|---|---|---|
| Warning-natural environment | Forecasting or Prediction | 0.6 | 1.4 |
| | (Animals) Sensing Earthquakes | 0 | 0 |
| | More to Come? Link? | 0.1 | 0 |
| | Volcanic Eruption | 0.1 | 0 |
| | Tsunami Warning | 0.6 | 0.9 |
| | Weather Worries | 0.3 | 0.2 |
| | Secondary Land Threats | 0.2 | 0.1 |
| Warning-built environment | At Risk: Buildings (or Infrastructure) | 0.4 | 0.1 |
| Warning-economic environment | Economic Vulnerability | 0 | 0.3 |
| Warning – social environment | Other Health Warnings | 0.1 | 0 |
| General Warnings | At Risk: Cities, Regions/Scenarios | 0.4 | 0.1 |

Other types of possible warnings are also pertinent to DRR as is shown in Table 7.19. These relate to the threat of the triggering event and of secondary and tertiary consequences across all environments, in all phases of the DRR cycle.

The existing literature includes six separate strands of discussion relating to communication of warnings as shown in Table 7.20. These were or will be discussed in the sections as indicated in the right hand column of Table 7.20.

**Table 7.19: Warning types and related DRR codes**

| DRR Code | Warning type | Example |
|---|---|---|
| 2 | outside of disaster | short-, medium or long term warning about future threat |
| 8 | in disaster | aftershocks, public health, evacuation decisions, planning for delivery of Response actions (includes provisioning/logistics) |
| 11 | implications of recovery options | balancing time and cost to rebuild with long-term vision to build back better |
| 5 | (lack of) progress implementing solutions | lessons learnt, lost opportunities, achieving DRR overall |

<u>Media headline framing of risk assessments and warnings</u>

Media headline story type framing sets the scene for the way risk assessments and warnings are viewed by all citizens. For topic 2 the Stuff headlines after the Darfield quake emphasised 'earthquake' or 'quake' 'risk' for Christchurch and Wellington. 'Scientists' featured, as did the 'Moon man' in relation to 'prediction' and 'warning'. 'Threat', 'big', 'danger' 'fears' in relation to 'rock' ('Port Hills') and 'flood' were also mentioned. The ODT headlines were quite similar although they focused on 'fault' (risk) and to a lesser extent 'liquefaction'.

In contrast topic 11, recovery assessment headlines from Stuff were overwhelmingly about the 'Christchurch' 'rebuild'. Kaiapoi (a town damaged in the Canterbury earthquakes) also featured as did 'plan' and 'zone' and 'residents'. 'Experts' 'reports' and (Minister) Brownlee featured less in headlines however the body-text of articles showed Minister Brownlee firmly in control of what was said about assessments. There were too few topic 5 ('learning', 'lessons', 'answers', 'reports', 'denies') and topic 8 assessment articles.

In the year and half before the Canterbury earthquakes there were only three articles relating to risk assessment topics in the ODT. However these were not alarmist and related to predictions as the articles on Stuff were. One of the three ODT articles focused on global vulnerability, one on New Zealand's overall natural disaster risk and the third on a specific heritage building being declared 'unsafe' ("Protected building declared 'unsafe'" Morris, 2009). This gives rise to the recommendation:

**Recommendation 72 (DRR topic 11):** All – Find additional ways and opportunities to discuss recovery assessments transparently.

**Table 7.20: Issues in communicating warnings**

| To achieve DRR | From scientists' perspective | From media perspective | Discussion/ conclusions | Sxn. |
|---|---|---|---|---|
| How to communicate that bad things might happen? | citizens don't understand statistics and probability | statistics and probabilities technical and do not make easy story | "Anywhere, anytime", or scenarios could be used rather than probabilities or relative risk. | 6.74 |
| | credibility is threatened by pseudo-scientists | criticised when report pseudo-scientific predictions, but feel pressure to do so when other media have | Is it ethical to use pseudo-scientific warnings to discuss DRR (and ignore the credibility aspect)? | 7.7.11 |
| How to communicate in a way that people act rather than ignore? | criticised for overly alarming or reassuring (alarm is one of forms of sensationalism that media charged with) | | What is 'normal' risk and who decides | 7.7.2 |
| | authorities concerned that reaction to alarm is panic | | What are, and who decides 'appropriate reactions to risk' | 7.7.2<br>7.7.16 |
| | there is an expectation that scientists put the results of their studies in context (e.g. advocate for DRR) | some media see themselves as advocates for public good, others not | Threat of earthquake alone does not suffice. Secondary and tertiary risks in other environments also need to be communicated | 5.76 |
| | | | Social psychological research shows benefits of providing solutions | 7.6.1 |
| | have typically not provided detail of assessments to public | too much detail? | Provision of evidence of costs and benefits | 1.1.1 |
| | | | Perceived need for 'social marketing' of specific DRR actions rather than providing information on a range of options | 5.6.10 |

### 7.7.2 Alarm versus reassurance: why a bit of both is good

> *"The people who complain about "scaremongering" when the truth is printed would possibly be the first to moan "why weren't we told" if there was another large quake and no warning of any possible risk had been communicated earlier. Sweeping it under the carpet is unlikely to reduce the chance of something happening."*
>
> "When Gossip fills the gap" (Gorman, 2011i)

Two different messages are needed to satisfy both optimists and pessimists. Both alarm and reassurance are valuable in DRR and a balance of both needs to be communicated.

There is a repeated rhetoric that the media sensationalise alarm. Previous researchers that have discussed the topic of alarm and research have used a variety of terms to describe this aspect of risk communication (Table 7.21).

All of these aspects can be seen in two New Zealand media articles about the possibility of aftershocks after the Darfield earthquake (Table 7.22). These quotes present the seismologist perspective.

Perhaps because what information is alarming or reassuring is a matter of opinion (Sandman, 1994) previous natural hazard media content studies have reported variable findings as to whether the media alarms or reassures. Sandman found that media were more alarming, that media underplayed risk. Another perspective is that different media with different political leanings create different stories, some alarming, some reassuring (Nimmo, 1984). Yet another view is that official announcements in the media are typically alarming (Schanne & Meier, 1992). Another thread to the discussion is that probability is an instrument where similar information is used both to alarm and reassure (Westefeld, 1996). Scanlon (2011, p. p233) suggested *"failure by officials to issue a warning may be a result of the myth that people panic, a myth perpetuated by the media".* (A later section (7.7.11) describes the representation of panic in the New Zealand media analysed.)

There were measured rather than extreme examples of both alarm and reassurance in the New Zealand media in relation to general earthquake forecasting, and Canterbury earthquake forecasting. Example headlines are: "Bigger earthquake predicted to come" (Pepperell, 2010), "Fault-lines 'no reason for panic'" (Littlewood, 2011) and "Reassurance after (earth)quake prediction" (K. Johnson, 2011b). Psychology professor John McClure argued in a media article (Fea, 2011) that concern in the wake of the Canterbury earthquakes should have been used by Civil Defence (see quote on p. 497 of this thesis). An example of an article that suggested that the New Zealand government's issuing and the

**Table 7.21: How previous research framed the topic of alarm/reassurance.**

| Research framing of and findings about alarm/reassurance | Research literature |
|---|---|
| blowing hot and cold<br>creating ambiguity<br>sensationalism or underplaying | (Turner, 1980) |
| risk claiming and denying | (Perez-Lugo, 2001) |
| hype - extravagant or intensive publicity or promotion<br>overstating/understating<br>disparities between raising expectations/eventual realities | (Nehrlich & Halliday, 2007) |
| amplification/attenuation of risk | (Lindell & Perry, 2004; Tansey, 2004) (Burgess, 2012; Pidgeon, Kasperson, & Slovic, 2003; Rodrigue, 2004; Sandman, 1994) |
| how scary messages should be | (Witte, 1995) |
| alarm related to 'politics of fear' | (Furedi, 2007) |
| local authorities have a tendency to 'over-react', or 'cry wolf' | (De la Cruz-Reyna & Tilling, 2008), or (R. A. Olson & Olson, 2001; R. S. Olson & Nilson, 1982; Turner, 1993) |
| social institutions amplify or attenuate risk perceptions by altering risk signals | (Tansey, 2004) |
| whenever news is more alarming than reassuring it is related to alarming official announcements and press releases | (Schanne & Meier, 1992) |
| threat or fear appeal misguided anyway – should be using positive appeal | (Sims & Baumann, 1983) |
| probability is an instrument where similar information is used both to alarm and reassure | (Westefeld, 1996) |
| not wanting to upset people, sending a positive message | (Lamontagne, DuBerger, & Stevens, 1992) |
| concern about panic or hysteria, social disturbance, or public unrest | (Farley, Barlow, Finkelstein, & Riley, 1993; Sol & Turan, 2004; Turner, 1980) |
| desire on the part of officials and decision-makers to avoid psychological anxiety from alarming, to protect the public and avoid the aforementioned panic, social disturbance or 'public unrest'. | ((McCartney, 2011; Sol & Turan, 2004; Turner, 1980) |
| "alarming content about risk is more common than reassuring content or intermediate content - except, perhaps, in crisis situations, when the impulse to prevent panic seems to moderate the coverage." | (Sandman, 1994, p. 254) |
| myth of panic | (Scanlon, 2011; Yoshii, 1990) |
| pseudo-scientists or 'maverick science' causing alarm or 'pseudo-disasters' (most of literature in relation to Iben Browning/New Madrid earthquake prediction but also predictions in Greece and Peru) | (Dearing & Kazmierczak, 1993; Echevarría, Norton, & Norton, 1986; Hirose, 1986; Kerr, 1981; Major, 1993; Nigg, 1982; Ordono, 1984; Shipman, Fowler, & Russ, 1993; Showalter, 1993; Smith, 1996) |
| predictions by officials, e.g. Palmdale bulge, Parkfield (US) and Kawasaki (Japan) earthquake predictions | (Mileti, Fitzpatrick, & Farhar, 1992a, 1992b; Ohta & Kitao, 1977; Savage, 1993) |
| the 'Hiratsuka incident' was an accidental broadcast of a tape-recorded warning about great Tokai earthquake on outdoor loudspeakers on October 31 1981. Media reported extreme reactions 'panic' but did not report that 80% of citizens were not able to hear the warning | (Hiroi, Mikami, & Miyata, 1985) |
| social cues (particularly perceived actions of significant others) had a greater effect on planned actions than belief in Browning prediction | (Farley et al., 1993) |

**Table 7.22: Two reassurance-related quotes from New Zealand media articles**

| |
|---|
| *We had certainly been warned after the 7.1 quake that there was a chance of an aftershock as large as one degree of magnitude lower, about a 6. While there were plenty of magnitude 5s, as the weeks passed the threat of that big aftershock receded. ... There is also a very evident political angle to all of this. GNS Science natural hazards manager Dr Kelvin Berryman has been briefing Cabinet, Minister for Earthquake Recovery Gerry Brownlee, the Earthquake Commission and the Christchurch City Council on the science. As head of a Government research platform spanning Crown research institutes and universities, he cannot afford to go public with loose theories or break consensus views. He talks frequently about the need for a consistent message and is painfully aware that people in Christchurch are already scared, "so we don't want to wind them up any more". With new information, interpretations can change quickly." ... "I think the Boxing Day quake is a concern, but we would prefer it be on the backburner for the moment. We can't say anything useful at the moment, except wind people up. "We will be working on that quake. By raising the topic, you are raising doubts." Berryman says there has been no Government directive to keep quiet about the risk from that fault. ... Unlike New Zealand's small pool of experts, Furlong, who has been a visiting fellow at the University of Canterbury and University of Waikato since the September quake, has the luxury of being able to talk more freely. "Healthy debate is very good and not generated by a consensus viewpoint. There hasn't been enough discussion and that is unfortunate. "It could be a bit to do with the size of the country. There aren't enough people in any one field to be able to challenge each other. In the United States, you have these debates all the time, but there's enough of us and you can fight it out. It leads to a better result. - "What's Next?"(Gorman, 2011c)* |
| *Under scrutiny yesterday [at the Royal Commission], Berryman admitted GNS Science was aware of the possibility of a more devastating tremor striking near central Christchurch after the magnitude-7.1 shake on September 4, 2010. However, in the first few weeks after the September quake the possibility of more devastating aftershock was intentionally not discussed. It was considered that it would be unhelpful for a "traumatised" public. "It's rather alarmist to say there could have been a bigger event. "This morning, Berryman again defended not publicising the possibility of a more damaging quake and labelled coverage of his comments in the New Zealand Herald newspaper "disappointing". GNS had not withheld the information but did not publicise it simply because the possibility were so slim and so frightening. "There is also the possibility of a meteorite strike," he said." - "(GNS Science's) fault (research) funding bid failed. - "(GNS Science's) fault (research) funding bid failed" (Heather, 2011h)* |

media's coverage of a tsunami warning associated with the Chile earthquake in March 2010 was 'over the top' and a case of 'crying wolf' was "The boy who cried tsunami"(Espiner, 2010).

According to Atwood and Major (2000) pessimists focus on the 'alarming' content of news reports (about pseudo-scientific prediction), while optimists seem to focus on the 'reassuring' content (Atwood & Major, 2000). Pessimists require mostly information about specific tasks that can be performed to reduce potential loss of life and property their feelings of vulnerability, optimists require information that stresses the fact that risks are real and should not be discounted along with key preparation that must be undertaken to reduce risk. Therefore a combination of messages to satisfy the separate needs of optimists and pessimists is required. Both of these aspects have been covered in earlier recommendations.

Furthermore citizens will not trust scientists if they are perceived to be avoiding the truth (perhaps to avoid alarming them).

One topic that typically results in reassuring comment by earth scientists relates to remotely-triggered seismicity and whether earthquakes that occur a long distance away but shortly after major earthquakes have been triggered by them (these are *"More to Come? Link?"* stories). Triggering of volcanic activity as a result of earthquake activity is another such topic. New Zealand scientists have tended to downplay any links, both in media articles themselves, and in on-line comments to those articles.

<u>More to Come? Link and Volcanic Eruption</u>

Online commentators (who claimed they held earth science qualifications) were dismissive of reported rumours about the possibility of hot water or gas release having been caused by the Canterbury earthquakes, and suggestions that there might be an eruption of the (extinct) Banks Peninsula volcano. In "Surging springs not a sign of volcanic activity" (Gorman, 2011e) published after the Port Hills earthquake and again after the June aftershocks "Lyttleton eruption not possible" (Gorman, 2011k) scientist sources denied such a possibility. The body text of the article gave details about how it was usual for ground water to be affected by earthquakes. The opportunity to briefly point out the difference between a tectonic fault-producing earthquake such as the Darfield earthquake and tremors associated with magma body rise was not taken (as it was not in any earthquake-related *Volcanic eruption* story type published in New Zealand analysed in this study. It was not acknowledged that links between volcanic activity and earthquakes were being investigated and published by earth scientists. For example Dzierma and Wehrmann (2010) or Yukutake et al. (2011) in relation to 2010 Concepcion, Chile earthquake, and Hakone volcano and the 2011 Tohoku-Sendai, Japan earthquake respectively. Furthermore the public had reason to believe that there may be an association between earthquakes and volcanoes from media stories such as "Indonesia volcano erupts again" (Associated Press, 2010c) in which it was stated that:

> *There is some debate as to whether seismic activity like the 7.7-magnitude quake that spawned last week's tsunami can trigger volcanic eruptions. But with Merapi's eruption 24 hours after that tremor, the government wasn't taking chances. It has raised alert levels of 21 other volcanoes - many of which have shown an increase in activity, rumbling and belching out heavy black ash - to the second- and third- highest levels in the last week, mostly as a precaution, said Syamsul Rizal, a state volcanologist.*

and "Chilean volcano grounds flights" (Associated Press, 2011c):

> *The volcano's last major eruption was in 1960, shortly after a 9.5 magnitude earthquake, the most powerful in recorded history, struck Chile. Some scientists have said that last year's 8.8 quake in Chile increased the likelihood of volcanic activity due to shifts in pressure along the Earth's tectonic plates.*

It is therefore suggested that earth scientists explore ways to acknowledge the possibility of links with and triggering of volcanic activity and other earthquakes but explain why, as they did in the New Zealand example above, if they rule out such activity. The possibility of foreshocks, as per the quote in Table 7.23, is another topic that Cantabrians suggested could have been better acknowledged by earth scientists.

### 7.7.3 Citizen perspectives on prediction, reactions to risk and relationship to informed decision-making varied widely

In this research survey and interview responses and in on-line comments on media articles suggest that scientists are conflicted over when it is acceptable to claim a seismic risk and when to err on the side of denial. They also hold differing views as to the acceptability and tolerability of risk, and indeed the degree of investment in risk reduction. The latter viewpoints will contribute to whether scientists recommend DRR action or inaction.

Of all earthquake story types *Forecasting and Prediction* stories generated the most on-line reader comment. For example, 96 comments on "Moderate quake probability jumps 50 per cent" (Heather, 2011i) and 211 comments to "No big Wellington quake coming" (NZPA, 2011a). The comments to the latter often castigated seismologist Ristau for being like the 'Moon Man' Ring; that he was predicting with little certainty.

In this research survey respondents and interviewees had a variety of comments to make about risk, prediction and alarm and reassurance including *"communicating to a populace that is already on edge is very difficult."* (website respondent W217) and *"I don't think there's been healthy balanced information about earthquake risk"* (Interviewee I020).

Table 7.23 shows quotes from interview that further illustrate the variety of perspectives on the topic of prediction, reactions to risk and the relationship to informed decision-making.

The following recommendation stems from the above and other commentators' narratives on prediction and pseudo-science, and the observations in section 7.4.13. It also fits with Turner's observations decades ago:

> *A substantial minority of the population believes that the scientists, public officials, and news people know more about the prospect of earthquake than they are willing to tell the public – and that responsible public leaders are withholding information indicating that awful things are going to happen... By ignoring rumours rather than airing them and presenting authoritative contradiction, the media may have fostered the conviction that valid information was being withheld.*
>
> (Turner, 1980a, p. 283)

**Recommendation 73 (any DRR topic):** All - Do not ignore rumours or false claims, if a claim is false briefly explain why.

The other recommendations below relate to the discussion in Chapter 4 about communication of risk the need to balance alarm and assurance (see also section 7.7.2), citizen perspectives on prediction, reactions to risk, and relationship to informed decision-making (section 6.8.4) and the following observation.

Pertinent to this discussion is the debate over the L'Aquila trial (Alexander, 2013, 2014, 2015; Cocco et al., 2015; Gabrielli & Di Bucci). Scientists were sent to trial for not having spoken up when assurances were made that there was no reason act differently (to sleep outside rather than in buildings known to be vulnerable to collapse) in the light of increased seismic activity in the weeks preceding the L'Aquila earthquake. None of this discussion considered citizen choice. In essence what the Italian media and the sources in them failed to do is provide citizens with options in DRR (cf. Chapter 4). Note that the New Zealand media, following earth scientist comment portrayed the reason for trial as failure to predict.

**Recommendation 74 (DRR topics 2, 5, 8 and 11):** Scientists and officials - Risk assessments: tell how they were derived and by whom and be aware that risk tolerability and acceptability varies (see also recommendation 92).

**Recommendation 75 (DRR topics 2, 5, 8 and 11):** All - When warning balance alarm and reassurance.

The following section includes a recommendation (76) that suggests increasing threat in a specific situation.

**Table 7.23: Perspectives on prediction – scientist, media and citizens**

The below are quotes from scientists, media and citizen interviewees. Table 7.21 presented Interviewee I024's perspective as reported in the media. Table 7.24 presents Ken Ring, the 'Moon Man's perspective.

Scientist

*The Press One of the unfortunate things that happened in Christchurch was [that] the inability of science to predict precisely the sequence of events led people to believe that the scientists didn't know what they were talking about. And that caused people to look elsewhere for more definitive advice or comment – and they turn to uninformed commentators who were giving more precise predictions. – Interviewee I013*

Media

*The Press deliberately didn't give [Ken Ring] any coverage for as long as possible… but then it got the stage that there were so many people doing things, people talking about it, Air NZ saying there were enough flights out of the city on that day, where we just could not ignore it anymore. – Interviewee I010*

Citizens

*… To have had the February event and the high ground accelerations, and then June – a big quake and then a bigger quake straight afterward, and that's not normal, and then that happened again in December – things don't happen like that.*

*… we needed the reassurance that somebody knew, and we wanted somebody to say, "this is how it works."*

*... this feels totally and utterly unpredictable and even the scientists who at the beginning were trying to put some predictions around things and saying well this would be the normal sequence, that kind of got blown out of the water. And now I don't think people believe too much in the science of 'what's normal' because, our normal now is the every 5-6 months we'll have a big quake. …. The people that lived here became the experts more so than the scientists and we knew that every five to six months we'd have a big earthquake. That's become our normal. That's our perception, people are waiting now.*

*... what citizens have experienced is not normal, our faith in science swayed.*

*We wanted the science to be reassuring in the beginning. And to tell someone that you might look like Christchurch that wouldn't give anyone any reassurance. Reassurance is important, when it first happens. – Interviewee I029*

*I think people get the hang of the general patter, you get a big shake and then you're going to get aftershocks but they're going to be of decreasing magnitude ... so when in June and again in December we had a foreshock (well you didn't know it was a foreshock until you go the next one) and then you got a bigger on ... that went against everything anyone had ever really been told. I think that actually probably swayed a bit of faith in what the scientists were telling us. – Interviewee I010*

*People's views as whether information being provided in response was true, 'correct' and valid were incredibly diverse. It's unhelpful for the media to present extreme views, and particularly that there are secret agendas. – Interviewee I018*

**Table 7.24: Perspectives on prediction – Ken Ring, the 'Moon Man'**
Interviewee I025, Ken Ring, the 'Moon Man's perspective on prediction is presented below. (Table 7.21 presented Interviewee I024's perspective as reported in the media. Table 7.22 presented quotes from scientists, media and citizen interviewees).

| Pseudoscientist |
| --- |
| Ken Ring's (I025) descriptions of the situation surrounding his interview on Campbell Live (which resulted in articles such as (Jo Gilbert, 2011; K. Johnson, 2011a, 2011b) indicated that he considered that he was treated poorly, harangued and harassed by scientists and authorities. He referred to being "silenced by [government Minister] Dr Nick Smith", who Ring alleged cited a law repealed in 1987 about rioting. In relation to his prediction for 20th of March 2011 Ring claimed that the earthquake that occurred at 9.45pm was an *"Intensity 7 that was marked down in magnitude ... It should have been a 6 but was reported as a was 5.1. ... It didn't wreck any buildings because most of them were already down."* |
| In interview Ring made reference to personal choice and informed decision-making, but in relation to warning only |
| *"My job as a forecaster is to warn ... You can't be responsible for people's reactions."* |
| Regarding the media he suggested: |
| *"It is up to the media to ask themselves what they want for the good of the community ... and not to sell newspapers and grab whatever they can."* |
| Ring explained the value of his predictions as: |
| *"that way people don't have to be on full alert all they time they just need to be a bit wary around particular times"*. |
| Ring asserted that scientists have a policy of not informing even if they know what is coming because they don't want to contribute to anxiety, and for political and financial reasons. Ring further asserted that Western science involves confusion being spread as a means for justifying more research, researchers, and funding of research, and used earthquake prediction as an example. |

### 7.7.4 Warnings are taken more seriously if threat and likelihood are increased; both increase when the focus is national rather than local or regional effects

A recommendation that relates to emphasising threat has been suggested by Mileti (1982). The probability of an earthquake increases in any given time period the greater the area. Emphasising national effects will increase the unit of the public perceiving the threat, and the probability will be increased as well. An example of such as statement is *"at least a million New Zealanders (around 25 per cent of the population) are expected to experience shaking great enough to damage household contents and buildings in the next 50 years"* (ODESC, 2007). Such statements convey salience, relevance and immediacy in a way that referring to 1:1000 year events or 25% probabilities do not. Given that discounting risk is common it is perhaps worth studying the effect of references to long earthquake return periods on attitudes to mitigation before using these to frequently.

**Recommendation 76 (DRR topics 2 and 7):** All - Emphasise possible national effects not individual fault or regional probabilities.

### 7.7.5 When communicating warnings outside disaster use simple scenarios: ‘anywhere-anytime’ or ‘when not if’

This section discusses why it has been concluded that inevitability rather than predictability should be a focus of warnings outside disaster (topic 2).

It is known that citizens are less motivated to adopt seismic hazard adjustments if they hold erroneous beliefs about warning provision or immediate predictability (Whitney et al., 2004). Since earthquakes are not predictable it follows that inevitability should be the focus of earthquake warnings.

J. F. Johnson et al. (2009) noted that media discussion in the US appeared to have shifted toward the inevitability (in that case of wildfires) and what the public must do to protect themselves and their property.

In this research it was both the likelihood and the unpredictability of earthquake that respondents resoundingly wished to have better communicated (e.g. website survey respondent W084). While some (e.g. website survey respondent W196) wanted to know ‘chance’ of an earthquake happening, a far larger proportion recognised the importance of realising that New Zealand is generally earthquake-prone and that an earthquake could happen anywhere, anytime, maybe today. Website survey respondent W153 was concerned that communication needed to convey that *“earthquakes don't necessarily occur where we expect them to (on known fault lines like the Alpine Fault), so those who think they live in "safe" areas could be at risk.”* Interviewee I008 suggested the message should *“not [be] saying ‘if you have an earthquake – but saying ‘when’”.* Interviewee I009 emphasised *that “scientists and CRIs have a responsibility to articulate that New Zealand is at high risk of earthquakes everywhere.”* Interviewee I011 suggested that: *“Instead of being told often how many faults are unknown out there – which is a problem all over the world … we will never know them all … people should be reminded that earthquakes are expectable not predictable.”*

Potentially damaging faults were known to exist near the Christchurch (the Canterbury museum had information, the geological map for Christchurch published 6 months before the earthquake acknowledged a risk of near-source faults that may have damaging faults that could affect the city (Interviewee I027) and Q-Files were available to Cantabrians

(ECAN, 2008b). However the fact that maps of relative risk had been published showing Christchurch at the extreme seaward edge of New Zealand (therefore relatively far from the Alpine Fault, the mostly likely source a major earthquake) meant that many Cantabrians perceived their risk of experiencing a damaging earthquake as low, rather than high, but lower than, say Wellington. These maps proved to be of little value when the reality was an event occurred in a moderate risk area rather than an 'expected' higher risk area.

As explained by Kevin Furlong in "Scientists weigh danger of more earthquakes" (L. N. Risk, 2011):

> *The 6.3 magnitude quake was evidence that a "relatively minor" earthquake could have a major impact if it struck close to a city, and all New Zealanders should learn from the event. ..."There's nowhere in the country that's exempt from a moderate earthquake.*

**Recommendation 77 (DRR topics 1 and 2):** Scientists - Keep it simple; New Zealanders are exposed and vulnerable to earthquakes anywhere, anytime (see also recommendation 88).

### 7.7.6 All communities are vulnerable to some form of hazard

Citizens and media must have previous experience with a particular hazard to consider warnings relevant (Mileti & O'Brien, 1992; Palm, 1990; Perez-Lugo, 2001; Wilkins, 1985). In the absence of such experience it is important to emphasise that every community is exposed and vulnerable to some form of hazard/disaster and give community-specific examples and encourage individuals to identify property-specific information as per the following recommendation.

**Recommendation 78 (DRR topics 1 and 2):** All - Emphasise that disasters can happen in any community, give community-specific examples, and encourage individuals to find out what their property is particularly susceptible to.

### 7.7.7 Probability and consequence are not the only ways to communicate risk

As noted in section 7.7.6 probability is the most common way of discussing risk in the New Zealand media. However given exposure and vulnerability are part of risk equation 4 (Chapter 2) exposure and vulnerability should be communicated.

Emphasising exposure suggests the need to be prepared anytime (Turner, 1982) – see also recommendation 77. Knowing about potential general exposure would not only enhance preparedness, but reduce psychological shock from ‘unexpected event’ (Seid-Aliyeva, 2006). As discussed earlier (section 7.5.10) emphasising probability of an event on known faults means that the possibility of rupture of an unknown fault is discounted (as was the case for the faults involved in the Canterbury earthquakes).

A rare example of a general exposure statement in the New Zealand media is *"One day there will be another major earthquake in New Zealand," [Hastings Mayor] Mr Yule said.”* in an ODT article about the Napier earthquake published on 03 February 2010 headlined “Hundreds commemorate NZ’s biggest disaster” (NZPA, 2010b).

**Recommendation 79 (DRR topic 2):** Scientists - Emphasise that the community should be concerned about general risk rather than specific possible events.

**Recommendation 80 (DRR topic 2):** Scientists - Communicate about exposure and vulnerability, not only probabilities or consequences (see also recommendations 81 and 82).

### 7.7.8 Communicate (worst-case) scenarios (consequences) rather than probabilities

Several countries, including New Zealand base legislation on disaster reduction measures such as building codes and land use planning on active fault data (Kiyomine & Atsuki, 2011). Probabilistic methods are employed e.g. New Zealand’s Seismic Hazard Model (1998-2000). It is therefore logical that scientists frame earthquake risk in terms of probability. As a result communication of probabilities prevails in scientist’s communication to the public also. Most articles about earthquake forecasting and prediction in the New Zealand media referred to likelihoods and probabilities of earthquake events occurring.

Although Lindell and Perry (2000) found otherwise review of previous research generally suggests there is a positive correlation between perceptions of likelihood and preparedness (McClure et al., 1999; Mileti & Darlington, 1995; Spittal et al., 2008). However judgements of likelihood do not translate into earthquake preparation in the way that judgments of consequence do (McClure, 2006; Palm, 1998). Some have suggested that people want to know consequences, want scenarios more than probability (G. Gregory et al., 1997) and research suggests that people do not cope well with probabilities (Mileti et al., 1992a). McClure therefore recommended that messages should focus on likely consequences of an earthquake rather than focusing solely on the likelihood of an earthquake.

**Recommendation 81 (DRR topics 2 and 7):** Scientists - Emphasise likely consequences and exposure (worst case scenarios) over likelihood of an earthquake.

See also recommendations 81 and 82 which relate to communication of exposure and recommendation which specifically encourages a focus on large –scale (national rather than local) consequences. For further comment about probabilistic messaging and its impact on risk assessments and DRR decision-making see section 7.7.17.

### 7.7.9 Present exposure and vulnerability statements early in articles to establish relevance and background knowledge

The New Zealand media built some expectations about risk through exposure statements at the very end of print media articles for international *Disaster Occurrence* stories or *Felt Occurrence* or *Aftershock* articles. An example statement is: *"Indonesia, a vast archipelago of 235 million people, is prone to earthquakes and volcanoes because it sits along the Pacific "Ring of Fire," a horseshoe-shaped string of faults that lines the Pacific Ocean."* (Kotarumalos, 2011).

The recommendation here is that DRR researchers engage with media to advocate for the 'template' for these stories be restructured so that the exposure statements are made earlier in the articles; if possible as 'relevance establishing' and 'background knowledge building' leads. This could apply to the background knowledge of any science and any risk topic not just that illustrated here.

**Recommendation 82 (DRR topics 2, 8 and 11):** Media – Place exposure or vulnerability statements early in articles wherever possible to establish relevance, and build expectations and background knowledge.

### 7.7.10 Vulnerability relates to all environments therefore warnings should also

> *"Our concern is that people are saying that the current standards are more than enough because everything survived so well, but there are others saying let's be very careful here because there is still a larger earthquake predicted." Prof Buchanan said.*
> "Canterbury quake 'not the big one'" (NZPA, 2010l)

Vulnerability relates to social and economic factors. For example old buildings that people cannot afford to structurally retrofit are an earthquake risk (R. Park & Paulay, 1975). As can be seen from Tables 5.14 there were few story types relating to warnings about built, social and economic vulnerability. Table 5.6 showed that of the 100 articles in the Stuff dataset most warning articles headlines related to the natural environment, and none focussed on economic vulnerability.

These observations result in the following recommendation:

**Recommendation 83 (environments and DRR topics 2, 8 and 11):** All – Don't only warn about the potential for earthquakes to occur; vulnerability should be discussed in terms of all environments, built, economic and social.

### 7.7.11 Concerns about the effect of scientific and pseudo-scientific predictions may be unnecessary

Within science communication literature there is a significant body of the older literature that concerned itself with commenting on pseudo- or 'maverick' science. However concerns about the effect of scientific and pseudo-scientific predictions may be unnecessary, drawing attention from more concerning aspects of DRR communication

Maverick science is defined as unorthodox scientific theory which is believed as credible by only one or a few scientists (Dearing, 1995). Predictions may be considered unorthodox because they are promulgated by self-appointed scientists, astrologers, psychics and religious leaders (Major, 1998) – e.g. the 2007 Bengkulu city earthquake premonition by a Brazilian mystic who ostensibly foretold the 2004 Sumatran event (Shannon, Hope, & McCloskey, 2011). The literature rarely acknowledges that some scientific theories that are not accepted are later proven. It is also interesting to note that Shepherd and Goode (1987) found that three out of ten scientists being quoted in the media in relation to a health issue were found not to even have one article cited. However, the implications for scientific credibility are not necessarily the same as the implications for DRR as the discussion below and in section 7.4.8 illustrates.

Of the disaster media research literature analysed in this research almost 10% focussed on pseudo-scientific predictions (Baldwin, 1993; Dearing & Kazmierczak, 1993; Farley, 1993; Farley et al., 1993; R.A Kerr, 1991; Major, 1993; Nigg, 1982; Shipman et al., 1993; C. Smith, 1996; Stevens, 1993; Tierney, 1993; Turner, 1980a; Wetzel, Hettinger, McMillan, Rayburn, & Nix, 1993; Yoshii, 1990, 1993). The focus in these studies seemed to be more on scientific credibility than on DRR outcomes.

There was significant attention in the New Zealand media given to ‘predictions’ based on a lunar causal link (cause 4d in Table 7.8) made by self-titled ‘astro-meteorologist’ Ken Ring. (Almost 20% on television and 38% in the ODT of story type 10 *Forecasting and Predictions related* to predictions based on a lunar causal link). Discussion in the media including comment on articles insisted that such predictions should not be reported in the media. However the implications for DRR of predictions based on causes that are not widely accepted was neither provided in scholarly discussion about earthquake predictions based on earth tides (the effect of lunar position relative to the Earth), or in the New Zealand media analysed in this research.

There have been many academic articles written about public response to earthquake predictions. These relate not only to so-called ‘pseudo-scientific’ predictions such as the Henry Minturn prediction of 1976, the Brady-Spence Lima prediction 1979-1981 (R. A. Olson & Olson, 2001), and the Iben Browning prediction where a self-proclaimed climatologist made predictions relating to the New Madrid seismic zone in 1990 (Baldwin, 1993; Clark, Veneziano, & Atwood, 1993; Farley et al., 1993; Lehman & Taylor, 1987; Major, 1993, 1998; Showalter, 1993; Sol & Turan, 2004) and the Pinotepa Nacional prediction (Ordono, 1984), but also to scientific prediction of the 1970s - such as the Palmdale Bulge (US) the Kawasaki (Japanese) prediction of 1974 (Ohta & Kitao, 1977), and the ‘dramatically successful’ scientific Haicheng prediction in China in 1975 (Turner, 1993). In the Haicheng prediction the success was due to a pronounced foreshock sequence, but where the warning recalled the most was by a non-scientist.

Much of the discussion in these articles centred around the social and economic consequences of earthquake predictions and warnings and the associated concerns about public panic, widespread economic disaster and the ‘cry wolf’ syndrome (Echevarría et al., 1986; Haas & Mileti, 1977; Kreps, 1980; R. A. Olson & Olson, 2001; R. S. Olson & Nilson, 1982; Turner, 1993; Zhong & Zhao, 2009). Most articles suggest media should not publish pseudo-scientific predictions.

R. S. Olson, Podesta, and Nigg (1989) suggested the fear of a specific prediction should be limited, but general concern about risk should be enhanced. Some studies suggested large-scale social and economic disruption would be the result of scientific predictions (Haas & Mileti, 1977; R. S. Olson et al., 1989). Other studies found preparedness to be enhanced by predictions (Mileti & Darlington, 1995; Mileti et al., 1992a, 1992b; Mileti & O'Brien, 1992).

Concerns raised in the literature about pseudo-scientific predictions include all those listed in Table 7.21, and also that acknowledging pseudo-scientific prediction legitimises them (Stevens, 1993). Much of the outrage expressed by scientists in media articles about pseudo-scientific predictions related to short-term predictions by individuals without tertiary earth science qualification, or without official positions.

As described in other sections citizens do not necessarily panic. There would be value in confirming whether citizens worry less if a) scientists utilise Rowan's four steps to avoid myths and misconceptions (section 4.2.13), and/or b) scientists rather than only refuting the pseudo-science, explained that there is little need to evacuate if buildings and infrastructure have been strengthened, or that (giving the Canterbury example) no-one died in a suburban home.

Pseudo-scientific predictions are perhaps not worthy of the degree of scholarly attention and media debate and should instead be treated as opportunities to mention possibilities in DRR. Some studies have reported that mitigation (preparedness) behaviours are catalysed by pseudo-scientific prediction (Farley, 1993; Mileti & Fitzpatrick, 1993; Showalter, 1993). Some consider that it is appropriate to use prediction to generate generic preparedness (R. S. Olson et al., 1989). The recommendation stemming from the observations in this section (and sections 6.7.1. 6.7.3 and 6.7.4) is that pseudo-science could be valuable for DRR communication.

**Recommendation 84 (DRR topic 2)**: All - Pseudo-science should be considered as having value in DRR communication; an opportunity to present stories or brief mentions about the science and DRR - for example why there is no need to evacuate if buildings have been strengthened.

### 7.7.12 People comprehend and interpret numerical likelihoods differently

Mathematical notions of probabilistic risk are quite different from journalistic narrations of risk (Mairal, 2011). The probabilistic format of scientific information can influence people's understanding of science and related choices and actions (e.g. Doyle et al., 2011). When communicating likelihoods both verbal and numerical terms and phrases should be communicated in conjunction with one another (Doyle et al., 2011).

**Recommendation 85 (DRR topics 2, 8 and 11):** All - Communicate numerical and verbal likelihoods together.

### 7.7.13 It is a myth that 'stress relief' from a small earthquake gives protection from a larger event

There is one earth science myth that is not typically addressed on earth science institution webpages that perhaps should be. The Californian Department of Conservation describe this myth as being that *"protection from large quakes is achieved through occurrence of smaller earthquakes"* (Department of Conservation California, 2014) , when that is not the case . This 'stress relief' myth has had serious consequences in terms of citizen decision-making. It is the step that came before the lack of warning that caused the charges and sentencing of officials including geoscientists in Italy, and the associated international outcry re scientific 'prediction' in mass media the world over (section 7.7.3).

The implications of a variant of this same thinking presented on the Stuff website in relation to further earthquakes in Canterbury should be clear to any reader.

> *However dismal the future appears, Christchurch residents can take some comfort in knowing that once the current series of aftershocks peter out, their little bit of New Zealand can forget about major earthquakes for several hundred years.*
>
> "Christchurch will rise from the rubble and boom again" (Bueguer, 2011)

Many earthquakes (aftershocks) were triggered by the initial Darfield earthquake on September 4 2010, (which itself involved multiple ruptures seconds apart on the same fault (Beavan et al., 2010)). It is accepted that the Darfield event triggered the February 22 2011 event (Stramondo et al., 2011).

**Recommendation 86 (DRR topics 1, 2 and 6):** All - Avoid reference to the 'stress relief myth'; that is suggesting that protection from large earthquakes is achieved through occurrence of smaller earthquakes.

### 7.7.14 Multiple events are not abnormal and one earthquake can trigger another

> *Scientists are reassuring people that earthquake activity in New Zealand – including three magnitude 4 quakes today - remains normal.*
>
> "Reassurance after quake prediction" (K. Johnson, 2011b)

This last statement is an oxymoron; it is equally not abnormal to have an occasional large magnitude earthquake; and not unprecedented to have multiple earthquakes, or a triggered sequence. Messaging after the Canterbury earthquakes increasingly included the statement that an aftershock of *"up to one magnitude less [than the original earthquake]"* might be expected (e.g. as made on September 4 2010 in “Huge earthquake rocks Christchurch” Press Reporters, 2010).

Section 7.4.8 outlined that since triggering is possible it is natural that citizens might ask if another large earthquake event might occur.

**Recommendation 87 (DRR topics 1, 2 and 6):** All - Asking ‘what will happen next?’ is natural; triggering should be acknowledged as possible, and if framed as unlikely the reason given.

<u>Classifying things as ‘dangerous’ or ‘safe’, ‘benign’ or ‘risky’ has implications</u>

How risky situations are framed matters (Bankoff, 2001; Eiser et al., 2012; Harries, 2008; S. Miller, 1997). An academic research article that clearly makes this point is “Fukushima: The myth of safety, the reality of geoscience” (Noggerath, Geller, & Gusiakov 2011). As well as having relevance to causal framing ‘risk classifications’ affect description of buildings as ‘earthquake-prone’, ‘earthquake-proof’ or ‘earthquake-safe’, and what they mean. In New Zealand ‘earthquake-prone’ meant anything less than 30% of the current building code at the time of the Darfield earthquake. However as this was never explained in the media before the earthquakes, and rarely afterward, misperception about the terms remains.

A variant of ‘safety’ messaging is the hazard maps referred to in section 7.3.2 where areas far from the Alpine fault such as Christchurch were shaded ‘green’, implying safety.

**Recommendation 88 (motivation and DRR topics 2, 8 and 11):** All - Dangerous or Safe? Recognise that ‘safe’ or ‘safe than’ implies no or less action needs to be taken.

Given the survey and interview respondent requests in respect of aftershocks (Table 6.10) aftershock warnings (recommendation 53) are important.

### 7.7.15 Warnings and action advice should be linked to background science

Section 4.2.14 discussed the importance of linking information to solutions and action. Although it has been established by social psychologists that the link between provision of background hazard information, forecasts and citizen preparation is tenuous, it is this hazard information-preparedness link that is most prevalent in the New Zealand mass media; that is earth scientists mentioned the need to ‘prepare’ without giving details of specific actions or the benefits of these (e.g. quote in section 5.6.6). Furthermore the type of preparations suggested may not been seen as having value by citizens.

**Recommendation 89 (motivation and DRR topics 2, 8 and 11):** Scientists - Include cost:benefit information, and a greater number of possible DRR actions and/or details about those actions in research publications and the media (avoid using an overly simple 'hazard information will result in preparation' link).

### 7.7.16 Evacuation is a reasonable reaction to risk

Scholars have noted what Hiroi et al. (1985, p. 42) referred to as *"over-dramatisation of reaction to warnings or disasters, including incommensurate use of the term 'panic'"*. There is an expectation of panic in relation to warnings, including pseudo-scientific warnings, as discussed in section 7.7.2.

In this study it was shown that if one considers a greater body of earthquake-related articles the reactions are portrayed in a more balanced fashion, though the term panic is still used frequently in headlines, and might more reasonably be framed as 'running to safety' or to meet up with loved ones.

*Reaction to Risk* headline story types were present in the New Zealand mass media in the number Table 7.25 and Appendix Table 12.1 All media gave between 0.9 and 1.6% of coverage to *Reactions to Risk* (warning) headlines. The other 'DRR Options' subgroups 'Approach to DRR' and 'New policies or Procedures' also build impressions of reactions to risk, with the reaction being mostly toward DRR actions in between 3.8-9.3% of coverage (Table 7.2). The 'Warnings/Risk' group of articles may contain body text references to reactions to risk (Table 7.18). In the case of television before the Darfield earthquake this may have constituted up to 12% of coverage.

Self-evacuation has almost always been treated as if those who wish to leave are unreasonable. That is until a recent publication by van Stiphout, Wiemer, and Marzocchi (2010) relating to the L'Aquila earthquake.

**Table 7.25: Proportions of reaction to risk headline story types in NZ media**
Numbers of *Reactions to Risk* headline story types (left hand column) identified in media analysis of TV1 (centre column) and ODT datasets (right hand column).

*(Un)prepared citizens* and *Reviewing Authorities Preparations* story types (part of 'DRR Review' group of stories) are included (in italics) as they contain elements of risk reaction in them. *Staying/Going* story types are also included as they discussed, in the Canterbury earthquakes not only a reaction to damage and disruption but also to risk of ongoing aftershocks. (This was not the case for *Students staying or Going* which are typically framed as stories about the the consequences the student left behind and their host families and host schools)

| Subgroup and Headline Story types | No. TV1 items | No. ODT articles |
|---|---|---|
| Restricted Access | 13 | 27 |
| Fear Flee or Panic | 7 | 11 |
| (Evacuation) Rational Reaction | 1 | 8 |
| Code Compliance | 0 | 3 |
| Discounting Risk | | |
| (In)action | 1 | 4 |
| Don't Worry (Authorities/Experts Denial of Risk) | 0 | 2 |
| (Un)prepared Citizens | 1 | 5 |
| Reviewing Authorities Preparations | 0 | 5 |
| Staying/Going | 6 | 63 |

Self-evacuation is in essence what the *Fear, flee or panic* story types recorded, although the stories did not frame the behaviour that way. In the *Staying/Going* story types in Canterbury-earthquake related articles the 'going' part was mostly self-evacuation from aftershocks.

Evacuation may also occur as a result of scientific or pseudo-scientific predictions (section 7.7.11). Where scientists do not advise evacuation in these situations they have discounted risk. While there were few headlines in which authorities overtly discounted risk, there were many body text references where experts or officials reassure citizens about risk (e.g. the quotes in section 7.8.2). Authorities also discount risk due to cost (section 7.7.17).

**Recommendation 90 (responsibility, motivation and DRR topics 3, 6, 9, 12):**

Media - Record all reactions to risk and positively frame responses that achieve DRR goals – evacuation may be reasonable, not 'panic'.

### 7.7.17 Seismic hazard analyses: New Zealanders aren't aware of the differences

The relative worth of two distinct types of seismic hazard analysis; deterministic and probabilistic was discussed in (Panza et al., 2011). Put simply a deterministic approach (deterministic seismic hazard assessment or DSHA) places emphasis on the severity of the potential outcome, worst possible or worst-case scenario, in this case the maximum credible earthquake (MCE). A probabilistic approach looks instead to the most likely scenario.

According to Mualchin (2011) the California public had not been involved in the discussion and outcome of seismic regulations, which they described as being controlled by a few experts and special interest groups, unlike active participation in environmental issues. The public accept DSHA but a few people prevent its use and control use of probabilistic assessments instead (Mualchin, 2011). *"Active participation by the public is necessary to ensure effective earthquake regulations for public safety."* (Mualchin, 2011, p. 405).

An example of how citizens misunderstood the basis of DRR decisions is the decisions for tsunami barriers along the Sendai cast. Citizens interpreted 'safety' as being related to MCE rather than a more probable earthquake of lower magnitude and thus did not run to higher ground after the Tohoku earthquake in 2011 (Ando, Ishida, Hayashi, & Mizuki, 2011; Oki & Nakayachi, 2012).

In making any assessments choices are made. New Zealand scientists utilise probabilistic seismic hazard assessments as the basis for their advice regarding cost versus benefit, and DRR decisions (Appendix 1 and Interviewee I029). For structures with a life longer than a typical 'design life' of 50 years (e.g. heritage buildings) estimates of seismic input based on PHSA are often unsatisfactory (Mualchin, 2011). There is no evidence from literature reviewed, surveys or interviews or media content that New Zealand citizens are aware of the distinction between assessments based on DSHA and MCE and the criteria on which the assessments were made.

This gives rise to the following recommendation, which blends a point made by I012 and the above discussion:

**Recommendation 91 (DRR topics 2, 8 and 11):** Scientists and Officials - Make clear that experts themselves made choices, and had to discount some risk (for example in choosing to design according to a most probable, rather than a maximum credible earthquake).

The above is part of a wider discussion about acceptable risk and viable, bearable and equitable solutions, as is discussed in the following section.

### 7.7.18 Communicate whether evaluation of risk and solutions shows they are acceptable, bearable, viable and/or equitable

Psychometric risk perception and communication research has shown that people want to understand, if not be involved in risk-benefit trade-offs (Pidgeon, 1998). Information about the values and perspectives of different groups and the trade-offs each are willing to make or have made, should be provided (Renn, 1998b). Citizens require information that enable them to decide whether risks are bearable, equitable, viable, and therefore sustainable and thus tolerable or acceptable (see Figure 3.6). Citizens *"need to know what was known, what data were missing, what the scientific consensus was ... how the risk estimates were derived and why they [are] different"* if indeed they do vary (Friedman, 1994, p. 207).

With DRR commonly placed in a sustainability paradigm and drawing from Jeanneret's (2008) article on the framing of sustainable development, any discussions of the costs and benefits of DRR should arguably consider what is bearable, viable, and equitable (see Figure 3.4a). Ann Fisher (1991) suggested a need to communicate about tolerable risk rather than 'acceptable risk', suggesting 'acceptable' might be taken to mean approaching 'zero risk'. However Jeanneret (2008) described viable solutions as ones that last or are 'value for money', bearable solutions as those that are culturally or socially tolerable, ethical solutions as ones that are ethical and fair and just, and acceptable solutions are those that all three other criteria. If this is to become a public discussion these terms will need to be explained in the media.

The lack of discussion in the media about acceptable risk and vulnerability assessments has led to debate about alarm and assurance and what appropriate actions are (section 7.7.2).

The following recommendations summarise the conclusions from this discussion:

**Recommendation 92 (DRR topics 2, 8 and 11):** All - Draw out a public discussion about acceptable risk and viable, bearable and equitable solutions at different phases of DRR in relation to different environments.

**Recommendation 93 (responsibility and DRR topics 2, 5, 8 and 11):** Media and Officials - Frame official decision making as 'on behalf of', and giving due consideration to the community in terms of participatory process.

### 7.7.19 Cost versus benefit evaluations and DRR – investing in DRR

> *Several questions [lie] are at the heart of risk interpretation and action. How should different costs and benefits be valued? Whose costs and benefits should be given most weight? How fair is any distribution of costs and benefits between different parties or stakeholders, between geographically separate regions and between present and future generations?*
>
> (Eiser et al., 2012, p. 10)

It is important that money is invested in DRR (C. Kenny, 2009); invested 'where it counts' (Kellet & Sparks, 2012). Information about relative costs and benefits of investing in DRR must be communicated to meet citizen needs (Hornig, 1993; McClure, 2006; Palm, 1998). Information is required not only about the cost and benefit factors traditionally weighed by risk assessors but about implementation, regulation, and ethical considerations (Hornig, 1993; Pidgeon, 1998). Who set the limits and what was the goal? Citizens should be shown the value of insuring against low probability high loss events, and not only probable small loss events to counter a tendency to insure only against the latter (Slovic et al., 2000). This includes 'insurance' at a societal level. An example is whether to design for maximum credible earthquake for lower-probability ground motions (e.g. Tsang, 2011).

A range of authors have analysed media coverage of costs versus benefits (Amberg & Hall, 2010). However none of these were studies of natural hazard-related content in terms of costs and benefits of DRR options. Scholars who shed some light on this topic include Singer and Endreny (1987) who concluded that there was insufficient information for 'rational decision-making' for DRR two decades ago. Sachsman, Simon, and Valenti (2004) found that US reporters said they rarely or never included risk assessment in their environmental studies.

On the basis of what was provided in the New Zealand mass media between 2008 and the end of 2011 the media still do not provide sufficient information for citizens to understand let alone be involved in DRR-related assessments. Literature analysis has found that this is not solely due to the media. Earthquake-related academic articles about risk assessments did not discuss the information that citizens require, so that information about risk assessments is not readily available for the media to use.

The assessments being undertaken by official experts or by officials on the basis of science were not reported in the media. (This was despite official scientists being sources in the media (Table 5.31). Comment about costs and benefits was generally limited to brief or vague statements such as *"Engineers say cost-effective technology exists to combat* *earthquake damage"* (in "Make buildings bounce – engineers" by Cairns, 2011b) or *"I don't think it has increased the cost of development considerably"* (Dr Bray in an article about foundations in liquefaction-prone areas "Kaiapoi rebuild put on hold" by M. Wright, 2011a).

As noted in a previous section (7.7.17) the dominant framing in the New Zealand mass media between 2008 and 2012 in risk assessments was life safety. There was no discussion of the basis of design criteria or of insuring against low probability high loss events in the New Zealand mass media.

In keeping with the discussion and findings above Interviewee I021 wanted to know the cost of strengthening. Interviewee I009 thought there should be *"better articulation of the reasons (including science) for why we get to decisions"*. Interviewee I011 suggested that there is a need to *"compare the cost – not only direct but indirect costs of earthquake with how much it would have cost to have avoided the problems in the first place"*. Web survey respondent W109 only commented about engineering matters, wrote:

> *"Th[e] balance between building cost and building performance is not well understood by the public (and perhaps not well communicated by engineers). There needs to be more public debate about the level of performance that society wants to pay for"*.

Seismologist Kelvin Berryman (Interviewee I024) thought that there needed to be a *"public conversation around acceptable risk and tolerable impact"*.

I012 thought that it is important for people to understand that:

> *When you build something you've got two options, you build it so it can withstand anything nature can throw at it, or you balance the risks and the costs and come up with some pragmatic middle ground where you accept that there is an exposure to some risk but you're not over-engineering to the point you can't afford something. Throughout the life of that construction, and when there is a disaster people need to remember what the trade-off was that was made, and not feel hard done by when what residual risk was accepted, happens.*

An example of an article published after the Canterbury earthquakes that gave more of the above information than most others follows. Note that the headline was framed as a warning about the consequences to built environment in the event of a future earthquake conjuring up images of, rather than using probabilities.

> *A 2008 report co-authored by Dr Thomas highlights a major problem with the safety of homes should the "big one" strike. The report said about three-quarters of Wellington homes had problems with their foundations, which would cost more than $290 million to fix. However, doing so would limit damage from a significant quake to about $1.8 billion - $2b less than if the strengthening work were not done, the report*

*said. "A lot of these issues with foundations were obvious in the Edgecumbe earthquake in 1987. It is nothing particularly new," Dr Thomas said yesterday. The cost of materials to secure foundations on older homes can be as low as $500 per household, he said.*

"Wellington Earthquake Devastation Would Rival Christchurch" (D. Burgess, 2011)

Note that no media articles analysed provided textual information or info graphics showing the relative value of damage (potentially or actually) prevented to the cost to mitigate. Admittedly not many research articles contain this information either. An example of a research article that does contain this information is (C. Davis, Keilis-Borok, Kossobokov, & Soloviev, 2012).

**Recommendation 94 (motivation and DRR topics 3, 6, 9 and 12):** All - Provide information about cost versus benefit; the relative value of different DRR measures, and the potential savings if an event were to occur.

### 7.7.20 DRR was framed as costly especially when life-safety was the goal

Ideally effort spent on DRR should be framed in the media as a worthwhile investment. The reality is that the overwhelming framing in the New Zealand media was that DRR is costly. For example stories of the *Code Compliance* type framed Council enforcement of policy regarding vulnerable buildings as necessary at the same time as framing need for code compliance as overly costly.

Those stories that mentioned mitigation solutions overwhelmingly framed them as costly (Fairfax NZ News, 2011d). For example in an article about the 2011 national elections *"Reserve Bank Governor Alan Bollard has also warned of further cost blowouts caused by over-judicious building standards. Disaster preparedness is necessary and desirable, but not costless," he said last month."* (Hartevelt, 2011c).

Rebuild issues in 2012 and 2013 stories were framed as an 'extra cost burden' created by the Canterbury earthquakes (e.g. "Costly high-tech systems vital to rebuild" by M. Wright, 2011e). The body text of the latter article did however mention DRR actions as potentially achieving cost effectiveness - *"Where [the council] proposes to use these alternate solutions they'll have to demonstrate the improved resilience and the cost benefit as well."* Two months *before* the Darfield earthquake the first line of Stuff article "Quake policy nears completion" (Fairfax NZ News, 2010a) was "*A new Christchurch earthquake policy that could cost building owners hundreds of millions of dollars will be finalised this week"*. Discussion after the Canterbury earthquakes about buildings codes was as I018 put it *"mired in affordability"* without having provided details of cost. Only a few headlines framed DRR measures as cost-effective (e.g. “Make buildings bounce - engineers” by Cairns, 2011b).

Mitigating against earthquakes may not be considered an urgent need unless more basic needs have been fulfilled (Asgary & Wilis, 1997). However even in the poorest of countries it is important that DRR is viewed not as an expensive luxury but a necessity to break the vulnerability cycle, for which resources and funding should be available.

Adoption of, or failure to adopt self-protective measures is said to be the result of individual cost versus benefit analysis (Mileti & Sorenson, 1987; Palm, 1981). Some claim that citizens do not act because of high cost (e.g. Lagorio, 1990) and that there have been suggestions that less costly and less time-consuming DRR solutions should be the focus of DRR communications (Major, 1998). While it is important to counter the perception that large expenditure is required to mitigate; a large benefit may be achieved without a large cost (McClure, 2006) this is not always necessary since a study in New Zealand has shown that cost is not an over-riding factor in deciding whether to engage in household DRR actions (McClure, Spittal, Fischer, & Charleson, 2014). Citizens factor other social costs higher than dollar costs. It has also been found that perception of vulnerability to earthquake had a greater effect than cost in relation to purchasing insurance (Palm et al 1990).

The influence and framing of cost as a barrier has not been well explored from other perspectives. For example Nisbet and Mooney (2007) note that policy and decision makers often employ an ‘unfair economic burden’ frame in justifying non-expenditure. In conclusion the following recommendation may be made in respect of framing of costs related to DRR:

**Recommendation 95 (motivation in all DRR topics):** All - Avoid framing DRR as costly or time consuming; it is an investment, show the potential benefits.

An example of such a framing is *“The two recent Christchurch earthquakes have shown that a modest investment in education and research can save thousands of lives and billions of dollars. The world is watching to see what we do next.”* (Prof Andy Buchanan in an opinion piece “Wrecked buildings are test specimens” Buchanan, 2011).

### 7.7.21 Communication of response and recovery needs assessments (topics 8 and 11) has been little researched

Response and recovery needs assessments are an aspect of DRR about which there has been little research (either earthquake-related or natural hazard-risk media). There was also little media coverage of either response or recovery needs assessments either in the headlines (Table 7.3 and Figure 7.2) or in the body text of articles or broadcast items analysed in this research. Exceptions are briefly outlined below.

Benini, Conley, Dittemore, and Waksman (2009) interrogated factors shaping decisions about relief delivery to earthquake-affected communities in Pakistan in 2005-06. They suggested not only that there has been little research into whether survivor needs or logistical convenience were more influential, but also that needs assessments themselves were under-developed.

### 7.7.22 Response-needs assessments cover many topics as shown in Table 7.26

Response-needs-related recommendations identified in previous natural-hazards media research are outlined in Table 7.26. These issues raised by previous researchers relate to relief goods, search and rescue, health needs, housing needs, and the longevity of needs overall, into recovery. The papers and the discussions that these recommendations derived from framed these issues as media misconceptions, myths and missing frames that work to the detriment of DRR.

Framing of needs, whether informal or official, has been shown to affect the level of donations from near and afar (Voorhees et al., 2007) as needs information is utilised by foreign governments and NGOs in relation to disaster aid (Arakaki, 2011; Driessens et al., 2012; Eisensee & Strömberg, 2007; Franks, 2006; Joye, 2010; Potter & Van Belle, 2004, 2009; Van Belle, 1999, 2003; Van Belle & Hook, 2000), and by individuals to determine their level of charitable giving (P. H. Brown & Minty, 2008; Olsen, Carstensen, & Høyen, 2003; Oösterhof, Heuvelman, & Peters, 2009; Seo et al., 2011). Representation of those needs is therefore important.

Caldwell et al. (1979) referred to ‘precipitous promises’ in the media regarding housing reconstruction. This was at the very early stages of recovery, before any assessments by

**Table 7.26: Crisis (response) needs communication topics**
This table shows information needs about usual services, arrangements specific to disaster and restrictions and restoration of services. The basis for the table was Noda (2000)'s Table 9 of perceived gaps in crisis communication. All of these topics were communicated in the New Zealand mass media to varying degrees. Italicised text relates to topics not on Noda's list. But mentioned in the New Zealand mass media.

| About (usual services) | About (specific to disaster) | Restrictions and restoration relating to disaster |
|---|---|---|
| | State of emergency | curfew(s) |
| medical care (physical) | earthquake insurance | *roading* and transport including *air transport* |
| store/business opening hours | building assessment processes | evacuations |
| counsellors and psychiatrists | volunteers | utilities including telephone |
| funeral services | alternative arrangements water | banking and other bill payments |
| weather information | availability of particular foods/products | education |
| veterinary services | debris clearance | 'return to normal' |
| communication channels | free food services | |
| | alternative arrangements shelter | |
| | Insurance/reinsurance | |
| | consultation and other events | |
| | financial assistance | |
| | personal safety in disaster/aftershocks | |
| | health and safety relating to recreational activities – boating/swimming depending on debris and pollution assessments | |
| | special dispensations/taxation | |
| | new policy and legislation | |
| | recovery institutions | |

experts or consultation with victims had occurred. The implication was a recommendation that communication not occur until assessments had been undertaken.

Recommendations about what matters in communicating needs assessments may also be drawn from Chapter 4 (Tables 4.3 and the 7T strategy in section 4.3.2); in particular transparency, what was incorporated into risk analyses and where citizens can get information about risk assessment processes. The recommendations presented at the end of the section blends these generic communication-related recommendations with those of other researchers.

In the New Zealand mass media analysed needs assessments were most often mentioned in terms of findings of, or the rationale for actions by authorities. However details of the assessments or their limitations would not be given. For example in "Builders needed to fix quake damage" (NZPA, 2010n) then Minister of Building and Construction Maurice Williamson indicated that a further 500 licensed builders were wanted in Christchurch, but did not indicate how the figure of a total of 1600 licensed builders was derived. Business needs and concerns were also reported, but as with other mentions of needs the basis for the assessments was not given, and there was no comparison with what had occurred after historical earthquakes.

Individuals have their own personal needs assessment and decision-making processes to fulfil in response. This is predominantly, whether to stay or go, whether this is temporary or longer-term evacuation because of damage, disruption, distress or perception of increased risk. There should be a balance of perspectives about the costs and the benefits surrounding issues such as in *Staying or Going* or *Restricted Access* stories (e.g. "Business owners storm quake cordon" NZPA, 2011e). Businesses need access to premises in which to conduct work and access records and access to area it may be easier for authorities to limit access to (in the Canterbury earthquakes this was called the red zone).

Noda (2000) on Table 9 gave a list of the contents of the publications that community groups provided to fill perceived gaps in crisis information provided by traditional media after the Kobe (Great Hanshin-Awaji) earthquake in Japan, 1995. Noda's list was adapted to fit with what was communicated in the Canterbury earthquakes. Noda's list focused on information that illustrates consequences, and therefore identifies citizen needs defining what needs to be managed.

Combining Noda's list of gaps identified by Japanese citizens in crisis communication, with what was communicated in the New Zealand media illustrates the many response assessments that one might expect should be communicated in the media.

The lists in Table 7.26 were compiled considering needs in respect of all environments, psychological as well as physical needs, and acknowledging that individuals have their own personal needs assessment and decision-making processes. It would be expected that associated assessments communicated about these needs whilst illustrating citizens as achieving DRR at the same time as the success of government initiatives in DRR.

An aspect of response assessments that has not been discussed in existing disaster media literature is the effect of the media on insurance and re-insurance company decision-making; yet the decisions of individuals in these institutions have reverberating ramifications for not only those directly affected by earthquakes but also the wider population. Initially after the Canterbury earthquakes there was a period in which homebuyers in regions of the South Island of New Zealand other than Canterbury could not purchase insurance, and later insurance premiums increased by at least 50%. Insurer perception appears from a reading of (Bevere et al., 2011) to have been linked to media portrayal of seismic risk in Canterbury, at least initially, before a scientific and political delegation to reinsurers in London and Europe in September 2011 (Hartevelt, 2011a).

### 7.7.23 Recovery needs assessments have rarely been discussed in the media

Compared with what is needed in response, what is needed in recovery was rarely mentioned in either academic DRR or media research. There are few academic articles on the topic of assessment choices in recovery to draw from. Thus the primary recommendation in respect of recovery assessments is for media and sources to ensure that the topic of recovery is raised. The media's role in communicating who has calculated what in terms of recovery assessments and the costs and benefits of recovery decision-making is rarely if at all discussed, in any of the bodies of literature reviewed.

For both response and recovery assessments the focus both in media content, and analysis of media content has been on the decisions made, rather than of any explanations of the assessments, evaluations and weighing and balancing of the decision-making process.

Stories relating to land-use and land zoning are summarised on Table 7.27 and show that there was little provided about land decisions in the mass media, despite the thousands of homes that were affected. Property owners were sent information directly from the authorities. There were also public meetings. However the average citizen would not find a mass media article that summarised the land decisions giving either the background geotechnical evidence, or other factors that were part of the analyses and evaluations that led to the decisions.

A secondary issue is that where the data and information relating to recovery decision-making was alluded to in the mass media it was predominantly in relation to a restricted number of disciplines. Peter Wood, president of the Society of Earthquake Engineers, also an emergency management adviser with the Ministry of Civil Defence and Emergency Management, recognized this. Wood alerted the media, sources, and citizens to this through his opinion piece published a few days after the Darfield earthquake (P. Wood, 2010).

Bryner PhD Build 20170401FINALPRINT.docx There are two recommendations that may be made with regards needs assessments:

**Recommendation 96 (DRR topic 8):** All - Illustrate that the needs for every disaster are not the same and take time to be assessed.

**Recommendation 97 (DRR topic 8):** All - Show all stakeholders as involved in assessing response needs.

### 7.7.24 Resilience assessments involve reviews, audits, inquiries and lessons learnt (topic 5)

> *The report recommends all reinforced buildings in New Zealand be improved to protect the public from falling hazards and that they should meet at least 67 per cent of the standard required for a new building … Robert Gilbert, who lost his 22-year-old son Jaimie, in the February quake, said the nation was "honour-bound" to follow the report's recommendation … "We need to learn something from all those deaths. As a nation we are honour-bound to do this".*
>
> "Earthquake-Strengthening Steel Rods Failed in Christchurch" (Gates & Carville, 2011)

Analysis of past events provides an opportunity to learn lessons that may be applied to the future (Nehrlich & Halliday, 2007). Earthquakes provide an opportunity for communities to reassess the utility and robustness of past practice in disaster risk reduction (DRR) and to formulate strategies to reduce the effects of possible future events.

> *Community resilience requires that a community be able to both critically reflect on what has occurred and also develop a vision for the future; therefore media coverage needs to explore the past and the future.*
>
> (Houston et al., 2012, p. 620)

Audit leads to understanding of outcome expectancy. In Chapter 2 the importance of communicating about DRR in a way that positive outcome expectancy is supported was discussed. While media did mention actions to take to prevent risk Choi and Lin (2008) noted that newspapers rarely mentioned the expected outcomes of taking recommended actions. Some of the outcomes will be costs, the others benefits.

Media utility in communicating the outcomes of reviews and inquiries that audit DRR performance has rarely been mentioned in academic literature, except in respect of recovery. Besley and Nisbet (2011) referred to the media playing a role in supporting public debate in relation to recovery, and suggested the media are influential in terms of the acceptability of advocacy for recovery-related issues. Souza and Martínez (2011) mentioned media monitoring of compliance during reconstruction. These assessments about recovery

**Table 7.27: Timeline of key land-use related media reports September 2010 to end December 2011**

| | | | |
|---|---|---|---|
| 07 | Oct | 2010 | An initial land report by geotechnical consultants to the EQC was delivered to EQC a month after the Darfield earthquake (ODT). |
| 21 | Oct | 2010 | Two weeks later the government announced the first details of land decisions, and it was announced that certain lands would be remediated using by the creation of land dams. |
| 06 | Oct | 2010 | The government's intention was for a speedy rebuild (and recovery). For example "Efforts afoot to speech up quake rebuild". This topic died in the ODT, but continued in the local print media, Stuff. |
| 02 | Dec | 2010 | Stuff announced that a three-year wait for rebuilding was likely due to necessary land remediation work. |
| 26 | Jan | 2011 | Stuff reported "EQC due to release reports" (Heather, 2011a). All was effectively resolved when the Feb 22 2011 event occurred. |
| 22 | Feb | 2011 | On February 22 even greater areas of land were affected by a combination of liquefaction, lateral spreading, liquefaction induced subsidence, and vertical displacement downward. This necessitated a review of all previous work, further extensive field work to support yet more land use decision-making. Work was undertaken in March, April and May, after a spate of conjecture in all media in early March that large areas would have to be abandoned. Rock fall and cliff collapse in the Port Hills area added a further line of geotechnical investigation. |
| 03 | Mar | 2011 | Science reporter Paul Gorman article quoted Dr Mark Quigley's opinion that "Christchurch fault risk 'crucial' to rebuild" (Gorman, 2011b). |
| 17 | Mar | 2011 | Article in Stuff that scientists see no reason not to rebuild (Gorman, 2011d) |
| 01 | Jun | 2011 | By early June there were frustrations about the lack of information about decision-making and delays in decision-making (articles coded as "*Recovery Progress"* and *"Reviewing Communication"*). Stuff ran articles "Public has 'right to know data'" (Gorman, 2011g), and the next day "Residents frustrated over lack of land reports"(Heather, 2011d). |
| 11 | Jun | 2011 | "Some areas 'simply not feasible to rebuild'" (Heather, 2011e) - Stuff ran this article |
| 23 | Jun | 2011 | There was concern and some confusion as to whether the land decisions were materially affected by the June 13th events. The first definitive land decisions and associated government land acquisition payments for any land to be abandoned, were announced on 23 and 24 June 2011 in all media. Residents in areas with most significant land damage (red-zoned) now had certainty, with further decisions for other zones to be rolled out over the following months. |
| 25 | July | 2011 | Communication of evidence basis for decision making is again raised in the media with Stuff headline "Brownlee refuses to release papers" (D. Williams, 2011c-b). |
| 26 | Aug | 2011 | There were no other reports tracking the rollout decisions in the ODT until October. Only audiences reading the news media reports on Stuff would be party to concise and clear statements by Minister Brownlee summarising what presumably had been told to community meetings, but was certainly far from widely understood public knowledge "*Anyway, we have already released the major scientific factors which have informed our decisions so far. Those are the change in land height, which is evidenced by the Lidar (light detection and ranging) data and other readings; areas of serious lateral spreading, cracking and liquefaction; and the resulting thin crust issues which make the land too weak to support residential dwellings using traditional building techniques, not to mention unfeasible for the installation of underground horizontal infrastructure like sewers and water. We've made it very clear that geotechnical advice on the minimum crust thickness required to support residential dwellings is 1.5 metres. That's a minimum 1.5m of firm, compacted material in which to anchor building foundations*." In "Red zone offers extremely fair", an opinion piece by Minister Brownlee (Brownlee, 2011). |
| 26 | Oct | 2011 | An announcement was made that most orange-zoned properties had turned green. |
| 01 | Nov | 2011 | Opinion piece voicing concern that little media comment would occur "Lianne Dalziel" Friday release 'buries' land report" (Dalziel, 2011) |
| 25 | Nov | 2011 | "EQC Canterbury Assesses Green-Blue Homes (Done red, orange, now feeling blue)" (Heather, 2011j). |
| 26 | Dec | 2011 | The analysis period ended shortly after the December 2011 aftershocks and associated liquefaction amidst suggestions by Mayor Bob Parker that engineers would reassess, and probably rezone some areas as uninhabitable "Areas may return to red-zone after latest quakes" (APNZ, 2011). |

performance are distinct from assessments contributing to recovery decision-making that are part of DRR communication topic 11.

J. Cowan et al. (2002) noted that disaster anniversary coverage typically includes discussion of lessons learnt. Other mentions in the academic literature of the media's role in terms of communication of disaster lessons learnt were typically in relation to a researcher reviewing media coverage to ascertain what the lessons were (e.g. Lan, 2009; Wilkins, 1986). There is however little said of the communication of impressions of comparative readiness or reduction phase activities

While there are many references to accountability for disasters in academic articles (as discussed in section 7.4) one has to search hard for academic articles that speak of media communication of DRR measures required or additional measures that might be taken. Exceptions are Cate (1994) who referred to the media's responsibility in identifying and communicating to the public, specific DRR measures that have either succeeded or failed. Jalali (2002, p. 133) mentioned *"development of a critical political public"*.

In total 6% of the New Zealand ODT stories were of a type that relates to topic 5 (including assessments or audits of DRR practices, DRR cost versus benefit and resilience assessments). However, the articles typically featured few of the sixteen features of well-regarded communication or followed the 7Ts strategy. The story groups were 'DRR Review' stories – *Criticism, Praise or Findings of Audits* – subgroup 'Reviewing DRR Measures'. Keywords identifying these story types are presented in Appendix 9.4. Thirteen story types were identified as shown in (Stories framed as problem identification (cause) were discussed in section 7.4). An example of a topic 5 story is "Post-quake fear a 'missed opportunity'" (Fea, 2011) in which Victoria university psychology professor John McClure stated:

> *"Civil Defence failed to use the "mild anxiety" that flooded the nation immediately after the Canterbury earthquake to get the rest of the country prepared for natural disasters … in psychological terms that was negligent. They lost a window of opportunity nationally."*

Few survey respondents made mention of their needs or expectations in relation to communication topic 5 (Table 7.5 and Figure 7.3). One interviewee's comment (I029) about the New Zealand mass media stories surrounding the Canterbury earthquakes was *"the [media's] stories are not good enough to be called an audit, they're just sensationalist rubbish generally"*.

### 7.7.25 It is unusual for content analyses to consider risk trade-offs and assessments.

Resilience assessments are in their infancy (chapter 2) so it is perhaps unreasonable to expect them to be communicated.

Survey responses clearly showed that for citizens who have not experienced disasters, understanding of citizen responsibility for DRR is focused on actions in response and household mitigation. For Cantabrians there was a greater focus on understanding the assumptions made on behalf of citizenry in recovery.

Research by CARMA (2006) showed that there were significantly more negative citations about the local government relief work after the Bam earthquake than positive or neutral references: For Hurricane Katrina this was extreme: 90 negative references, 20 positive and 16 neutral (CARMA, 2006). This level of detail was not assessed in this research. However, 'Reviewing DRR Measures in Response' subgroup of New Zealand earthquake-related stories accounted for less than 1% of the total coverage in the ODT (Appendix 10).

Citizens surveyed in this research have said they could cope better with delays if they could plan around them; this requires communication. In particular there should not be overpromising in relation to response timeframes; the number of days citizens should expect to survive on their own should be increased in readiness messaging.

### 7.7.26 Social capital is increased and DRR is achieved through communication of lessons

Research and media articles about natural disasters that include the phrase 'lessons learned' or 'lessons learnt' in their titles are part of DRR topic 5. Some disaster researchers have noted these lessons are often ignored, archived or forgotten (Tierney, 2007; S. N. Williams, 2008). There is a tendency both to repeat past mistakes and 'reinvent the wheel' by trying to innovate in ways that have already been well tried elsewhere (Alexander, 2010). It is important to apply what is learnt from disasters rather than perpetuating a cycle *of "lessons learned about 'lessons learned'"*(Kennedy et al., 2008, p. 34). It seems that lessons are identified, but rarely truly learnt.

It would seem obvious that communicating the lessons to be learnt, that have been identified from previous events is an important part of DRR communication. However, how lessons are communicated is not a topic identified in the mass media communication, or risk communication literature. The importance of identifying and communicating specific measures that have either succeeded or failed to reduce the impact of natural hazards have mention by only a few researchers in DRR-communication (e.g. Cate, 1994; J. Cowan et al., 2002; McClure, Sutton, & Wilson, 2007).

In this research the topic of lessons to be communicated might have been gained from any of the story types listed in Table 7.28.

The article quoted below contains one of the most in-depth statements about DRR of any of the media datasets. It emphasizes the importance and value of DRR, and the importance

**Table 7.28: Lessons, review and inquiry story types**
Lessons, review and inquiry story types in New Zealand media identified from media analysis of TV1, ODT and 1000-Stuff datasets. The number of articles in both pre- and post-Darfield ODT datasets is shown in the right hand column (see the data table in Appendix 6 re 1000-Stuff articles and television items). These are a subset of the 'DRR Cause/Review' story group. 'Reflecting on Responsibility' subgroup articles that consider cause of disaster are also included as there is an element of inquiry and review in them also.

| Subgroup | Headline Story Type | **No. ODT articles** |
|---|---|---|
| Reviewing DRR Measures | | |
| | Lessons or Reflections | 26 |
| | Reviewing Authorities' Preparation | 5 |
| | Doing Better/More in Response | 47 |
| | Aid Issues | 7 |
| | Awards Commendations or Thanks | 32 |
| | Reviewing Communication | 26 |
| | Citizen Awareness & Cultural Memory | 2 |
| | Reviewing Construction & Codes | 24 |
| | Heritage Building Matters | 41 |
| | Insurance Problems | 12 |
| Other Recovery Progress | | |
| | Recovery Progress | 21 |
| | Recovery Legislation | 13 |
| | Reviewing Land Use | 3 |
| Reflecting on Responsibility | | |
| | Liability, Litigation or Inquiry | 22 |
| | Inquest/Cause of Injury | 10 |

of planning, initiative and leadership, as well as the uncertain nature of consequences. However the article, published on 17 June 2010, 3 months before the Darfield earthquake, did not contain any reference or links to practical steps that the individual or businesses might take. Nor did it outline just what leaders are doing.

> *Without a doubt, planning, preparation and practice for emergencies saved many lives," he said. "What happened in Chile is a most powerful example that taking practical steps before an emergency helps save lives and helps recovery." Mr Hamilton said preparation could be the difference between life and death. "Chile's experience shows that we can do things as households, neighbourhoods, businesses, NGOs (non-government organisations) and governments that will help us in a disaster," he said. "It also shows that we cannot be complacent. We do not, and cannot,*

*know everything about nature and how a disaster will play out. "I have returned with a strong view that planning, initiative and are a potent mix to help reduce the impact of a disaster and increase the speed of recovery".*

John Hamilton CDEM Director- "NZ can learn from Chile quake: Expert" (NZPA, 2010n)

A story that would fit the recommendation criteria for communication of assessments (Chapter 4) was told in interview:

*One of the lessons learned from Canterbury is in lifelines mitigation – they know how much was invested in things identified in their lifelines project ($6M) and their current estimate of what they have saved in terms of direct asset replacement is $65M – and that is not counting downstream effects in terms of productivity and avoided losses and so forth.*

Dr Hugh Cowan then EQC Research Manager - Interviewee I006

However this key learning (also discussed in Fenwick, 2012) from Canterbury was not reported in the thousands of mass media articles analysed.

<u>Compilation of existing 'lessons' is required before media can publish about 'lessons'</u>

The New Zealand mass media could potentially have drawn on the lessons identified from any of the earthquakes listed in Table 3.7 as well as hundreds of overseas events, including those listed in Tables 5.7a-c.

The percentage of 'lessons' articles identified in the various datasets was though, only between 0.5% and 1% of the total of each earthquake-related media dataset articles. Articles headlining lessons learnt related only to the Canterbury and Concepcion earthquakes. As noted in sections 5.2.15 and 5.2.16 mention of lessons from overseas events to New Zealand in the body text was rare. Notably this was only in relation to three earthquake events (San Francisco, Napier and Gisborne, not even Kobe or Sichuan), and not from other major international disaster events (such as Hurricane Katrina, which has been widely researched).

The most recent earthquakes in New Zealand were the 2009 Fiordland earthquake and the damaging earthquake in late 2007 in the small city of Gisborne (see Tables 3.7 and 3.8 for details).

The 2009 earthquake was of large magnitude but located far from an urban centre. As a result there was very little property damage. It is perhaps unsurprising therefore that few parallels were drawn when the Canterbury earthquakes occurred. The Gisborne earthquake, however, also attracted nearly no media comment about lessons learnt either, only the comment above that portrayed business owners and managers as typically preparing poorly and being unrealistically optimistic. Yet, the unreinforced masonry buildings of the Gisborne central business district suffered severe damage in 2007. Some buildings required demolition, as occurred in Canterbury. Even after the Darfield earthquake there were only a few online print media article or television items that mentioned Gisborne, let alone recovery actions.

A rare example of an article that discussed lessons relating to the Gisborne 2007 earthquake emphasised that they were lessons learned about businesses owners. The lessons were published within the body text of an article with the unrelated headline “Unrealistic optimism bounces back” (Sharpe, 2010) shortly after the Darfield earthquake. That article summarised lessons identified as follows:

> *A report by Opus International Consultants after the Gisborne earthquake in 2007 found that "while the careful become more careful", those that had no preparation measures for a disaster were even less likely to employ measures afterwards.*
> *The report said studies on the Mt Ruapehu eruptions in 1995-96 and the 1989 California earthquake showed that people returned to "unrealistic optimism" within three months. … The Opus report also found that, as organisations sought to learn from an event, they tended to blame other organisations or individuals for hardship "instead of taking responsibility for their own poor managerial decisions". … The Opus report on the Gisborne quake found key areas in which business owners and managers made ill-informed decisions that affect the potential to reduce the impact of a natural disaster and impede recovery. These include: A heavy reliance on low-effort disaster preparedness measures offering little assistance in a crisis. Delaying the strengthening of a property to the current standard. Under-insuring their income and property. There is a risk that the lessons learnt are not implemented.*

Consequently few who were not local residents, their contacts, or DRR researchers could have much knowledge of lessons learned from those two New Zealand events, as they attracted nearly no media comment even after the Canterbury earthquakes, and when they did the primary (headline framing) was that most individuals around the globe don’t prepare for earthquakes.

This absence of ‘lessons learnt’ articles should not be considered a mass media failing. As noted in section 5.2.14 the reality is that there are no known academic studies where lessons learnt from multiple earthquake events have been compiled. Only 0.8% of the earthquake-research articles analysed referred to lessons learnt. These all related to only one event and discussed lessons from one disciplinary perspective only. This absence of readily distilled information will need to be remedied before journalists can be expected to communicate more about lessons. The following recommendations are linked.

**Recommendation 98 (all DRR topics but mostly topic 5):** Media – Articles about lessons should be carefully headlined as ‘lessons identified’ unless they truly are ‘lessons learnt’.

**Recommendation 99 (all DRR topics but mostly topic 5):** Scientists/DRR advocates - Lessons identified (to be learnt) by scientists and DRR practitioners need to be compiled ready for media to use when disaster events occur or are commemorated.

### 7.7.27 Communicating lessons learnt, reviews, inquiries; the ‘blame game’ is necessary for DRR success

There is much written generally of the media’s propensity for attributing ‘blame’ and ‘criticism’, in particular of the official response to disasters (see section 7.4). However there are two aspects of these statements that do not stand up to scrutiny.

1) The discussion tends to ignore the benefits of not perpetuating practices that are harmful to society – DRR failures or not heeding DRR lessons learnt; besides 2) causal or responsibility framing in headlines accounted for less than 1% of all articles both in this study and in previous research (e.g. Fu et al., 2012). In this research only 181 (<1%) were stories related to the issue of responsibility.

DRR success depends on identifying and learning lessons and increasing thought, time and financial investment into DRR actions. Media and DRR-communication sources have a choice as to whether they frame the audit and review as blame and scapegoating, or on a genuine desire for improvement through applying solutions to lessons identified and learnt.

The need for a greater emphasis on the attribution of responsibility was emphasised in section 7.2. Blending this with the discussion here yields the final recommendation for this chapter:

**Recommendation 100 (responsibility and all DRR topics, mostly 4 and 5):** Media and Officials - When discussing DRR measures, show authorities taking responsibility for failings and describing how they intend to improve.

-blank-

## 7.8 In summary; rather than convincing people of threat communicate about DRR options (each of the aspects of equation 6)

Mileti et al. (1992a) considered that the US media *"fostered preparedness"* (p.16), *"convinced people to take action"* (p. 18) and was typically unsuccessful in attempts to *"convince people of risk of low probability-high consequence events"* (p. 19). In New Zealand in the period 2008-2012 'convincing' along with descriptions of consequence were still the most common types of earthquake-related media communication.

This chapter is best summarised by compiling the recommendations in this chapter (see Appendix 18). More recommendations were generated relating to topics where previous scholars have focused their attention. As the list is long, key recommendations are drawn out in the following chapter (three key recommendations for considerate communication in Table 8.1 and one recommendation for each of the 12 DRR topics in Table 8.2).

Another way to condense what has been learnt in this chapter about the communication of solutions is to comment on each of the key aspects of reduction in Equation 6 (Chapter 2 p. 57). *Avoidance* (choosing to live in another location) was framed in the media as risk averse at best, and odd at worst. *Structural mitigation* was framed as necessary but costly. *Legislation* was also framed as 'to be expected' but decided by experts. *Preparation* was emphasised. There were few overt mentions of *participation.* Nor was *incentivisation* mentioned much. This latter point was also noted by Russell et al. (1995). Commentary about *communication* focussed on warnings. *Education* was framed as requiring understanding earth science aspects of the hazard. There was very little in the New Zealand media directly referring to *adaptation, integration, duplication,* and relatively little relating to *innovation* despite New Zealand and New Zealanders having been at the forefront of this. Mentions of *leadership* and governance were only in relation to response activities and recovery decision-making.

There were many examples given throughout the chapter where communications did not achieve best-practice in terms of telling 'the whole story', 'telling it like it is', 'touching base with the audience' or 'telling them what they want to know', including 'tangible action'.

In short, the communications fell short of being 'comprehensive', and were neither complete nor fully considerate.

-blank-

# 8 Summary and key recommendations

## 8.1 DRR relies on us more effectively communicating science in the mass media

### 8.1.1 An introduction to the background and value of this research

This concluding chapter summarises the range of ways this research has contributed to better communicating earthquake- and DRR-related sciences in the mass media.

This research was designed to reveal what aspects of the communication of earthquake-related science content could be improved to achieve more 'effective' communication of disaster risk reduction.

The earthquakes in the Greater Christchurch (Canterbury) region of New Zealand in 2010 and 2011 were central to this research; used as a case study to identify how the sciences of DRR were communicated in New Zealand between 2008 and 2012 - before and after the Canterbury earthquakes.

In-depth review of a wide communication-related literature identified key features of 'well-regarded' or 'effective' and 'considerate' science and risk communication, whatever the topic. These sixteen features beginning with the letter 'C', and an associated seven-step 'complete' communication strategy may be of interest to any science communicator (details in Chapter 4, summarised in section 8.3.2).

For the DRR-related media researcher a set of theoretically robust 'frames' was established so that future comparative analyses are possible.

A methodology was developed for analysing for 'comprehensiveness' of DRR-related content. One example of such a frame set is the "DRR-topics wheel" which illustrates how DRR content may be summarized into twelve topics (section 3.6.5 and section 8.2.10).

Both science-communicators and DRR-related media researchers are likely be interested that an issue cycle for all four phases of DRR-related science was created (Chapter 5).

Scientists, science communicators and DRR-advocates may find it interesting that the presence and absence of particular DRR-related science issues in the Canterbury-related media was identified (section 5.4). Furthermore, this research not only established how earthquake-related science was portrayed in the media, but also how research knowledge from each of the sciences of DRR matched what was present in the media (Chapter 6).

The DRR-advocate may be heartened that this research identified over 155 different earthquake-related media headline story types in the New Zealand media. Each of these story types can be used to effectively communicate the many ways we can reduce the disastrous consequences of earthquakes.

Chapters 5-7 contained more than 100 practical recommendations of ways better communicate science in those stories; variously useful to the media, earthquake- and DRR-science researchers and media sources. The recommendations comprehensively combined findings from previous research, and observations derived from this research. The recommendations were drawn from the findings of previous communication and DRR research, citizen survey and interview, and the comparative analysis of written and broadcast media content with the headlines and abstracts of over research content about earthquakes. Observations and recommendations were related to the frame codes developed when establishing the research methodology. Recommendations are summarised in section 8.3.

A more detailed summary of the methodology behind the findings and recommendations is summarized in section 8.2. Alignment of the research approach with ‘ethics’ and ‘deliberative inclusive practice’ is described in section 8.2. Results themselves are presented in section 8.3.

But first the background to this thesis is briefly reintroduced.

### 8.1.2 Communication and science are essential for disaster risk reduction

Communication and science are both essential for averting disaster, that is, for disaster risk reduction (DRR). Conversely deficiencies in either communication or science may contribute to disaster (Denis, 1995; Havidán Rodríguez & Dynes, 2006; UNISDR, 2009a).

Disaster risk reduction (DRR) is a set of solutions recognized under the United Nations’ International Strategy for Disaster Reduction Hyogo Framework for Action and Sendai Framework 2015 (UNISDR 2005, 2011b, 2015). Equation 6 (p. 57 of this thesis) expressed the actions that can be taken to achieve risk reduction[22].

[22] Avoidance + Structural Mitigation + Legislation + Preparation + Innovation + Adaptation + Communication + Education + Participation + Integration + Duplication + Leadership = Risk Reduction

Science plays a critical role in identifying and assessing risk and in DRR – in developing many of the risk management actions listed above (Lubcheno, 1998; Vogel et al., 2007; UNISDR 2009a, Xu, Gong and Li 2008; ICSU, 2008).

Communication has long been a key DRR strategy; particularly communication to many citizens at one time, through the mass media, (Cate, 1995; Drabek, 1979, Lombardi, 1997; Rohrmann, 2003b; UNISDR, 2005; UNISDR, 2015).

### 8.1.3 Practical suggestions to improve DRR-related science communication were the aim of this research which was based on an earthquake-related case study

The aim of this research was to contribute to existing practical suggestions for improving the communication of the science to achieve successful disaster risk reduction.

This research examined the mediation function between science and society's 'wicked problem' of disasters (section 1.3.1) by questioning;

1 – What review of existing scholarship, surveys, interview and stories in the mass media reveals of how communication of earthquake science might be improved, so as to lead more directly to disaster reducing outcomes; and

2 – What theoretically and ethically robust strategies and recommendations could the mass media and their sources employ to improve earthquake-related DRR-communication[23].

This research was built around a case study of DRR-communication from a country (New Zealand) where the need for integrated planning to reduce vulnerability and build resilience[24] to disasters was recognized, at least in theory. For New Zealand was considered to have a *"comprehensive risk management approach in addressing the consequences of hazards, across the four elements… - risk reduction, readiness, response and recovery"*[25]), and the understanding that *"building disaster risk resilience relies on us understanding a complex set of dynamic factors within the natural, social, economic and built*

---

[23] Note that no existing term adequately describes communication of DRR or DRR-related science. While previous researchers have variously referred to 'risk', 'warning', 'disaster', or 'crisis' communication the term DRR-communication is used here to underscore that this research related to all phases of the DRR cycle, and communication not only of identified risks and their assessments (warnings).

[24] Resilience may be equated with coping capacity which the UNISDR (2009b p. 8) defined as "the ability of people organisatons, using available skills and resources to face and manage adverse conditions, emergencies or disasters".

[25] In New Zealand a 'DRR-cycle' has 4 phases - reduction, response, recovery and readiness (the 4Rs). The reduction phase occurs when society is not preoccupied with disaster. The readiness phase involves planning for quick and appropriate response. The response phase involves assistance during or immediately after a disaster. The recovery phase relates to rehabilitation, reconstruction and regeneration.

The origins of the DRR cycle are debated but may be traced to the 1920s (Coetzee and van Nierkirck 2012), in New Zealand the DRR goal of resilience is viewed as central to these four phases (Mamula-Seadon, 2009) which, while they are sometimes graphically down as as separate, are typically overlapping and interwoven (Goennen, 2008; Pfiel, 2000).

*environments*[26]*"* (Smith, 2009, p. 71). The Hyogo Framework (UNISDR, 2005), which acknowledges the importance of communication in achieving DRR success, was also recognized in New Zealand.

### 8.1.4 The media influence 'frames', social constructions of risk, disaster, DRR-culture and associated social change

Framing was relevant to this study as how communications are framed creates 'DRR culture' (section 1.3.5).

What and how information is communicated in the media - 'framing' - affects how issues are perceived, how responsibility for them is understood and motivation for any resulting action[27] (cf. Cacciatore et al., 2016).

What and how mass media communications about DRR are 'framed' creates individual and societal 'expectations' relating to DRR (McClure et al, 2009), creating what might otherwise be termed 'cultures' of, disaster, of risk, of risk reduction (Schencking, 2008), and by extrapolation of individual and collective 'coping capacity' and perceptions of efficacy in and responsibility for DRR.

### 8.1.5 Communications influence citizens to act to reduce risk and increase resilience

Contemporary researchers with an interactionist perspective believe that communication and construction of mental models occur together (Bostrom et al, 1994) such that using the example of DRR) people individually and collectively understand what disaster is, believe they are at risk, and act to reduce risk (Mileti & Darlington, 1997). Essentially, people and communities armed with knowledge - an understanding of what causes disasters, estimations of risk, and what the possibilities are in reducing disaster risks - are able to make individual and collective choices about the actions they will take to avoid or otherwise manage those risks (see section 2.4.10 and Table 4.1 and 4.2). Wise choices and actions lead to resilience to disasters (section 2.4.6).

---

[26] 'Environments' or 'capitals' are a concepts from environmental studies and economics that reflect community assets or capabilities, including the physical or built, economic or financial, human (e.g. demography, education , helth), social (including political and cultural), and the variously termed natural, environmental or biospheric resources (Bebbington, 1999l Putnam, 2000; Samuelson and Nordhaus, 2004; Weichselgartner and Kasperson, 2010). Jeanneret (2008) included a diagram from Wikipaedia to show sustainability at the intersection of three 'preoccupations', social, economic and envirn=onmental (natural).

[27] Frames affect awareness, learning, mental models, salience, sense-making, perceptions, social constructions, interpretations, decision-making and action. Frames can involve, influence or justify (1) goal definition; (2) problem identification (consequences or 'situations'); (3) attributions of blame and responsibility for issues; (4) diagnoses of cause; (5) perceptions, interpretations and assessments of the significance of consequences or issues, linking cause and effect; (6) treatment of recommendations or actions; (7) responsibility for enacting the solutions; (8) judgments and/or (9) outcomes or actions, strategies or interventions taken (Hallahan, 1999; Hendriks, 2005; Kuypers, 2009a; Leach et al., 2010; Nisbet, 2009, 2010; Porto, 2007a; A. Stirling, 2008a). In addition frames influence (10) evaluations of a character's legitimacy, in any debate about any of the aforementioned aspects (Entman, 2004). Frames thus shape how issues and events are diagnosed, perceived and interpreted, character is evaluated and responsibility for problems and their solutions is attributed (Carragee & Roefs, 2004; Iyengar, 1991).

## 8.2 A varied but integrated methodology was used to holistically analyse DRR communication

### 8.2.1 There were seven stages to this research

The primary research questions were explored in seven stages as described in section 1.5.1

The methodology was mixed, ranging from comprehensive literature review from many disciplines, survey and interview, and content analysis (summarised in sections 8.2.2 and 8.2.14, 8.2.13-8.2.15 and 8.2.6 respectively).

Content analysis was used to compare and contrast a varied body corpus; global earthquake-related science research articles, women's magazines and on-line print news, the speech acts in television broadcasts, and survey and interview responses. The adapted framing research methodology used described in sections 3.4-3.7 is summarised in section 8.2.13.

The intent was to holistically consider DRR communication filling research gaps where possible as the following sections describe.

### 8.2.2 Literature review identified a number of gaps that this research could and did fill

Literature review was fundamental to this holistic research. Literature review contributed not only to the compilation of previous research findings but was crucial in development of the analysis methodology.

An initial scan of previous literature showed that many problems had previously been identified with communication about natural hazards, risk and, or disaster. The issues and suggested remedies (where they existed), were many and diverse, but had rarely been collated. Consequently literature reviewed was drawn from diverse disciplines, from research relating to risk communication, disaster-, hazard-, warning-, crisis, public health and environmental communication and media effects (Figure 1.1).

A broad literature was reviewed as the first of 5 stages of mixed methods research

Five bodies of communication-related literature were reviewed and analysed (section 3.2.1).

Through early literature review it became clear that previous science, risk and disaster communication research approaches varied depending on the perspective and the aims of the researchers. Some researchers were concerned with communicative ideals, others focused on aspects of communication that achieved particular DRR goals, but it was rare to find research that considered both. This study considered transparency of both communicative and DRR goals as crucial to the research's success.

### 8.2.3 The research approach was solutions-focussed, citizen-centric and holistic

For reasons discussed in sections 8.2.4-8.2.11 the research approach for this study became a deliberate, if somewhat bold attempt to consider communication of earthquake-related science for DRR in a manner that was:

a) solutions- rather than problem-focused (in relation to communication and DRR)

b) 'democratic', 'citizen-centric', 'ethical' or 'considerate' in insisting that not only should communicative goals be transparent, but that citizen and societal issue-related goals (in this case DRR-related goals) should be achieved through communication that is 'complete' in the sense that it meeting citizen expectations of science communication; including collectively being

c) as holistic or 'comprehensive' as possible, in terms of content.

Research objectives were refined and the mixed-methods research methodology was developed to remain true to points a) to c).

Other media-research-related gaps that literature review identified that this research could fill are outlined in the following sections.

### 8.2.4 The focus in this study was on recommendations

Researchers in both DRR and communication promote a 'solutions', or 'recommendations' focus. It is particularly important to communicate about solutions, not only about 'phenomenon identification' - problems (Finkel, 2011; O'Brien et al, 2010; Takeuchi, 2011; Zeng, Chen, and Liu, 2008). There should also be a shift from hazard-related problem identification, to risk-management or solutions-focused approaches to DRR (Amman 2006; Rodriguez and Dynes, 2006; Davis 2011).

Literature review identified that a problems focus existed in science- and risk communication research. Deliberate efforts were made for this research to be aspirational instead.

### 8.2.5 Solutions to a range of problems associated with different DRR stakeholders were needed

The problems in DRR-related communication have historically been attributed to different 'stakeholders'[28] in science or risk communication as shown in Figure 4.1.

This research identified only one researcher as having not only summarised risk-communication-related problems but having also linked the problems to solutions. Rowan (1994) summarized problems in risk communication, a branch of science communication related to DRR, to five areas as shown in the 'CAUSE' mnemonic described in Table 2.6. By implication better science, or risk communication would result in improved DRR awareness, understanding of DRR and engagement in DRR (trust in the credibility of the science and those who communicate it, acceptance of solutions and enactment of effective response).

However, since Rowan's were problems and solutions concerned primarily with how citizens responded to scientists' communications, only a subset of possible solutions (not those related to other DRR-media-related communication stakeholders) were represented. Furthermore Rowan focused on *what* needed to be improved rather than *how* communicated content could be improved.

The aim of this practical solutions-focused research was therefore to discuss and find ways to address as many of the problems shown in Table 4.1 as possible, including for example claims of media sensationalism and or bias, or citizen cynicism about how policy- and decision-makers use and portray science in the media.

### 8.2.6 Both communicative and DRR goals[29] should be transparent

Literature review had identified that analysing how well science is communicated requires an understanding of the reasons for its delivery and the end-goal (section 3.3.1. It is important to measure the success of communication against the purpose or objectives of the communication (Neresini and Pelligrini 2008; Rowan 1994b).

---

[28] Social issues (like DRR) and their communication, risk and science in society are most often discussed and analysed in terms of the perspectives of four key societal groups. The groups are variously referred to as 'stakeholders', 'social actors', 'characters', or 'sources'. Business, risk- and environmental-management literature would tend to refer to the stakeholders who have particular interest in issues. Social scientists refer to social actors (Van Leeuwen, 1996; Wellman & Berkowitz, 1988), communications researchers to characters, and media researchers to sources. A source is any person, or institution interviewed or quoted directly or indirectly in a story (Hornig Priest et al., 2006). As this research has drawn from each of the aforementioned disciplines the terms characters, stakeholders, sources and social actors are used interchangeably throughout the thesis. The four key groups typically referred to when discussing communication of issues are: 1) media - journalists, editors, producers 2) scientists/experts 3) governments/authorities or officials - the policy and decision-makers whether political or administrative, and 4) citizens (Hampton, 2009; Kornelis et al., 2007).

[29] In DRR communication there are twin goals, DRR and communication (section 3.1.1).

Science communication had commonly been considered in terms of its entertainment or educative success, or the degree of specific behavioural change effected by its delivery. Similarly, review of historical studies of mass media communication relating to hazards and disaster indicated that those studies had also focused on 'accuracy' and science literacy.

However, review of previous DRR-related communication research found that neither communication-related nor DRR-related goals had often been clearly stated in academic research. For example previous studies of natural-hazards-, risk- and disaster-media typically implied a desire to achieve DRR-success. However few of those studies clearly articulated what particular DRR goals were sought.

The following sub-sections (8.2.7-8.2.9) describe contemporary communication and DRR goals that form the basis to this research.

### 8.2.7 DRR and related communication goals are situated in a 'democracy' paradigm

As discussed in Chapter 2 contemporary DRR goals mentioned in international DRR-research literature are all situated in a democracy paradigm; variously framed as life-safety and other aspects of public health and public safety, humanitarian assistance, vulnerability reduction, resilience-building, or sustainable development (section 2.5.10).

Rather than top-down, technocratic communication (about DRR), communication is needed that is 'beyond bottom up' (Irwin, 2008), 'ethical' (Cronin, 2003) or 'democratic' (section 2.2). This is communication should assist all citizens, scientists, policy- and decision-makers and 'lay-public' alike, make informed decisions (Gastil, 2008; Habermas, 2001).

The transformation of scientific knowledge into sustainable community practices relies on science communicators who understand the need for 'stakeholder engagement', 'citizen involvement', multi-stakeholder dialogue', 'local community consultation' public participatory process, or 'deliberative inclusive practices' (DIPS), and act as 'knowledge brokers' who don't so much 'push science' but use it to explain (Bielak et al., 2008). In this research 'sustainable community practice' means and requires the already introduced 'culture of DRR' where scientific research and its communication lead to resilience to disaster.

In short, communication of disaster risk reduction (DRR) should be participatory, democratised and scientifically robust. This fits with ideals of 'ethical' risk communication, and ideals enshrined in the United Nations' International Strategy for Disaster Reduction

Hyogo Framework for Action and Sendai Framework 2015 (UNISDR, 2005; 2011b; 2015). Such communication has been referred to in this research as 'considerate' communication.

### 8.2.8 A 'culture of DRR' is achievable through communication that is 'considerate'

Social-psychological research presented in Chapter 2 suggests that DRR goals are most likely to be achieved if DRR-communication is 'considerate' and aligns with citizen needs, 'resilience indicators', and the recommendations for risk and DRR-communication presented in Figure 4.2.

A range of academic literature that relates to social psychology of seismic hazard adjustments[1][30] suggests that cognitive constructions of disaster and risk perceptions influence reduction behaviours (see review by Solberg et al, 2010). Research shows that along with other 'resilience indicators'[31] belief in self-efficacy, outcome expectancy, empowerment and trust are particularly powerful in positively influencing reduction behaviours (e.g. Paton et al, 2010). Particular risk communication frames that align with these resilience indicators and citizen information needs will assist in achieving successful DRR-communication as shown in Figure 4.2 (Rowan, 1994b; Pomeroy, 2010).

### 8.2.9 'Comprehensiveness' of communications was identified as important and under-researched

When both communication and scientific endeavour are idealised as needing to be participatory, democratised, ethical, and transparent (e.g. various in Tully, 2007; UNISDR, 2007, Valenti & Wilkins, 1985) the goal of the communication is arguably not persuasion, or a specific behavioural outcome. Instead it is communication that involves provision of information from a range of perspectives, information that generates public debate and discussion that leads to effective individual actions and or policy or other collective action outcomes (cf. Valenti & Wilkins, 1985).

Key to this research was the thesis that, in order to provide holistic knowledge of DRR, the 'awareness' or 'education' approach rather than simply being accurate, must show evidence of understandings across a range of elements that comprise DRR that is, of being 'comprehensive'. Identifying what 'comprehensive' DRR is was a significant part of this research.

---

[30] Seismic hazard adjustments are a subset of possible risk management or DRR actions as defined in Solberg (2010).

[31] Reflection on previous research showed that ten resilience indicators (trust, critical awareness, action coping, outcome expectancy, empowerment, self-efficacy/self-confidence, individual and community participation (Paton, 2005, 2007), and leadership and teamwork (Seville, 2009) correlate well with contemporary risk communication aims (Table 4.2).

### 8.2.10 Ways of assessing comprehensiveness of DRR knowledge were identified

Communications should be comprehensive (section 4.2.4); DRR knowledge communicated should be comprehensive (section 2.5.10), and to be comprehensive all, or at the very least a wide range of aspects of DRR should be communicated.

Before analysis could occur various theoretically robust ways of assessing how 'comprehensive' DRR communication were identified, as summarised in Table 7.1.

As framing analysis had been identified as a way of assessing comprehensiveness (Chapter 3), the following series of frames grounded in issue-related (DRR) theory, were used to assess issue-related (DRR) content:

a) all four environments (natural, built, social and economic); and

b) all four phases of DRR (readiness, response, recovery and reduction)[32]

c) three stages; 1) risk identification 2) risk assessment 3) risk management[33]

d) the twelve disciplinary groups[34].

Frames a) and b) combined represent twelve topic areas for DRR. Those topics areas are shown in the DRR-communication topics wheel (Figure 3.4); the wheel and twelve topics represent the first rigorous compilation or synthesis of what the large number of 'interventions' or possibilities in DRR with a clear intersection with disaster research theory[35].

### 8.2.11 Comprehensiveness of media content has not been previously assessed, and sets this research apart

Literature review had shown that analysis that considered DRR comprehensively was rare. Previous media analyses rarely analysed for risk reduction except in relation to warnings. No studies had considered as this study did, coverage of all three stages of risk management.

---

[32] See section 2.5.2 and footnote 26

[33] Three stages of individual and institutional risk assessment (Keey, 2000)

[34] As discussed in section 2.5.8 collaboration between, and integration of knowledge derived from multiple scientific disciplines was identified as ideal in DRR and a key mechanism for DRR success. Literature review revealed that there had been little previous research that considered whether or how scientists were advocating for a particular issue (e.g. DRR) let alone whether they were being 'honest brokers' (Hendy, 2016) in conveying the multiple perspectives of risk and risk management and their dependency on different goals (cf. sections 1.3.10, 2.2.1-2.2.3, 2.3.1 and 2.5.10). Previous research certainly did not often consider how policy- and decision-makers or the media might better represent the scientific disciplines contributing kowledge to a particular issue in society, if at all.

[35] While some researchers have mentioned fairly comprehensive lists of topics (e.g. Fred Cole, OFDA personal communication in Southern (2009); Hiroi, Makami and Miyata 1985; Kreps, 1989; Liu 2009; Needham, 1986) in every case some topics were missing and, or there was no clear intersection with disaster research theory.

Discussions of DRR communication often relate to aspects of individual seismic hazard adjustment. This analysis was also distinctive in that it looked at how DRR was mentioned and discussed in the broadest sense of DRR (e.g. qualitatively in relation to each element of equation 6 (p. 57), or quantitatively across the 4Rs and three stages of the risk management cycle).

This research was also unique in having identified a way of categorising DRR content into twelve distinct and theoretically robust topic areas as described in section 3.6.5 (Table 3.4). Whether the content emphasised the natural, built, economic or social environment, was also coded; very few recent studies had mentioned these frames, let alone quantitatively assessed for them (an exception was Miles and Morse's 2007 study).

No studies had previously assessed in much detail science and scientists' relative contribution to DRR, either through research or the media. This research identified and coded what topics science sources have commented on across a range of scientific disciplines in a range of media (primarily on-line print media and television).

### 8.2.12 This is the first study to have created a DRR-relate science issue cycle

Very few previous studies have considered the life-cycle of science or risk-related story types in the media, let alone DRR-related science story types. This research contributes to the former (a risk-related science story cycle) by having created the latter (a cycle of DRR-related science stories).

This research built on previous work into science or environmental risk frame changes in the media over, and research that recorded temporal changes in disaster reporting (Table 5.2.9). The DRR-science-story frames identified and DRR-science-issue cycle developed in this study considered the results of both science- and DRR-media story types relating to earthquakes and enabled a visual representation of the comprehensiveness and balance (or imbalance) of how earthquake-science-related issues were presented in the New Zealand media (section 5.4 and Figure 5.6). The imbalances obvious in Figure 5.6 should at least in part able to be addressed as per recommendations summarized in section 8.3.

### 8.2.13 The content analysis was qualitative and quantitative

Analysis of the bodies of media content surrounding the Canterbury earthquakes allowed measurement of the comprehensiveness of earthquake-related DRR communications in New Zealand. Analysis was qualitative and quantitative and the stages after comprehensive literature review used a narrative-based framing methodology that considered a range of frame types; motivational, responsibility and issue frames.

The content analysis chosen followed a ten-step method of framing analysis (Table 3.4) closely resembled Giles and Shaw's (2009) media framing analysis (MFA), which is a mixture of quantitative and qualitative macro- and micro-analysis, and is applicable to the textual elements of any communicated content (such as the research and media datasets analysed in this research). Since omissions and inclusions in text are important (Gamson, 1989; Stallings 1990; Richardson, 2007) attention was on presence, absence and emphasis in content using Huckin's (2002) method (steps 4-8 in Table 3.4).

This method allowed identification of areas where communication was not 'comprehensive'. The method enabled results to be discussed in terms of a) what science knowledge was communicated, b) which science disciplines were represented, c) who the sources used were (which scientists, from which institutions), d) whether the science was linked to possibilities in DRR, e) what non-scientists were saying about hazard, risk and reduction, and f) whether and how often the communication promotes concepts of self- or community- efficacy in DRR.

### 8.2.14 The media content analysed was influenced by the findings of literature review and also sets this research apart

The media corpus analysed included multiple datasets including, i) online print media, ii) online television broadcasts, iii) and the articles in two women's magazines. This was the first ever study of the portrayal of earthquakes, natural hazard risk, disaster or DRR in women's magazines.

Almost four years of earthquake-related coverage was analysed, a period spanning the 4Rs, starting 18 months prior to the first (Darfield M7.1) earthquake on September 4 2010, through response to, and recovery from that earthquake and subsequent aftershocks, to the first anniversary of the February 22 2011 M6.3 event. Most other media analyses focused on warnings immediately preceding an event, response and very early recovery, typically analysing at most period of only a few months. This study related to all phases of the DRR cycle.

This research adds to the less than 10% of media content analyses relating to Australasian or Asian media (see Appendix Table 6.4). It joins only one other study of media content of earthquakes in New Zealand (J. Cowan et al., 2002).

While many previous risk- and science-communication studies considered communication practices, fewer have analysed the content in terms of how it compared with scientific research. In this research the media corpus was analysed not only to assess what had been communicated to citizens, but this was compared both to a very large body corpus of global earthquake-related research, and with the survey or interview responses of over 450 citizens as to what they thought about the media communication.

### 8.2.15 Earthquake-related research was assessed to understand purported media biases

The mass media have been recognised not only as a part of science communication, a driver of social change but also as a key component of successful DRR in all phases of the DRR cycle (see Figure 4.1). At the same time the media has been frequently criticised for hampering DRR efforts, frame imbalances or 'framing biases', particularly for bias and sensationalism in media stories about earthquakes, risk and disaster.

In order to better understand framing biases identified in the media analysis, a proxy data set for earthquake-related research was developed (section 3.5.3). This proxy data set was also analysed (stage 4 of the research methodology – section 1.5.1). The headlines and abstracts of 4376 earthquake-related research articles from a range of scientific disciplines about one or more of twenty globally significant earthquakes that occurred between 2008 and 2011 was analysed in the same way as the media articles.

### 8.2.16 As DRR communication should align with citizen needs the content of answers to survey and interview were analysed using the same frames

The importance of identifying and confirming citizen needs and citizen satisfaction (section 3.3.1) stimulated the next phase of the research. In this survey and in-depth interview identified opinion from New Zealanders with a range of roles and responsibilities outside, and within DRR as to how earthquake-related information has been and should be communicated.

New Zealand citizens were asked for their reflections and opinions of earthquake-related media communication before, and after the Canterbury earthquakes. This was achieved through a survey of 441 citizens and face-to-face interviews with 29 individuals representing different stakeholder groups and scientific disciplines (stages 2 and 3 of the research methodology - section 1.5.1). Collectively those surveyed or interviewed exhibited a broad demographic, disciplinary and DRR background (Tables 3.1-3.3).

The interviewees were selected because of their involvement with and understanding of the Canterbury earthquakes as media, media sources, scientists or because they were citizens who used the media because they lived in Canterbury or had family in Canterbury during 2010 and 2011. Seventeen of the interviewees were media sources during the Canterbury earthquakes; ten were authors or co-authors of academic papers relating to the Canterbury earthquakes, and one was the first pseudoscientist known to have been interviewed as part of science communication research or academic research into communication of earthquake prediction.

The content of answers to survey and interview were analysed using the same frames as used in the analysis of academic research papers and media content.

## 8.3 Results, recommendations and discussion

### 8.3.1 The results of this research were presented in Chapters 4-7

Chapter 4 brought together findings from review of a wide communication-related literature to identify sixteen features of effective science and risk communication and create a solutions–focused strategy for science and risk communication as described in section 8.3.2. Results of framing analysis were presented in Chapters 5, 6 and 7 along with reflections, conclusions and recommendations based on those results, and the findings of previous research (stages 6 and 7 of the methodology – Table 3.4).

The main conclusions of the research, based on the literature review, framing analysis, and interview results, are presented in the following subsections.

While this research focused on examples relating to the communication of scientific knowledge that is specifically earthquake-related some recommendations relate equally to DRR-communication relating to any hazard, or even science communication in general.

### 8.3.2 Sixteen features of effective science and risk communication were identified and a solutions-focused strategy created

As was mentioned in an earlier section to be considerate communications should provide information that meet citizen needs and provide the evidence-basis for citizens to come to their own decisions about risk and DRR.

Review and summary of literature of yielded a set of 16 features of effective science- and risk-communication (Table 4.4), and a solutions-focused (7Ts) strategy for best-practice DRR communication.

The 7Ts strategy involves seven elements or steps beginning with the letter 'T' to cover off when communicating about science and risk. Those seven aspects are: 1) telling a story, 2) the whole story, 3) a story that is theoretically robust, 4) where the teller touches base with the audience, 5) tells it like it is, 6) tells what the audience wants to know, and 7) tells a story that begins, concludes or includes options for tangible action (see section 4.3.1 for more details).

The strategy is aligned with the sixteen features of effective communication identified from literature review, which are: 1) considerate of the needs of the audience by providing communication that is all of; 2) clear, 3) captivating and 4) comprehensive, 5) credible, 6) counteracts myths, 7) is comprehensible, 8) concise, 9) confirmable, 10) concrete and is 11) contextualized [in that it communicates 12) complexity, is 13) comparable, 14) addresses concerns and 15) acknowledges uncertainties]. A communication that exhibits best practice will be 16) complete, in that it includes all of these features (and thus includes all of the components of the 7Ts strategy).

Of the 16Cs, considerateness ('democratic' communication) and completeness were selected as the most important as they are overarching features. Comprehensiveness was the third feature quantitatively explored in this research, chosen because this was a previously under-researched area.

### 8.3.3 Survey and interview respondents mirrored the findings of previous research

Survey and interview respondents contributed a variety of suggestions for improvements to the communication of earthquake-related science. Most of these reflected their stakeholder or disciplinary perspectives, and mirrored conclusions or recommendations already made by previous researchers. Exceptions were that a) many suggestions were made about the communication of aftershocks, b) there were requests for more detail about what to do in and after an earthquake event and in situations where 'drop, cover and hold' do not apply, or beyond it, c) about the need for better information relating to engineering assessments, and d) for more transparency about the criteria being applied to recovery and other risk assessments.

Reasons for communicating DRR given by survey respondents (not something previous research had considered) were summarised in Table 4.3.

### 8.3.4 Results of media analysis showed a range of imbalances

Over 6000 earthquake-related online print media articles, 80+ hours of television news and 86 women's magazine articles, and the headlines and abstracts of over 4500 earthquake-related academic articles were coded and analysed as was summarised in section 8.2.

The main findings of the media analysis were presented in chapters 6 (which focused on the sciences of DRR as presented in the New Zealand media) and chapter 7 (which focused on the 12 DRR topics, the 4Rs and framing of the attribution of responsibility for DRR.

A range of imbalances were identified relating to different frame sets as described in the following sections; science and scientists (section 8.3.5), 12 DRR topics (section 8.3.6), the 4Rs (section 8.3.6) and framing of responsibility for DRR (section 8.3.8).

### 8.3.5 More science, particularly compilation of previous research findings is needed to support DRR communication

One of the 'imbalances' was that mentions of engineering, applied earth science, health, social and environmental and other sciences were few compared with those of seismic processes and other pure earth science. However, this is not an imbalance attributable to the media.

Analysis of the earthquake research proxy dataset suggested significantly different research is needed to support the communication of earthquake-related science. More research is particularly necessary for economics, environmental science, information decision and management sciences, public administration and political science, and urban studies and planning science. More willing scientist media sources for each of the above, and cognitive and behavioural sciences are required to communicate not only their science, but also to advocate for DRR.

Overall only approximately 25% of the scientists survey in this research considered themselves to be DRR advocates. It is not easy to find scientists willing to be media sources in DRR (Turner, 1982). Consequently it may be beneficial to have an agency or institution oversee media communication of DRR. Possible organisations in New Zealand would be JCDR, GNS or the Science Media Centre). The organisation(s) should be ready to comment whenever warnings are made, myths or rumours surface, and when large events occur.

Earth scientists (as opposed to those who study other sciences listed in Table 3.14) commonly gave at least some DRR advice; advice that was typically about preparation, and outside their direct area of expertise (section 6.5.9). Some researchers have suggested that scientists should give advice only in their field of expertise, or if outside, then provide a clear evidence-basis for that advice (section 4.2.5). At the same time citizens expressed a desire for advice. It was identified that Dr Quigley, recipient of the 2011 New Zealand Prime Minister's award for science communication, made a particular effort prior to interviews to understand questions raised by the media and other citizens, and research answers to those questions, and thus provide information aligned with citizen needs.

Analysis of New Zealand earthquake-related media (chapter 6) revealed that earth science and, to a lesser extent building science (engineers) dominated the media coverage, and that there are many aspects of DRR the social scientists could and should comment on.

Despite a focus on earth science before the Darfield earthquake, basic information about the nature of secondary earthquake hazards (e.g. liquefaction and rock-fall) had not been communicated. For example rock-fall continued to be a topic that did not receive much attention even after the Darfield earthquake, until rock-fall occurred during the Port Hills earthquake five months later.

### 8.3.6 There was a focus on response and consequences, and probability

In relation to the 12 DRR topics results showed:

- a prevalence of media article headlines and sections of articles relating to earthquake occurrence and consequence (hazard effects, damage to the built environment and social harms) - disaster consequences or 'events' were referred to far more than risk or risk reduction.
- little explanation of cause of disaster or vulnerabilities of built communities, or the aspects of human community that contribute to disasters
- ways that vulnerabilities might be reduced were infrequently communicated
- a focus on probability and consequence rather than risk exposure
- few articles explaining hazard and risk assessment processes
- an absence of articles relating to response and recovery needs assessment
- little detail on possibilities in avoidance or mitigation; and
- only a small number of 'lessons learnt' articles or references to learning from previous earthquakes and disasters, both local and international.

Considering the 4Rs - the emphasis was on recording damage and other earthquake effects (harms and consequence) rather than discussions of risk, risk assessment and its management (risk reduction). Stories focused predominantly on earthquake occurrence and the response phase of the DRR cycle. Recovery was rarely mentioned in New Zealand mass media before the Canterbury earthquakes occurred. Such emphasis on one of 4Rs (response) at the expense of all others does not provide a balanced view of the possibilities in DRR.

### 8.3.7 Media focus on events and harms is not necessarily detrimental to DRR

While in Chapter 5 the notions of issue-, and event-triggers were explored using the online print, and television datasets the conclusions in this research were rather different to previous research.

Firstly it was identified that previous research had not clearly defined the difference between events, and issues. The blurred lines between issues and event may be seen in Table 5.1. The two issue-triggers of interest in this research were identified as DRR and science.

Event-triggers identified in earthquake-related media stories include earthquake occurrences or disasters, science-research related events, scientific forecasts and pseudo-scientific predictions; these are examples of DRR-event-story-triggers that may be used to communicate about DRR.

In keeping with the findings of other research (e.g. Singer and Endreny, 1987) there was an 'earthquake events' or harms focus to mass media reporting of disaster and risk (section 5.2). However that the 'harms' focus is detrimental to DRR is questioned in this research. As some survey respondents commented, the reality of their Canterbury earthquake experiences was closer to 'Hollywood' portrayal of earthquake and disaster than they would have anticipated. Citizens wished they had known more about potential consequences, particularly the potential number and duration of aftershocks, the possibility of liquefaction, and the social consequences including that mental anguish might occur for many years after an event.

### 8.3.8 Content analysed suggested citizens should focus on household preparations

This research showed there was limited media discussion about business and corporate or institutional preparations. Attribution of responsibility for reducing exposure to seismic risk focused on, a) individual preparation (survival actions and a few basic household seismic adjustments), or b) implied that government and experts should be left to legislative and regulatory decision-making on risk reduction options (e.g. in seismic strengthening, construction, land use, insurance, and response and recovery planning).

Officials and experts made decisions based on science that was not explained in the media. Communication about the application of science to DRR solutions was rare. It was unusual for scientific information to be presented as the evidence basis for either advice or decisions about policy or legislation. Where issues were discussed the emphasis was often on polarised viewpoints and problems. What seemed lacking was clear and concise articulation of possible solutions.

### 8.3.9 Opportunities to communicate DRR were missed

Empowerment is an integral part of the HFA and Sendai ideals and DRR-related policy and legislation the world over. This research showed that opportunities were repeatedly missed to communicate the many DRR options available for individuals, businesses, governments and communities to implement.

Media provision of warning information and information in crisis (response) might be described as ‘satisfactory’ overall (in terms of citizen survey responses and attention to the topic). However, there was insufficient to assist communities to appropriately identify all hazards, to inspire individuals and households to prepare at home or at work, or to ensure citizens would advocate for mitigation of the built environment.

Public desire for certainty sparked interest in pseudo-scientific prediction without there having been the caution that prediction offers only limited opportunities for risk reduction. Detailed discussion of risk assessment and risk management (reduction) was rare. Where risk was discussed, mentions of probabilities predominated, and there were few mentions of ways to avoid or mitigate exposure.

The media focused on earthquake processes and effects such as liquefaction after the Darfield earthquake, perpetuating a natural hazards focused framing. This framing contributed to a lack of societal appreciation that disasters are caused at the intersection of a hazard with a human community. Combined with a very narrow framing of DRR options, this has meant that few citizens appeared (from survey results) to fully appreciate the fact that, while nothing can be done to mitigate the hazard (earthquake), a wide variety of demonstrably successful DRR options are available for human communities to use to reduce seismic risk.

### 8.3.10 The New Zealand media wrote over 150 different story types relating to earthquakes – all opportunities to communicate DRR

There were however many story types through which DRR might have been communicated.

This research recognized that while it is possible to categorise and group media stories according to DRR theory, categorizing and grouping in this way obscures the wide variety of media headline story types that fit within those categories and groups (Figure 5.12-5.16).

Yet there are in fact many existing earthquake-related media headline story types (155 were identified in all, and 88 of these were used before the Darfield earthquake).

As earlier described existing natural-hazards and disaster media research combined with suggestions from citizen survey and interview responses identified opportunities to improve the content of these media stories (see recommendations in Chapters 5-7).

Consequently there is no real need for there to be more earthquake stories or for continuing dismay that the stories are often triggered by earthquake events. Instead, using events, and improving the existing story types would make a significant difference to DRR success. For example earthquake occurrence, or pseudo-scientific prediction could be recognized as DRR-event story triggers that are opportunities to communicate about DRR and science.

Ways to improve the comprehensiveness of DRR-related science topics in media stories have been summarised in the following section (see Tables 8.1 and 8.2). In future DRR advocates could work with media to improve the existing story types using story type examples and the recommendations (see Table 8.3).

### 8.3.11 Recommendations

One hundred recommendations made in response to the combination of literature review, media analysis and survey and interview responses as presented in Chapters 5, 6 and 7 comprise the major conclusions of this research.

Seven recommendations were based on analysis of the earthquake-related story types (Chapter 5), 28 recommendations on the science and the scientists in them (Chapter 6). A further 65 DRR-topic-specific suggestions as to how to improve these story types were presented throughout Chapter 7. All 100 recommendations are listed together in Appendix Table 18.

<u>The primary recommendation to engage all citizens in building resilience is:</u>

1) Communicate considerately: use the 7Ts strategy for communicating effectively, mindful of the 16Cs, DRR and communication goals.

Science- and risk-communications should be considerate by providing the audience information to be used in individual and community decision-making. The 16Cs are sixteen features beginning with the letter ‘C’ that summarize the ideal characteristics of ‘effective’, or well-regarded science- and risk communications, including the need to be clear about both the communicative and DRR goals presented in Chapter 4. Communication of any risk-related issue that involves science should be clear about the goals (both communication and DRR-related) that it aims to achieve (Neresini & Pellegrini, 2008). The overarching DRR goal should also be communicated. Thus DRR-communications should be clear about contemporary DRR goals – such as whether DRR is being considered in a sustainable development, resilience-building paradigm and where post-event functionality not only life-safety is the aim.

The secondary recommendation is:

2) to communicate comprehensively.

More stories about DRR options, innovation, costs, investment, lessons identified and cause are needed. Scientists, DRR advocates and the media should work together to balance story types across the DRR-science issue types cycle (see Figure 5.6). The detail required in relation to these story types is shown in Table 8.1.

The recommendations align; a) contemporary best-practice in science- and risk-communication based on principles of participatory democracy as summarised in Chapter 4, where individuals are supported by open and transparent messaging that provides the evidence-basis they require for individual decision-making or understanding authorities' decisions; b) social-psychological research that shows that providing individuals with information that illustrates that they have control in decision-making results in more DRR actions being undertaken, and enhances trust in authorities' decision-making; and c) research that identifies that pessimists require reassuring messages while optimists require alarming messages.

Sustainability goals are more likely to be achieved if all environments are considered and communicated. This will require a greater emphasis on both the natural and the economic environments than is currently being presented in the mass media.

There will be a greater likelihood of DRR success if DRR is supported by knowledge transfer relating to all sciences of DRR not only earth science. Detailed suggestions to improve communication of each of the twelve disciplinary groups were presented in Chapter 5. In summary the background knowledge and evidence-basis for advice and decisions should be provided by all sciences involved in DRR, not only earth scientists. In particular social scientists should be asked more often to communicate about earthquakes

**Table 8.1: Key recommendations for achieving comprehensive communication**

Key recommendations for scientists, DRR advocates and the media to achieve comprehensive communication as discussed in chapter 7 are as shown below.

**A. DRR Options**

1. More stories are needed that emphasise DRR options (risk management solutions):

1) That all aspects of risk are controllable through DRR (consequence, exposure and vulnerability)

2) The wide range of risk management options[36]

3) That many scientific disciplines contribute knowledge about the wide range of DRR solutions

4) The suitability and success of particular DRR actions; and

5) Who is responsible for DRR – i) reporting should balance individual with institutional responsibility, and show evidence of business and community engagement in DRR actions; ii) all stakeholders, individuals, communities and governments should be portrayed as having at least some of the resources necessary to work together to ready themselves for, respond to, and recover from earthquakes (this is to illustrate efficacy).

**B. Cause**

1. Ensure that citizens fully understand that while hazards trigger disasters it is a complex combination of individual and collective community choices that create disaster;

1) Attributing disasters to fatalistic or natural causes should be avoided

2) Showing a range of contributing factors including those relating to societal choice illustrates the variety of options possible to reduce disasters; although

3) Responsibility for DRR should be emphasised over accountability (cause of disaster)[37].

**C. Risk assessments**

1. Stories about risk assessments are required that transparently discuss costs and benefits not only in monetary terms but also as to what is bearable, equitable and viable and therefore sustainable (cf. Figure 3.5a). Stories framed this way are likely to increase trust to the point that citizens see the value in engaging and participating in DRR.

2. Communicate about response and recovery needs assessments, audits, investigations and inquiries (do not focus only on hazard assessments):

a) tell how assessments were derived and by whom

b) if the communication is a warning, balance alarm and reassurance

c) avoid a focus on the likelihood of a hazard occurring, or the disastrous consequences - if a damaging hazard event does occur this does not illustrate any of the multitude of ways that citizens and communities can and do participate in DRR.

[36] That is options relating to i) any of equation 6 (p. 57) ii) all 'environments'; and iii) all phases of the DRR cycle .

[37] If there is to be imbalance the imbalance should favour risk management / DRR options).

**Table 8.2: Twelve DRR-topic-related recommendations**

Below are key recommendations for each of the twelve DRR topics (section 3.6.5, Table 3.4) as discussed in detail in chapter 7.

**Topic 1 - Provide background from multiple disciplines relating to multiple events.** If information is being provided as background then be sure to communicate both risks and solutions that represent multiple disciplinary perspectives, and clearly draw from the results of research about multiple events.

**Topic 2 -** Keep it simple; **communicate using scenarios, and the idea that New Zealanders are exposed** and vulnerable to earthquakes and their secondary and cumulative effects**, anywhere, anytime**. Do not label announcements or documentaries etc. as 'alarmist' when risk is identified.

**Topic 3 - Show that damage is selective** rather than inevitable **depending on which of the many possible solutions or innovations was applied**. Drawing attention to possible and successful DRR actions, and selective damage reduces fatalism.

**Topic 4 - Represent cause as an interplay of factors, emphasise the controllable social aspects** and call for change. Communication that recognises all of the factors that create disasters is required. Broaden representation and discussion of cause in the media so it understood that disasters are not caused by supernatural causes, by natural causes alone, nor solely by social, political or technical failures. Recognize that a complex interplay of all of these factors together contributes to disasters.

**Topic 5 - Communicate more about lessons identified or learned and resilience assessments.** The story types that illustrate the communication of disaster risk reduction audits are primarily *Lessons learnt* and *Inquiries and Inquests*. It is suggested that a future focus should be resilience assessments, as the ways of assessing resilience are further developed.

**Topic 6 - Readiness is not just about having a survival kit**, mention recovery planning, business, organisational and community planning, insurance and opportunities to be involved in policy and legislative development too Media analysis showed recovery planning was missing from media representation of how individuals, businesses and governments and communities as a whole prepare for disasters.

**Topic 7 - Communicating about consequences is valuable but should be balanced across all 4 environments and about positive consequences as well as harms**. Previous studies have identified that media reporting of disaster is harms-focused. The implication is that this is a negative thing, yet citizens need to know possible consequences to understand what might occur, and how those consequences might be avoided, prevented or reduced. Citizens also need to know that some things that come of disaster are good (e.g. see topic 9).

**Topic 8 - Portray all stakeholders involvement in needs assessment** not only emergency managers.

**Topic 9 - Emphasise that most citizens behave and adapt well in disaster** and are involved in mutual aid in response. The reality of disaster is that mutual aid is a far more frequent human behavioural response than maladaptive behaviour. Showing how citizens successfully adapt to disaster situations increases their perception of self-efficacy and therefore (social psychological research shows) also results in greater involvement in DRR. Businesses and authorities are also adaptive in response.

**Topic 10 - Recovery takes a long-time** but communications should use references to a 'return to normal' carefully. Citizens in survey, and through media articles expressed concerns that the long-term nature of unwanted consequences had not been adequately communicated prior to the Canterbury earthquakes. At the same time they indicated that early references to normalcy in the media were not appreciated.

**Topic 11 - Frame recovery decision-making as 'on behalf of' citizens**, and giving due consideration to the community in terms of participatory process (e.g. community input into 'building back better'). In Chapter 7 the communication of land-use planning in the media after the Canterbury earthquakes and survey and interview respondent comments about this were used to illustrate the importance of communicating the evidence basis for recovery assessments and opportunities for community involvement in this.

**Topic 12 - Portrayal of leaders that are linked with and listen to their communities is vital in 'building back better'.** Leadership is a resilience indicator (Chapter 2) and leadership and their linkages to the scientific and local communities are known, from the writings of recovery experts and through survey responses to be important in recovery. Leaders that recognize both difficulties and opportunities, and who communicate options in keeping with the 7Ts strategy and mindful of the 16Cs, are needed.

and/or DRR. It would be beneficial for DRR-researchers from a range of disciplines to compile more pre-prepared information about multiple historical earthquake disasters; this background evidence basis should broaden disaster statistics and include a summary of key causes of disaster. In particular having a range of scientists as sources, and particularly social scientists would mean that causal attributions are more likely to reflect the full (human) cause of disaster, not only cause of earthquakes.

### 8.3.12 Suggestions for future research into DRR-related science communication

This research drew together an almost overwhelming body of existing knowledge about the communication earthquake-related DRR. Some of the following suggestions for future research in to DRR-related science communication relate to how messages are communicated, others to what is communicated.

This research showed that some of the key criticisms of media portrayal of DRR reflect DRR-research-related-thinking or gaps in research. One example is the attention to specific and single earthquake events (section 5.2.14). Another example is the often over-simplistic portrayal of the cause of disaster (section 7.4).

Compiling previous suggestions, assessing and discussing them against ideals of ‘considerate’ and comprehensive’ communication frames has been a first step. The next step is to empirically test the value of the suggestions.

The seventeen suggestions for future work (Table 8.3) are aligned with key conclusions and recommendations. However the list is by no means exhaustive. Given the number of conclusions made in chapters 5, 6 and 7, many other suggestions and the relative value of particular recommendations could also do with empirical testing.

**Table 8.3: Seventeen suggestions for future DRR-communication research**

| | Suggestion |
|---|---|
| 1 | Identify how differences in goal framing affect the DRR-actions or intentions of different stakeholder groups. |
| 2 | Explore how policy-and decision-maker sources rationalise DRR-related policies when communicating in the media, and what this means for how DRR-advocates or experts might better communicate DRR fundamentals and lessons learned (either in direct conversations with those stakeholders or when communicating in the media) |
| 3 | Study whether scientists/experts from each of the DRR disciplines communicate differently, and how they might better communicate earthquake- and DRR-related knowledge in one-on-one conversations with policy- and decision-makers |
| 4 | Test the effects of the multitude of causal and attribution of responsibility frames on DRR actions and intentions – or more specifically, research to empirically prove what people take from natural attributions |
| 5 | Compare the reporting of the wide range of maladaptive and adaptive behaviours presented in the mass media, in disaster with reports in non-disaster periods |
| 6 | Extend the body of research into media's role in modulating the public acceptability of risks (whether and how communication tolerability, viability and how bearable they are alters involvement in DRR). |
| 7 | Establish the nature of any relationship between media portrayal of leaders, authorities and individual involvement in decision-making processes with attitudes to DRR |
| 8 | Inform the media of the many ways that DRR and the scientific evidence basis for achieving it can be communicated, remembering that this relates not only through science reporters but through reporting on breaking news, the courts, the environment, sport and human-interest stories. |
| 9 | Establish similarities and differences between international and New Zealand media earthquake-related story types. |
| 10 | Compile multi-disciplinary earthquake-related DRR 'lessons learnt' from academic papers, and/or through citizen survey. |
| 11 | Identify ways for research to better align with citizen needs and the questions that citizens have, or for extrapolating this from existing research when papers typically answer different (scientific) questions. |
| 12 | Summarise what is known about each aspect of DRR (Table 7.1) in respect of multiple earthquake events. |
| 13 | Translate key knowledge about each DRR topic into simple sentences that are ready for use by sources when disaster events occur. |
| 14 | Create headlines that better reflect DRR messages and in particular how mitigation and preparation topic headlines might be made more interesting. |
| 15 | Test the 7Ts strategy (section 7.3) and/or Rowan's 4 steps A-D (section 4.2.13). |
| 16 | Research the reasons why so few of the scientists recognise themselves as DRR advocates (as results of this study showed), and consider what might be done to alter scientists' perception so that they see their work in the greater context of DRR, and understand that value in communicating their findings to citizens, not only others in academia. |
| 17 | Establish the types of advice expected from scientists from different disciplines, how this affects trust in DRR advice and which types of advice result in uptake of which DRR actions. |

## 8.4 Concluding statements

This research involved a systematic methodological approach to assessing the content of mass media communication of sciences of DRR. The New Zealand setting and mass media, and the Canterbury earthquakes were used in a case study that has allowed assessment of how comprehensive earthquake-related media content was in comparison with academic research, and whether media content was considerate of citizen information needs.

This research identified over 155 different story types in the New Zealand media that can be used to communicate the many ways we can reduce the disastrous consequences of earthquakes. The body of the thesis contains recommendations for more than 100 ways to improve those stories. These recommendations were drawn from a combination of the findings of previous communication and DRR research, citizen survey and interview, and the comparative analysis of written and broadcast media content and research content about earthquakes.

Earth science and earth scientist sources received the lion's share of 'earthquake-related' attention before during and after the Canterbury earthquakes. Most of that media attention was on risk identification and hazard assessment rather than risk management (solutions).

A considered effort by scientists and journalists to acknowledge uncertainty and explain risk in terms of more than simply probability seems warranted.

Linking evidence-based information from a wider range of sciences that emphasises a far wider range of possibilities in preparation, avoidance and mitigation, is clearly needed, as are explanations of real and relative costs of avoidance and mitigation options. Innovation and adaptation should be showcased. Emphasising solutions, and self- and community-efficacy in DRR would also be helpful.

Communication is needed that empowers and builds trust by providing science-backed examples of solutions to societal issues such as earthquakes, in ways that promote self- and community-efficacy and thus empower all citizens to be involved in DRR. The reasons for advice or decisions where these have been made on behalf of the community need to be clearly articulated, along with their scientific evidence basis. Communication should show successful DRR-leadership and inspire a 'DRR culture'.

The major creative challenge in future will be for disaster researchers and journalists to work together to find new adjectives, metaphors and simple sentences that assist in highlighting the social system vulnerabilities that contribute to losses, and in capturing resilience-creating concepts. Human-interest stories that bring together the arts and the sciences are suggested as an ideal way of achieving such a focus on DRR.

# References

AAP. (2010, 4-Nov). Strong quake hits Tonga. *Stuff World News, www.stuff.co.nz*.

AAP. (2011, 28-Feb). Christchurch earthquake impact 'bigger than Katrina'. *The Press News, www.stuff.co.nz*.

Abrahamson, C. E. (1998). Storytelling as a pedagogical tool in higher education. *Education, 118*(3), 440-451.

Ackoff, R. (1989). From data to wisdom. *Journal of Applied Systems Analysis, 16*, 3-9.

Adamo, S. (2006). Constructing an event, contemplating ruins, theorizing nature: the Lisbon earthquake and some Italian reactions. *European Review, 14*(3), 339-349.

Adams, W. C. (1986). Whose lives count? TV coverage of natural disasters. *Journal of Communication, 36*(2), 113-122.

Alderman, D. H., & Ward, H. (2008). Writing on the plywood: toward an analysis of hurricane graffiti. *Coastal Management, 35*(1), 1-18.

Aldrich, D. P. (2011). The power of people: social capital's role in recovery from the 1995 Kobe earthquake. *Natural Hazards, 56*, 595-611.

Alexander, D. E. (1980). The Florence floods, what the papers said. *Environmental Management, 4*(1), 27-34.

Alexander, D. E. (1991). Applied geomorphology and the impact of natural hazards on the built environment. *Natural Hazards, 4*, 57-80.

Alexander, D. E. (1997). The study of natural disasters, 1977-1997: some reflections on a changing field of knowledge. *Disasters, 21*(4), 284-304.

Alexander, D. E. (2006). Trends, problems and dilemmas. *Journal of International Affairs, 59*(2), 1-24.

Alexander, D. E. (2007). Making research on geological hazards relevant to stakeholders' needs. *Quaternary International, 171*, 186-192.

Alexander, D. E. (2008). Mainstreaming disaster risk management. In L. Bosher (Ed.), *Hazards and the built environment: attaining built-in resilience* (pp. 20-36). London: Taylor and Francis.

Alexander, D. E. (2010). The L'Aquila earthquake of 6 April 2009 and Italian government policy on disaster response. *Journal of Natural Resources Policy Research, 2*(4), 325-342.

Alexander, D. E. (2013). An evaluation of medium-term recovery processes after the 6 April 2009 earthquake in L'Aquila, Central Italy. *Environmental Hazards, 12*(1).

Alexander, D. E. (2014). Communicating earthquake risk to the public: the trial of the "L'Aquila Seven". *Natural Hazards, 72*(2), 1159-1173.

Alexander, D. E. (2015). Reply to a comment by Franco Gabrielli and Daniela Di Bucci: 'Communicating earthquake risk to the public: the trial of the 'L'Aquila Seven'. *Natural Hazards, 75*, 999-1103.

Altheide, D. L. (1976). *Creating reality: how TV news distorts events*. Beverley Hills, CA: Sage.

Amberg, S. M., & Hall, T. E. (2010). Precision and rhetoric in media reporting about contamination in farmed salmon. *Science Communication, 32*(489), 489-513.

Ammann, W. J. (2006). Risk concept, integral risk management and risk governance. In W. J. Ammann, S. Dannenmann, & L. Vuillet (Eds.), *Risk 21: coping with risks due to natural hazards in the 21st century* (pp. 3-23). London: A. A. Balkema, Taylor and Francis.

Anbarci, N., Escaleras, M., & Register, C. A. (2005). Earthquake fatalities: the interaction of nature and political economy. *Journal of Public Economics, 89*, 1907-1933.

Anderson, A. (1997). *Media, culture and the environment*. London: UCL Press.

Anderson, A. (2006). Media and risk. In S. Walkiate & G. Mythen (Eds.), *Beyond the risk society* (pp. 114-131). London: McGraw-Hill.

Anderson, C., & McMorran, T. (2003). *An application of liquefaction hazard evaluation in urban planning*. Paper presented at the 2003 Pacific Conference on Earthquake Engineering. Paper Number 107. 8p.

Anderson, H., & Webb, T. (1994). New Zealand seismicity: patterns revealed by the upgraded national seismograph network. *New Zealand Journal of Geology & Geophyscis, 37*(4), 477-493.

Anderson, V. (2011a, 04-Mar). Vicki Anderson: Fight or flight? *www.stuff.co.nz*.

Anderson, V. (2011b, 24-Jul). Fracking - yes or no? *The Press News, www.stuff.co.nz*.

Anderson, V. (2011c, 3-Sep). Reading signs before a quake. *The Press News, www.stuff.co.nz*.

Anderson, V., & Kozanic, D. (2011, 8-Jun). It's not our fault' - scientists. *The Press News, www.stuff.co.nz*.

Anderton, J. (2011, 16-Mar). Wood ideal material for rebuild. *The Press News, www.stuff.co.nz*.

Ando, M., Ishida, M., Hayashi, Y., & Mizuki, C. (2011). Interviews with survivors of Tohoku earthquake provide insights into fatality rate. *Eos, Transactions American Geophysical Union, 92*(46), 411-412.

Antilla, L. (2005). Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environmental Change, 15*, 338-352.

Anzur, T. (2000). How to talk to the media: televised coverage of public health issues in a disaster. *Prehospital and Disaster Medicine Public Health and Disasters, 15*(4), 196-198.

APNZ. (2011, 26-Dec). Areas may return to red-zone after latest quakes. *Otago Daily Times, www.odt.co.nz*.

Arakaki, R., Ken. (2011). Indonesia's response to the 2011 great east Japan earthquake. *Asian Politics & Policy, 3*(4), 665-668.

Arceneaux, K., & Stein, R. M. (2006). Who is held reponsible when disaster strikes? The attribution of responsibility for a natural disaster in an urban election. *Journal of Urban Affairs, 28*(1), 43-53.

Ardagh, M., W., Richardson, S. K., Robinson, V., Than, M., Gee, P., Henderson, S., . . . Deely, J. M. (2011). The initial health-system response to the earthquake in Christchurch, New Zealand, in February, 2011. *Lancet, 379*(9831), 2109-2115.

Arifon, O. (2009). 2008 in China: A watershed year for communication systems and their use 2008. *Hermes, 55*, 57-63.

Arlikatti, S., Lindell, M. K., & Prater, C. S. (2007). Perceived stakeholder role relationships and adoption of seismic hazard adjustments. *International Journal of Mass Emergencies and Disasters, 25*(3), 218-256.

Armaş, I. (2008). Social vulnerability and seismic risk perception. Case study: the historic centre of the Bucharest Municipality, Romania. *Natural Hazards, 47*, 397-410.

Arnold, J. (2006). Disaster myths and Hurricane Katrina 2005: can public officials and the media learn to provide responsible crisis communication during disasters? *Prehospital and Disaster Medicine, 21*, 1-3.

Asgary, A., & Wilis, K. G. (1997). Household behaviour in response to earthquake risk: an assessment of alternative theories. *Disasters, 21*(4), 354-365.

Ash, J. (2010, 24-Sep). In-depth fault line research gets backing. *Stuff National News, www.stuff.co.nz*.

Ashlin, A., & Ladle, R. J. (2007). Natural disasters and newspapers: Post-tsunami environmental discourse. *Environmental Hazards, 7*(4), 330-341.

Ashwell, D. (2011). Restricted voices in the New Zealand GM debate: an analysis of New Zealand metropolitan newspaper coverage (1998 to February 2002). *East Asian Science, Technology and Society: an International Journal, 5*(4), 505-528.

Associated Press. (2009, 25-Jun). N. Korea runs nuclear test. *Otago Daily Times, www.odt.co.nz*.

Associated Press. (2010a, 08-Apr). Chile's latest quake toll is 486 dead, 79 missing. *Otago Daily Times, www.odt.co.nz*.

Associated Press. (2010b, 22-Jul). Moderate earthquake off eastern Taiwan. *Otago Daily Times, www.odt.co.nz*.

Associated Press. (2010c, 2-Nov). Indonesia volcanio erupts again. *Stuff World News, www.stuff.co.nz*.

Associated Press. (2010d, 20-Dec). The year the earth struck back/ disasters. *Stuff World News, www.stuff.co.nz*.

Associated Press. (2011a, 21-Mar). Japan earthquake recovery to take years. *Business Day, www.stuff.co.nz*.
Associated Press. (2011b, 05-Apr). Martelly victorious in Haiti election. *World News, www.odt.co.nz*.
Associated Press. (2011c, 07-Jun). Chilean volcano grounds flights. *Stuff World News, www.odt.co.nz*.
Associated Press with The Press. (2010, 22-Dec). Pacific quake sparks brief tsunami scare. *Stuff World News, www.stuff.co.nz*.
Atman, C., J., Bostrom, A., Fischhoff, B., & Granger Morgan, M. (1994). Designing risk communications: completing and correcting mental models of hazardous process, part 1. *Risk Analysis 14*(5), 779-788.
Atterstam, I. (1995). Media and risk communication. *Toxicology Letters, 82/83*, 211-214.
Atwood, L. E., & Major, A. M. (2000). Optimism, pessimism, and communication behaviour in response to an earthquake prediction. *Public Understanding of Science, 9*, 417-429.
Aykut, S. C., Comby, J., & Guilemot, H. (2012). Climate change controversies in french mass media 1990-2010. *Journalism Studies, 13*(2), 157-174.
Backhouse, M., & NZPA. (2010, 16-Oct). World should emulate NZ - Helen Clark. *World News, www.stuff.co.nz*.
Bakir, V. (2010). Media and risk: old and new research directions. *Journal of Risk Research, 13*(1), 5-18.
Balaji, M. (2011). Racializing pity: the Haiti earthquake and the plight of ''others''. *Critical Studies in Media Communication, 28*(1), 50-67.
Baldwin, T., K. (1993). Perceptions about others' responses to the Browning prediction; earthquake awareness in southeast Missouri: a study in pluralistic ignorance. *International Journal of Mass Emergencies and Disasters, 11*(3), 351-363.
Ball-Rokeach, S. J., & Loges, W. E. (2000). Ally or adversary? Using media systems for public health. *Prehospital and Disaster Medicine, 15*(4), 189-195.
Bandura, A. (1969). *Principles of behaviour modification*. New York: Holt, Rinehart & Winston.
Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioural change. *Psychological Review, 84*, 191-215.
Bandura, A. (1986). *Social foundations of thought and action*. Eaglewood Cliffs, N.J.: Prentice Hall.
Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology, 3*, 265-299.
Bankoff, G. (2001). Rendering the world unsafe: 'vulnerability' as western discourse. *Disasters, 25*(1), 19-35.
Bankoff, G. (2003). *Cultures of disaster: society and natural hazard in the Philippines*: Routledge Curzon.
Barakat, S., & Ward, G. (1995). Media and early warning: how western media and NGOs misrepresent the disasters story. *Stop Disasters, 25*, 23.
Barclay, J., Haynes, K., Mitchell, T., Solana, C., Teeuw, R., Darnell, A., . . . Kelman, I. (2008). Framing volcanic risk communication within disaster risk reduction: finding ways for the social and physical sciences to work together. *Geological Society of London Special Publication, 305*(1), 163-177.
Barnes, M., Hanson, C. L., Novilla, L. M. B., Meacham, A. T., & McIntyre, E. (2008). Analysis of media agenda setting during and after Hurricane Katrina: implications for emergency preparedness, disaster response, and disaster policy. *American Journal of Public Health, 98*(4), 604-610.
Basolo, V., Steinberg, L. J., Burby, R. J., Levine, J., Cruz, A. M., & Chihyen, H. (2009). The effects of confidence in government and information on perceived and actual preparedness for disasters. *Environment and Behaviour, 41*, 338-364.
Bauer, M. W., Allum, N., & Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda, public understanding of science. *Public Understanding of Science, 16*(1), 79-95.

Beaudoin, C. E. (2007a). Mass media use, neighbourliness, and social support. *Communication Research, 34*(6), 637-664.
Beaudoin, C. E. (2007b). Media effects on public safety following a natural disaster: testing lagged dependent variable models. *Journalism and Mass Communication Quarterly, 84*(4), 695-712.
Beaudoin, C. E., & Thorson, E. (2004). Social capital in rural and urban communities: testing differences in media effects and models. *Journalism and Mass Communication Quarterly, 81*(2), 378-399.
Beavan, J., Samsonov, S., Motagh, M., Wallace, L., Ellis, S., & Palmer, N. (2010). The Mw 7.1 Darfield (Canterbury) earthquake: geodetic observations and preliminary source model. *Bulletin of the New Zealand Society for Earthquake Engineering, B43*(4), 228-235.
Bebbington, A. (1999). *Capitals and capabilities: a framework for analysing peasant viability, rural livelihoods and poverty in the Andes. Croxton, S. (ed). A background paper for: policies that work for sustainable agriculture and regenerating rural economies. London., International Institute for Environment and Development*. Retrieved from London:
Beck, U. (1992). *Risk society: towards a new modernity*. London: SAGE.
Becker, J. S., Johnston, D. M., Paton, D., & Ronan, K. R. (2009). *Community resilience to earthquakes: understanding how individuals make meaning of hazard information, and how this relates to preparing for hazards*. Paper presented at the New Zealand Society of Earthquake Engineering.
Becker, J. S., & Johnston, D. M. M. (2000). *Planning and policy for earthquake hazards in New Zealand*. Retrieved from Lower Hutt, N.Z.:
Becker, J. S., Paton, D., Johnston, D. M., & Ronan, K. R. (2012). A model of household preparedness for earthquakes: how individuals make meaning of earthquake information and how this influences preparedness. *Naural Hazards, 64*, 107-137.
Becker, J. S., Saunders, W. S. A., Hopkins, L., & Wright, K. C. (2009). Planning for community recovery and restoration before disaster strikes.
Beech, J. (2011, 02-Aug). Quake trauma forum subject. *Otago Daily Times, www.odt.co.nz*.
Bellegarde-Smith, P. (2011). A man-made disaster: the earthquake of January 12, 2010−a Haitian perspective. *Journal of Black Studies*(42), 264-275.
Bendimerad, F. (2004). *The Boumerdes earthquake: lessons learned and recommendation*. Paper presented at the Proceedings from the World Congress on Earthquake Engineering, August 1–6, 2004, Vancouver BC, Canada.
Benini, A., Conley, C., Dittemore, B., & Waksman, Z. (2009). Survivor needs or logistical convenience? Factors shaping decisions to deliver relief to earthquake-affected communities, Pakistan 2005-06. *Disasters, 33*, 110-131.
Benoit, W. L. (1997). Image repair discourse and crisis communication. *Public Relations Review, 23*(2), 177-186.
Benoit, W. L., & Henson, J. R. (2009). President Bush's image repair discourse on Hurricane Katrina. *Public Relations Review, 35*, 40-46.
Berelson, B. (1952). *Content analysis in communication research*. New York: The Free Press.
Berger, D. (2009). Constructing crime, framing disaster: routines of criminalization and crisis in Hurricane Katrina. *Punishment & Society, 11*, 491.
Berke, P. R., Kartez, J. D., & Wenger, D. E. (1993). Recovery after disaster: achieving sustainable development, mitigation and equity. *Disasters, 17*(2), 939.
Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. *Natural Hazards, 41*, 283-295.
Bernhardt, D. (2011, 15-Jul). Faith and reason: 'Acts of God' ours to effect. *Otago Daily Times, www.odt.co.nz*.
Bernstein, K., T., Ahern, J., Tracy, M., Boscarino, J., A., Vlahov, D., & Galea, S. (2007). Television watching and the risk of incident probable post-traumatic stress disorder. *The Journal of Nervous and Mental Disease, 195*(1), 41-47.
Besley, J. C. (2010). Focusing on fairness in science and risk communication. In L. Kahlor & P. A. Stout (Eds.), *Communicating science: new agendas in communication* (pp. 68-87). New York: Routledge.

Besley, J. C., & Nisbet, M. C. (2011). How scientists view the public, the media and the political process. *Public Undersanding of Science*, 1-16.
Bettencourt, S., Croad, S., Freeman, P., Hay, J., Jones, R., King, P., . . . Van Aalst, M. (2006). *Not if but when adapting to natural hazards in the Pacific Island Region: a policy note.* . The World Bank. East Asia and Pacific Region. Pacific Islands Country Management Unit. 46p.
Bevere, L., Rogers, B., & Grollimun, B. (2011). Natural catastrophes and man-made disasters in 2010: a year of devastating and costly events. In T. Hess (Ed.) *Sigma 1*, Zurich, Switzerland: Swiss Reinsurance Company Limited. 40p.
Bickerstaff, K., Lorenzoni, M. J., & Pidgeon, N. (2010). Locating scientific citizenship: the institutional contexts and cultures of public engagement. *Science Technology Human Values, 35*, 474-500.
Bielak, A., T., Campbell, A., Pope, S., Schaefer, K., & Shaxson, L. (2008). From science communication to knowledge brokering: the shift from 'science push' to 'policy pull'. In D. e. a. Cheng (Ed.), *Communicating science in social contexts* (pp. 201-226). B.V.: Springer Science+Business Media.
Bier, V. M. (2000). On the state of the art: risk communication to the public. *Reliability Engineering Systems & Safety, 71*, 139-150.
Billet, S. (2010). Dividing climate change: global warming in the Indian mass media. *Climate Change, 99*, 1-16.
Bird, D. K., Chague-Goff, C., & Gero, A. (2011). Human response to extreme events: a review of three post-tsunami disaster case studies. *Australian Geographer, 42*(3), 225-239.
Birkland, T. (1997). *After disaster: agenda setting, public policy, and focusing events*. Washington DC: Georgetown University Press.
Birkmann, J. (2006). *Measuring vulnerability to natural hazards; towards disaster resilient societies*. Tokyo: United Nations University Press.
Black, J., & McLean, J. (2011). For better or for worse: how initial support provision adapted to needs. *New Zealand Journal of Psychology, 40*(4), 111-120.
Blaikie, P. M., Cannon, T., Davis, I., & Wisner, B. (1994). *At risk: natural hazards, people, vulnerability and disasters*. London: Routledge.
Blanchard-Boehm, R. D. (1998). Understanding public response to increased risk from natural hazards: application of the hazards risk communication framework. *Journal of Mass Emergencies and Disasters, 16*(13), 247-278.
Blumer, H. (1969). *Symbolic interactionism: perspective and method*. Los Angeles: University of California Press.
Boeije, H. R. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality and Quantity, 36*(4), 391-409.
Boholm, Å. (2003). The cultural nature of risk: can there be an anthropology of uncertainty. *Ethnos, 68*(2), 159-178.
Boin, A., & 't Hart, P. (2006). The crisis approach. In H. Rodriguez, E. L. Quarantelli, & R. Dynes (Eds.), *Handbook of disaster research* (pp. 42-54): Springer.
Bolduc, J. (1987). Natural disasters in developing countries: myths and roles of the media. *Emergency Preparedness Digest, 14*, 12-14.
Bolt, B. (2004). *Earthquakes*. New York: W. H. Freeman and Company.
Boniface, L. (2009, 31 Aug). Quake exposes household havoc. *The Dominion Post*.
Boniface, L. (2010, 12-Sep). The earthquake blame game. *The Press News, www.stuff.co.nz*.
Borah, P. (2009). Comparing visual framing in newspapers: Hurricane Katrina versus tsunami. *Newspaper Research Journal, 30*(1), 50-57.
Bosomworth, K., Handmer, J., & Dovers, S. (2014). Learning from analyses of policy frames and informal institutions in the fire management sector of Victoria, Australia. In B. C. Glavovic & G. P. Smith (Eds.), *Adapting to Climate Change, Lessons from Natural Hazards Planning; Environmental Hazards* (pp. 269-289). Dordrecht: Springer.
Bostrom, A., Anseiln, L., & Farris, J. (2008). Visualizing seismic risk and uncertainty a review of related research. *Annals of the New York Academy of Science, 1128*, 29-40.

Bostrom, A., Atman, C. J., Fischhoff, B., & Granger Morgan, M. (1994). Evaluating risk communications: completing and correcting mental models of hazardous processes, part II. *Risk Analysis, 14*(5), 789-798.
Bostrom, A., Granger Morgan, M., Fischoff, B., & Read, D. (1994). What do people know about global climate change? 1. Mental models. *Risk Analysis, 14*(6), 959-970.
Bowers, J. (1980). Some thoughts on communication. *Disasters, 4*(1), 22-26.
Bradbury, J. A. (1989). The policy implications of differing concepts of risk. *Science Technology Human Values, 14*, 380-399.
Brashers, D., E. (2001). Communication and uncertainty management. *Journal of Commuication, 51*(3), 477-497.
Braun, K., & Kropp, C. (2010). Beyond speaking truth? Institutional responses to uncertainty in scientific governance. *Science Technology Human Values, 35*, 771-782.
Brett, C. (2011, 22-May). Christchurch three months on. *Stuff National News, www.stuff.co.nz*.
Brossard, D., & Lewenstein, B. V. (2010). A critical appraisal of models of public understanding of science. In L. Kahlor & P. A. Stout (Eds.), *Communicating Science: New Agendas in Communication* (pp. 11-39). New York: Routledge.
Brown, N. (2003). Hope against hype - accountability in biopasts, presents and futures. *Science Studies, 2*, 3-21.
Brown, P. H., & Minty, J. H. (2008). Media coverage and charitable giving after the 2004 tsunami. *Southern Economic Journal, 75*(1), 9-25.
Browne, S. H. (2009). Close textual analysis: approaches and applications. In J. A. Kuypers (Ed.), *Rhetorical Criticism: Perspectives in Action* (pp. 63-76): Lexington Books.
Brownlee, G. (2011, 26-Aug). Red zone offers 'extremely fair'. *The Press News, www.stuff.co.nz*.
Brugnach, M., Dewulf, A., Henriksen, H. J., & van der Keur, P. (2011). More is not always better: coping with ambiguity in natural resources management. *Journal of Environmental Management 92*, 78-84.
Brumbaugh, D. S. (2010). *Earthquakes: science and society* (2nd ed.): Prentice Hall.
Brundson, D., & Evans, N. (2003). Integrating lifelines engineering with emergency management: the New Zealand approach. In J. E. Beavers (Ed.), *Advancing mitigation technologies and disaster response for lifeline systems* (pp. 29-38). Virginia: American Society of Civil Engineers (ASCE).
Bruneau, M., Chang, S., Eguchi, R., G., L., O'Rourke, T., Reinhorn, A., . . . von Winterfeldt, D. (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake Spectra 19*, 733-752.
Brunn, S. D. (2010). Cartooning and googling god and natural disasters: Iceland's volcanic eruption and Haiti's earthquake. *Mitteilungen der Osterreichischen Geographischen Gesellschaft 152*, 251-275.
Brunsma, D., & Picou, J. S. (2008). Disasters in the twenty-first century: modern destruction and future instruction. *Social Forces, 87*(2), 983-991.
Bryant, J., & Miron, D. (2004). Theory and research in mass communication. *Journal of Communication, 54*, 662-704.
Bucchi, M., & Trench, B. (2008). *Handbook of public comunication of science and technology*. London: Routledge.
Buchanan, A. (2010, 28-Sep). Leading the world in quake engineering. *The Press News, www.stuff.co.nz*.
Buchanan, A. (2011, 28-Mar). Wrecked buildings are test specimens. *The Press News, www.stuff.co.nz*.
Bueguer, J. (2011, 23-Jun). Opinion: Christchurch will rise from the rubble and boom again. *Otago Daily Times, www.odt.co.nz*.
Buescu, H. C. (2006). Seeing too much: the 1755 earthquake in literature. *European Review 14*(3), 329-338.
Bui, E., Rodgers, R., Herbert, C., Franko, D., Simon, N., Birmes, P., & Brunet, A. (2012). The impact of internet coverage of the March 2011 Japan earthquake on sleep and post-traumatic stress symptoms: an international perspective. *American Journal of Psychiatry, 169*(2), 221-222.

Burby, R. J., Beatley, T., Berke, P. R., Deyle, R. E., French, S. P., Godschalk, D. R., . . . Platt, R. H. (1999). Unleashing the power of planning to create disaster-resistant communities. *Journal of American Plannig Association, 65*(3), 247-258.

Burger, J. M., & Palmer, M. L. (1992). Changes in and generalization of unrealistic optimism following experiences with stressful events: reactions to the 1989 California Earthquake. *Pers Soc Psychol Bull, 18*(1), 39-43.

Burgess, A. (2012). Media, risk, and absence of blame for acts of god: attenuation of the European volcanic ash cloud of 2010. *Risk Analysis, 32*(10), 1693-1702.

Burgess, D. (2011, 8-Sep). Wellington earthquake devastation would rival Christchurch. *Dominion Post News, www.stuff.co.nz*.

Burkhart, F. N. (1987). Experts and the press under stress: disaster journalism gets mixed reviews. *International Journal of Mass Emergencies and Disasters, 5*(3), 357-367.

Burton, I., Kates, R. W., & White, G. F. (1978). *The environment as hazard*. New York: Oxford University Press.

Butterfield, T. (2011, 18-Feb). Quake prediction 'like a horoscope'. *Marlborough Express, www.stuff.co.nz*.

Cacciatore, M. A., Scheufele, D. A., & Iyengar, S. (2016). The end of framing as we know it ... and the future of framing effects. *Mass Communication and Society, 19*, 7-23.

Cai, H., Liu, L., & Wang, L. (2011). Automated multiple hierarchical classification of web news of unexpected events. *Journal of Beijing University of Technology, 37*(6).

Cairns, L. (2011a, 3-Jul). Hunt on for more robust dwellings. *The Press News, www.stuff.co.nz*.

Cairns, L. (2011b, 14-Aug). Make buildings bounce - engineers. *The Press News, www.stuff.co.nz*.

Calais, E., Freed, A., Mattioli, G., Amelung, F., Jónsson, S., Jansma, P., . . . Momplaisir, R. (2010). Transpressional rupture of an unmapped fault during the 2010 Haiti earthquake. *Nature Geoscience, 3*, 794-799.

Caldwell, N., Clark, A., Clayton, D., Malhotra, K., & Reiner, D. (1979). An analysis of Indian press coverage of the Andhra Pradesh cyclone disaster of 19 November 1977. *Disasters, 3*(2), 154-168.

Calsamiglia, H. (2003). Popularization discourse. *Discourse Studies, 5*, 139-146.

Cardona, O. D. (2004). The need for rethinking the concepts of vulnerability and risk from a holistic perspective: a necessary review and criticism for effective risk management. In G. Bankoff, G. Frerks, & D. Hilhorst (Eds.), *Mapping vulnerability: disasters, development and people* (pp. 37-51). London: Earthscan.

Carey, J. M., & Burgman, M. A. (2008). Linguistic uncertainty in qualitative risk analysis and how to minimize it. *Annals of the New York Academy of Sciences, 1128*, 13-17.

CARMA. (2006). *The CARMA report on western media coverage of humanitarian disasters*. European Offices of CARMA International, 17p.

Carr, L. J. (1932). Disaster and the sequence-pattern concept of social change. *American Journal of Sociology, 38*(2), 207-218.

Carragee, K. M., & Roefs, W. (2004). The neglect of power in framing research. *Journal of Communication, 54*(2), 215-233.

Carter, T. M. (1980). *Community warning systems: the relationships among the broadcast media, emergency service agencies, and the national weather service.* Paper presented at the Disasters and the Mass Media Conference, February 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 214-228.

Carvalho, A. (2007). Idealogical cultures and media discourses on scientific knowledge: re-reading news on climate change. *Public Understanding of Science, 16*, 223-243.

Carville, O. (2011a, 26-Aug). Royal commission hearings start in October. *The Press News, www.stuff.co.nz*.

Carville, O. (2011b, 29-Aug). Turtles Christchurch earthquake - Spreydon school. *The Press News, www.stuff.co.nz*.

Carville, O. (2011c, 13-Dec). Earthquake risk closes Canterbury hospital buildings. *Stuff National News, www.stuff.co.nz*.

Cassidy, A. (2008). Communicating the social sciences. In M. Bucchi & B. Trench (Eds.), *Handbook of Public Communication of Science and Technology* (pp. 225-236). London: Routledge.
Castells, M. (2010). *Communication power*: OUP Oxford.
Castilla, J. C., Manriquez, P. H., & Camano, A. (2010). Effects of rocky shore coseismic uplift and the 2010 Chilean mega-earthquake on intertidal biomarker species. *Marine Ecology, 418*, 17-23.
Cate, F. H. (1994). *The media and disaster reduction*. Roundtable on the media, scientific information and disasters at the United Nations World Conference on Natural Disaster Reduction.
CDEM. (2008). *National Civil Defence Emergency Management Strategy 2007.* Ministry of Civil Defence & Emergency Management with Department of Internal Affairs. Wellington, New Zealand.
CDEM. (2010). *Working from the same page: consistent messages for CDEM part B: hazard-specific information earthquakes. Ministry of Civil Defence & Emergency Management, New Zealand. 14p*.
Cerroni, A. (2006). *Science and knowledge society*. Utet, Turin.
Cerroni, A. (2007). Individuals, knowledge and governance in the 21st century. *Journal of Science Communication, 6*((4)).
Chacko, H. E., & Marcell, M. H. (2008). Repositioning a tourism destination - the case of New Orleans after Hurricane Katrina. *Journal of Travel & Tourism Marketing, 23*(2), 223-235.
Chaffee, S. H., & Rosert, C. (1986). Involvement and the consistency of knowledge, attitudes, and behaviors. *Communication Research, 13*(13), 379-399.
Chambers, R., & Henderson, R. (2011). An overview of the Canterbury District Health Board mental health service's response to the 2010-2011 Canterbury earthquakes. *New Zealand Journal of Psychology, 40*(4), 70-75.
Chan, K. L., & Zhang, Y. (2011). Female victimization and intimate partner violence after the May 12, 2008, Sichuan earthquake. *Violence and Victims, 26*(3), 364-376.
Chapman, K. (2011, 25-Feb). My hometown can be rebuilt - Brownlee. *The Press News, www.stuff.co.nz*.
Chen, H., Wu, N., Yuan, X., Gao, Y., & Zhu, D. (2009). Aftermath of the Wenchuan earthquake. *Frontiers in Ecology and the Environment, 7*(2), 72.
Chen, N. (2009). Institutionalizing public relations: a case study of Chinese government crisis communication on the Sichuan earthquake. *Public relations review, 35*, 187-198.
Chin, D. (2010, 25-Sep). Standards process robust. *The Press News, www.stuff.co.nz*.
Cho, S. H., & Gower, K. K. (2006). Framing effect on public's response to crisis: human interest frame and crisis type influencing responsibility and blame. *Public Relations Review, 32*(4), 420-422.
Choi, Y., & Lin, Y. (2008). A content analysis of the newspaper coverage of the three major hurricanes in 2005. *Public Relations Review, 34*, 294-296.
Chong, D., & Druckman, J. N. (2007a). Framing public opinion in competitive democracies. *American Political Science Review, 101*, 637-655.
Chong, D., & Druckman, J. N. (2007b). Framing theory. *Annual Review of Political Science, 10*, 103-126.
Christchurch Engineering Lifelines Group. (1997). *Risks and realities: a multi-disciplinary approach to the vulnerability of lifelines to natural hazards*. Retrieved from Christchurch, New Zealand:
Christoplos, M. J., & Liljelund, A. (2001). Re-framing risk: the changing context of disaster mitigation and preparedness. *Disasters, 25*(3), 185-198.
Chryssochoidis, G., Strada, A., & Krystallis, A. (2009). Public trust in institutions and information sources regarding risk management and communication: towards integrating extant knowledge. *Journal of Risk Research, 12*(2), 137-185.
Chug, K. (2011a, 2-Mar). Silt from Christchurch harbours unknown dangers. *The Press News, www.stuff.co.nz*.

Chug, K. (2011b, 25-Feb). Pain, fear, despair - and dehydration. *Stuff National News, www.stuff.co.nz*.

Chug, K. (2011c, 16-Mar). New Zealand safe from Japanese radiation. *The Press News, www.stuff.co.nz*.

Churchman, C. W. (1967). Guest editorial: wicked problems. *Management Science, 14*(4), B141-B142.

Cioccio, L., & Michael, E. J. (2007). Hazard or disaster: tourism management for the inevitable in Northeast Victoria. *Tourism Management, 28*(1), 1.

Clark, L., V., Veneziano, L., & Atwood, D. (1993). Situational and dispositional determinants of cognitive and affective reactions to the New Madrid earthquake prediction. *International Journal of Mass Emergencies and Disasters, 11*(3), 323-335.

Coburn, A. W., Spence, R. J. S., & Pomonis, A. (1994). *Vulnerability and risk assessment*. The Oast House Malting Lane Cambridge United Kingdom: Cambridge Architectural Research Limited.

Cocco, M., Cultrera, G., Amato, A., Braun, T., Cerase, A., Margheriti, L., . . . Todesco, M. (2015). The L'Aquila trial. In S. Peppoloni & G. Di Capua (Eds.), *Geoethics: the role and responsibility of geoscientists* (Vol. 419, pp. 43-55). London: Geological Society Special Publications.

Coetzee, C., & van Niekerk, D. (2012). Tracking the evolution of the disaster management cycle: a general system theory approach. *Jàmbá: Journal of Disaster Risk Studies, 4*(1), 9.

Cohen, E. L., Ball-Rokeach, S. J., Jung, J., & Kim, Y. C. (2002). Civic actions after September 11: exploring the role of multi-level storytelling. *Prometheus, 20*, 221-228.

Cohn, V. (1990). *Reporting on risk: getting it right in an age of risk*. Washington, DC: The Media Institute.

Coleman, C. (1993). The influence of mass media and interpersonal communication on societal and personal risk judgments. *Communication Research, 20*, 611.

Collins, S., Glavovic, B. C., Johal, S., & Johnston, D. M. (2011). Community engagement post-disaster: case studies of the 2006 Matata debris flow and the 2010 Darfield earthquake, New Zealand. *New Zealand Journal of Psychology, 2011*(40), 4.

Comfort, L. K., McAdoo, B., Sweeney, P., Stebbins, S., Siciliano, M. D., Huggins, L. J., . . . Krenitsky, N. (2011). Transition from response to recovery: a knowledge commons to support decision making following the 12 January 2010 Haiti earthquake. *Earthquake Spectra, 27*, S411-S430.

Conklin, W. A., & Dietrich, G. (2010). *Emergency communications using the web: matching media richness to the situation.* Paper presented at the Proceedings of the 43rd Hawaii International Conference on System Sciences Hawaii, 1-9.

Connell, C. (2011, 27-Aug). Big earthquake well overdue. *Marlborough Express, www.stuff.co.nz*.

Contreras, C. (2010). The hidden landscape of rubble. *Revista 180, 25*, 20-23.

Conway, G. (2010, 10-Nov). Building could have been saved/engineer. *The Press News, www.stuff.co.nz*.

Cooper, C. P., & Yukimara, D. (2001). Science writers' reactions to a medical "breakthrough" story. *Social Science & Medicine, 54*(12), 1887-1896.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., . . . van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*, 253-260.

Cotter, K., J. (2011). Selected resources on the Fukushima disaster. *Journal of Consumer Health On the Internet, 15*(4), 338-346.

Cottle, S. (2000). TV news, lay voices and the visualisation of environmental risks. In S. S. Allan, B. Adam, & C. Carter (Eds.), *Environmental risks and the media* (pp. 29-44). London: Routledge.

Covello, V. T., McCallum, D. B., & Pavlova, M. T. (1989). Principles and guidelines for improving risk communication. In V. T. Covello, D. B. McCallum, & M. T. Pavlova (Eds.), *Effective risk communication. The role and responsibility of the government and nongovernment organisations.* (pp. 3-16). New York: Plenum.

Cowan, H., Beattie, G., Hill, K., Evans, N., McGhie, C., Gibson, G., . . . Smith, P. (2011). The M8.8 Chile earthquake, 27 February 2010. *Bulletin of the New Zealand Society for Earthquake Engineering, 44*(3), 123-166.
Cowan, H., Middleton, D., & Hooper, G. (2009). Connections between research and resilience: the role of EQC. *Tephra: NZ Ministry of Civil Defence and Emergency Management Science and Education publication, 22*, 21-30.
Cowan, H., & Simpson, I. (2011). *Planning for disasters and responding to unforeseen complexity: the first large test for the New Zealand Earthquake Commission. Conference - Catastrophic Complexity. Aon Benfield Australia Limited.* Paper presented at the Catastrophic Complexity.
Cowan, J., McClure, J., & Wilson, M. (2002). What a difference a year makes: how immediate and anniversary media reports influence judgments about earthquakes. *Asian Journal of Social Psychology, 5*, 169-185.
Cowlishaw, S. (2010, 21-Oct). Quake land report released. *Stuff National News, www.stuff.co.nz*.
Cowlishaw, S. (2011, 5-Mar). Baker who predicted quake a 'great guy': colleague. *The Press News, www.stuff.co.nz*.
Cox, R., S., Long, B., C., Jones, M. I., & Handler, R., J. (2008). Sequestering of suffering: critical discourse analysis of natural disaster media coverage. *Journal of Health Psychology, 13*, 469-480.
CRED. (2012). EM-DAT Database. Centre for Research on the Epidemiology of Disasters Accessed from http://www.cred.be on 05 December 2012
Cronin, K. (2003). The ethics of risk communication. In J. Gough (Ed.), *Sharing the tuture: risk communication in practice* (pp. 73-84). Christchurch: Centre for Advanced Engineering, University of Canterbury.
Cronin, S. J., Petterson, M. G., Taylor, P. W., & Biliki, R. (2004). Maximising multi-stakeholder participation in government and community volcanic hazard management programs; a case study from Savo, Solomon Islands. *Natural Hazards, 33*, 105-136.
Crosson, S. (2010, 01-Oct-2010). Opinion: Faith and reason: 'It's a miracle nobody was killed'. *Otago Daily Times, www.odt.co.nz*.
Crozier, M., McClure, J., Vercoe, J., & Wilson, M. (2006). The effects of hazard zone information on judgments about earthquake damage. *Area, 38*(2), 143.
Curran, J., & Gurevitch, M. (2005). Introduction. In J. Curran & M. Gurevitch (Eds.), *Mass media and society (4th ed.)*. London: Hodder Education.
Cutter, S. L. (1996). Vulnerability to environmental hazards. *Progress in Human Geography, 20*(4), 529-539.
Cutter, S. L., Burton, C. G., & Emrich, C. T. (2010). Disaster resilience indicators for benchmarking baseline conditions. *Journal of Homeland Security and Emergency Management, 7*(1).
Cuzens, S., Coward, D., Galloway, C., Henriod, E., Hosken, K., Selkeld, D., & Wood, M. (2007). Planning and delivery. In J. Tully (Ed.), *Challenging the future: connecting the words in risk communication* (pp. 49-80). Christchurch: New Zealand Centre for Advanced Engineering.
Dabner, N. (2012). ‘Breaking ground’ in the use of social media: a case study of a university earthquake response to inform educational design with Facebook. *Internet and Higher Education, 15*, 69-78.
Dahlgren, P. (2005). Television, public spheres, and civic cultures. In J. Wasko (Ed.), *A companion to television* (pp. 411-432). Malden, MA and Oxford: Blackwell.
Daly, M., Becker, J. S., Parkes, B., Johnston, D. M., & Paton, D. (2009). Defining and measuring community resilience to disasters: a case study from Auckland. *Tephra: NZ Ministry of Civil Defence and Emergency Management Science and Education publication, 22*, 15-20.
Dalziel, L. (2011, 1-Nov). Lianne Dalziel: Friday release 'buries' land report. *The Press News, www.stuff.co.nz*.
Davis, C., Keilis-Borok, V., Kossobokov, V., & Soloviev, A. (2012). Advance prediction of the March 11, 2011 Great East Japan Earthquake: a missed opportunity for disaster preparedness. *International Journal of Disaster Risk Reduction, 1*, 5-20.

Davis, I. (2011). Reducing disaster risks 1980–2010: Some reflections and speculations. *Environmental Hazards, 10*(1), 80-92.
Davis, I., & Bellers, R. (1995). Communicating knowledge from academic researchers to the local level. *Stop Disasters, 26*, 18.
DBH. (2005). *Earthquake-prone building provisions of the Building Act 2004: policy guidance for territorial authorities*. Department of Building and Housing, Wellington, New Zealand. 32p.
de Jesus, J. (1995). *The Philippines after the 1990 quake and the Pinatubo eruptions*. Paper presented at the Wellington after the quake; the challenge of rebuilding cities Conference, Wellington, 27-29 March 1995. Earthquake Commission, Wellington and the Centre for Advanced Engineering, Christchurch, New Zealand. 209-214.
De la Cruz-Reyna, S., & Tilling, R. I. (2008). Scientific and public responses to the ongoing volcanic crisis at Popocatepetl Volcano, Mexico: importance of an effective hazards-warning system. *Journal of Volcanology and Geothermal Research, 170*(1-2), 121-134.
de Marchi, B. (1991). Effective communication between the scientific community and the media. *Disasters, 15*(3), 238-243.
de Marchi, B., & Ravetz, J. R. (1999). Risk management and governance: a post-normal science approach. *Futures, 31*(7), 743-757.
De Ville de Goyet, C. (1999). Stop propagating disaster myths (editiorial). *Prehospital Disaster Medicine, 14*(4), 9.
De Ville de Goyet, C. (2004). Editorial: Epidemics caused by dead bodies: a disaster myth that does not want to die. *Pan American Journal Public Health, 15*, 297-299.
Dearing, J. W. (1995). Newspaper coverage of maverick science; creating controversy through balancing. *Public Understanding of Science, 4*, 341-361.
Dearing, J. W., & Kazmierczak, J. (1993). Making iconoclasts credible: the Iben Browning earthquake prediction. *International Journal of Mass Emergencies and Disasters, 11*(3), 391-403.
Dearing, J. W., & Rogers, E. M. (1996). *Agenda setting*. London, United Kingdom: Sage.
Denis, H. (1995). Scientists and disaster management. *Disaster Prevention and Management, 4*(2), 14-19.
Department of Conservation California. (2014). Earthquake mythology or... don't believe everything you hear! Retrieved from http://www.conservation.ca.gov/index/Earthquakes/Pages/qh_earthquakes_myths.aspx on 14 November 2014
Deresiewicz, H. (1982). Some sixteenth century European earthquakes as depicted in contemporary sources. *Bulletin of the Seismological Society of America, 72*(2), 507-523.
Dieckmann, N., F., Slovic, P., & Peters, E. (2009). The use of narrative evidence and explicit likelihood by decisionmakers varying in numeracy. *Risk Analysis, 29*(10), 1473-1487.
Dillman, D. A. (2000). *Mail and internet surveys: the total design method* (2nd ed.). New York: Wiley.
Dillman, D. A., Schwalbe, M. L., & Short, J. F. (1980). Communication behavior and social impacts following the May 18, 1980 eruption of Mount St. Helens. In S. A. C. Keller (Ed.), *Mt. St. Helens: three years later* (pp. 173-179). Washington State University: Pullman, WA.
Djalante, R., Holley, C., & Thomalla, F. (2011). Adaptive governance and managing resilience to natural hazards. *International Journal of Disaster Risk Science, 2*(4), 1-14.
Dohaney, J., Brogt, E., Kennedy, B., & Wilson, T. M. (2015). Training in crisis communication and volcanic eruption forecasting: design and evaluation of an authentic role-play simulation. *Journal of Applied Volcanology, 4*(12), 26p.
Dornan, C. (1990). Some problems in conceptualizing the issue of 'science and the media'. *Critical Studies in Mass Communication, 7*, 48-71.
Douglas, M. (1985). *Risk acceptability according to the social sciences*. New York: Russell, Sage.
Downs, A. (1972). Up and down with ecology: the issue attention cycle. *The Public Interest, 28*(2), 38-50.

Doyle, E. E. H., Johnston, D. M., McClure, J., & Paton, D. (2011). The communication of uncertain scientific advice during natural hazard events. *New Zealand Journal of Psychology, 40*(4), 39-50.
Drabeck, T. E., & Quarantelli, E. L. (1967). Scapegoats, villains, and disasters. *Society, 4*, 12-17.
Drabek, T. E. (1979). Communication: key to disaster management. *Insight, 3*, 3-4.
Driessens, O., Joye, S., & Biltereyst, D. (2012). The X-factor of charity: a critical analysis of celebrities' involvement in the 2010 Flemish and Dutch Haiti relief shows. *Media Culture Society, 34*, 709-725.
Driscoll, P., & Salwen, M. B. (1996). Riding out the storm: public evaluations of news coverage of Hurricane Andrew. *International Journal of Mass Emergencies and Disasters, 14*(3), 293-303.
Druckman, J., N., & Bolsen, T. (2011). Framing, motivated reasoning, and opinions about emergent technologies. *Journal of Communication 61*, 659–688.
Drury, A. C., Olson, R. S., & Van Belle, D. A. (2005). The politics of humanitarian aid: US foreign disaster assistance, 1964-1995. *Journal of Politics, 67*, 454-473.
Dryzek, J. S. (2000). *Deliberative democracy and beyond. Liberalism, critics, contestations*. Oxford: Oxford University Press.
Dudding, A. (2011, 28-Aug). The year the earth shook. *The Press News, www.stuff.co.nz*.
Dunal, C., Gaviria, M., Flaherty, J., & Birz, S. (1985). Perceived disruption and psychological distress among flood victims. *Journal of Operational Psychiatry, 16*(2), 9-16.
Dunwoody, S., & Neuwirth, K. (1991). Coming to terms with the impact of communication on scientific and technological risk judgments. In L. Wilkins & P. Patterson (Eds.), *Risky business: communicating issues of science, risk and public policy* (pp. 11-30). New York: Greenwood.
Dutt, B., & Garg, K. C. (2000). An overview of science and technology coverage in Indian English-language dailies. *Public Understanding of Science, 9*, 123-140.
Duval, T. S., & Mulilis, J. (1999). A person-relative-to-event (PrE) approach to negative threat appeals and earthquake preparedness: a field study. *Journal of Applied Social Psychology, 29*(3), 495-516.
Dwyer, A., Zoppou, C., Nielsen, O., Day, S., & Roberts, S. (2004). Quantifying social vulnerability; a methodology for identifying those at risk to natural hazrds. *Geoscience Australia Record, 14*.
Dynes, R. R. (1998). Coming to terms with community disaster. In E. L. Quarantelli (Ed.), *What is a disaster: perspectives on the question* (pp. 109-126). New Yourk: Routledge.
Dynes, R. R., & Quarantelli, E. L. (1992). *Behaviour in disaster and implications for the insurance industry*. University of Delaware Disaster Research Centre Miscellaneous Report.
Dzierma, Y., & Wehrmann, H. (2010). Statistical eruption forecast for the Chilean Southern Volcanic Zone: typical probabilities of volcanic eruptions as baseline for possibly enhanced activity following the large 2010 Concepcion earthquake. *Natural Hazards Earth Systems Sciences, 10*, 2093-2108.
Easton, P. (2011, 14-Mar). NZ safe from nuclear fallout. *Dominion Post News, www.stuff.co.nz*.
ECAN. (2007a). *The Q files: liquefaction - the solid facts*. Environment Canterbury and Canterbury Civil Defence & Emergency Management Group, New Zealand, 9p.
ECAN. (2007b). *The Q files: tsunamis*. Environment Canterbury and Canterbury Civil Defence & Emergency Management Group, New Zealand, 14p.
ECAN. (2008a). *The Q files: defining moments in nature - natural event, natural disasters, natural hazards and risk*. Environment Canterbury and Canterbury Civil Defence & Emergency Management Group, New Zealand,16p.
ECAN. (2008b). *The Q files: earthquakes*. Environment Canterbury and Canterbury Civil Defence & Emergency Management Group, New Zealand, 14p.
Echevarría, J., A., Norton, K., A., & Norton, R. D. (1986). The socio-economic consequences of earthquake prediction: a case study in Peru. *Earthquake Prediction Research, 4*, 175-193.
Edgerton, G. (2000). Television as historian: an introduction. *Film & History, 30*(1), 7-12.
Editor's note, t. L. G. a. (2011). How communities in Christchurch have been coping with their earthquake. *New Zealand Journal of Psychology, 40*(4), 130.

Editorial. (2011, 07-Mar). National Party: Counting the political aftershocks. *Otago Daily Times, www.odt.co.nz*.

Eide, M., & Knight, G. (1999). Public/private service: service journalism and the problems of everyday life. *European Journal of Communication, 14*(4), 525-547.

Einsiedel, E. (2008). *Public participation and dialogue*. London: Routledge.

Einsiedel, E., & Thorne, B. (1999). Public responses to uncertainty. In S. M. Friedman, S. Dunwoody, & C. Rogers (Eds.), *Public responses to uncertainty: media coverage of new and controversial science* (pp. 43-59). Mahwah, NJ: Lawrence Erlbaum.

Eisensee, T., & Strömberg, D. (2007). News droughts, news floods and US disaster relief. *The Quarterly Journal of Economics, 122*(2), 693-728.

Eiser, J. R., Bostrom, A., Burton, I., Johnston, D. M., McClure, J., Paton, D., . . . White, M. (2012). Risk interpretation and action: a conceptual framework for responses to natural hazards. *International Journal of Disaster Risk Reduction, 1*, 5-12.

EM-DAT. (2014). EM-DAT: the OFDA/CRED international disaster database. Universite Catholique de Louvain, Brussels, Belgium: Centre for Research on the Epidemiology of Disasters (CRED). Retrieved 5 January 2014 from http//www.emdat.be.

Enders, J. (2001). Measuring community awareness and preparedness for emergencies. *Australian Journal of Emergency Management,, Spring*, 52-58.

Endres, D. (2010). Expanding notions of scientific argument. In L. Kahlor & P. A. Stout (Eds.), *Communicating science: new agendas in communication* (pp. 187-208). New York: Routledge.

Engel, D., Jaffe, C., & Scherer, C. (1996). *Social and scientific conceptualisations of risk in the mass media*. Paper presented at the Society for Risk Analysis annual meeting 1996.

Entman, R. M. (1991). Framing U.S. coverge of international news: contrasts in narratives of the KAL and Iran air incidents. *Journal of Communication, 41*, 6-27.

Entman, R. M. (1993). Framing: toward clarification of a fractured paradigm. *Journal of Communication, 43*, 51-58.

Entman, R. M. (2004). *Projections of power: framing news, public opinion, and U.S. foreign policy*. Chicago, IL: University of Chicago.

EQC & CAENZ. (1995). *Wellington after the 'quake: the challenge of rebuilding cities*. Proceedings of a conference held in Wellington, New Zealand, 27-29 March 1995. Earthquake Commission and Centre for Advanced Engineering New Zealand, 84p.

Espiner, C. (2010, 01-Mar). The boy who cried tsunami. *The Press News, www.stuff.co.nz*.

Evans, W., & Hornig Priest, S. (1995). Science content and social context. *Public Understanding of Science, 4*, 327-340.

Eyre, A. (2006). Remembering: community commemoration after disaster. In H. Q. Rodriguez, Enrico L.; Dynes, Russell (Ed.), *Handbook of disaster research* (pp. 441-455): Springer.

Fahnestock, J. (1986). Accomodating science: the rhetorical life of scientific facts. *Written Communication, 3*, 275-296.

Fairfax NZ News. (2010a, 27-Jul). Quake policy nears completion. *The Press, www.stuff.co.nz*.

Fairfax NZ News. (2010b, 6-Sep). Quake - govt gives $5 million. *The Press News, www.stuff.co.nz*.

Fairfax NZ News. (2010c, 6-Sep). Quake: what's working. *Stuff National News, www.stuff.co.nz*.

Fairfax NZ News. (2010d, 7-Sep). Taranaki buildings solid and safe - architect. *Taranaki Daily Times, www.stuff.co.nz*.

Fairfax NZ News. (2010e, 16-Sep). Quake - Surge in heart attacks. *Stuff National News, www.stuff.co.nz*.

Fairfax NZ News. (2011a, 2-Mar). Christchurch earthquake: Latest news - Wednesday. *The Press News, www.stuff.co.nz*.

Fairfax NZ News. (2011b, 8-Mar). Satellite shows Christchurch earthquake's ripples in earth. *The Press News, www.stuff.co.nz*.

Fairfax NZ News. (2011c, 14-Mar). Where is the safest place to live in NZ? *Dominion Post News, www.stuff.co.nz*.

Fairfax NZ News. (2011d, 3-Apr). Tsunami warning too costly for NZ. *Stuff National News, www.stuff.co.nz*.

Fairfax NZ News. (2011e, 6-Apr). Deal with earthquake jitters front on. *Dominion Post News, www.stuff.co.nz*.
Fairfax NZ News. (2011f, 11-May). 40-tonne boulder exploded off hillside. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011g, 16-May). Quality of drinking water unchanged. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011h, 27-May). 'Turtle safe' DVD for preschoolers. *Stuff National News, www.stuff.co.nz*.
Fairfax NZ News. (2011i, 14-Jul). Time right for innovative engineers. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011j, 3-Aug). Ask an Expert/ where does liquefaction come from. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011k, 3-Aug). Homeowners ignore safety notices. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011l, 26-Aug). Gerry Brownlee defends red zone decisions. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011m, 30-Aug). Earthquake Commission out of cash. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011n, 2-Sep). Earthquake ID process 'should be streamlined'. *The Press News, www.stuff.co.nz*.
Fairfax NZ News. (2011o, 30-Sep). 'Exceptional' shaking caused PGC collapse. *The Press News, www.stuff.co.nz*.
Farley, J. E. (1993). Public, media, and insitutional responses to the Iben Browning earthquake prediction. *International Journal of Mass Emergencies and Disasters, 11*(3), 271-277.
Farley, J. E., Barlow, H. D., Finkelstein, M. S., & Riley, L. (1993). Earthquake hysteria, before and after: a survey and follow-up on public response to the Browning forecast. *International Journal of Mass Emergencies and Disasters, 11*(3), 305-321.
Fasoyiro, L. (2009). Invoking the act of god defense. *Fasoyiro L. Invoking the act of god defense. Environmental and Energy Law and Policy Journal, 2009; 3(2):1–33., 3*(2), 1-33.
Faulkner, H., & Ball, D. (2007). Environmental hazards and risk communication. *Environmental Hazards, 7*(2), 71-78.
Fawcett, J. (2011). Organisational and cultural factors that promote coping: with reference to Haiti and Christchurch. *New Zealand Journal of Psychology, 40*(4), 64-69.
Fea, S. (2011, 24-Aug). Post-quake fear 'a missed opportunity'. *Southland Times, www.stuff.co.nz*.
Fearn-Banks, K. (2002). *Crisis communications*. Mahwah, NT: Lawrence Erlbaum Associates, Inc.
Feindt, P. H., & Kleinschmit, D. (2011). The BSE crisis in German newspapers: reframing responsibility. *Science as Culture, 20*(2), 183-208.
Fenwick, T. (2012). *The value of lifelines seismic risk mitigation in Christchurch*. Report commissioned by the New Zealand Earthquake Commission under its 'Science-to-Practice' Programme. New Zealand: NZ Lifelines.
Ferreira, C. (2004). Risk, transparency and cover up: media narrative and cultural resonance. *Journal of Risk Research, 7*(2), 199-211.
Field, M. (2009, 08-May). 'Big one' not coming yet. *Stuff National News, www.stuff.co.nz*.
Fielding, E. J., Lundgren, P. R., Bürgmann, R., & Funning, G. J. (2009). Shallow fault-zone dilatancy recovery after the 2003 Bam earthquake in Iran. *Nature, 458*(7234), 64-68.
Finkel, A. M. (2011). "Solution-focused risk assessment": a proposal for the fusion of environmental analysis and action. *Human and Ecological Risk Assessment: An International Journal, 17*(4), 754-787.
Finnis, K. (2004). *Creating a resilient New Zealand: can public education and community development campaigns create prepared communities? An examination of preparedness motivation strategies Ministry of Civil Defence and Emergency Management*. Wellington: Ministry of Civil Defence and Emergency Management, 113p.
Fioravanti, C., & Velho, L. (2010). Let's follow the actors! Does actor-network theory have anything to contribute to science journalism. *Journal of Science Communication, 9*(4), A02.
Fiorino, D. J. (1989). Technical and democratic values in risk analysis. *Risk Analysis, 9*, 293-299.

Fischer, H. W. (1994). *Response to disaster: fact versus fiction and its perpetuation: the sociology of disaster*. New York: University Press of America.
Fischhoff, B. (1995). Risk perception and communication uplugged: twenty years of process. *Risk Analysis, 15*, 137-145.
Fischhoff, B. (2006). The psychological perception of risk *The McGraw-Hill Homeland Security Handbook* (pp. 463-492). New York.
Fischhoff, B., Slovic, P., & Lichtenstein, S. (1982). Lay foibles and expert fables in judgments about risk. *American Statistician, 36*, 240-255.
Fischhoff, B., Waton, S., & Hope, C. (1984). Defining risk. *Policy Sciences, 17*, 123-139.
Fisher, A. (1991). Risk communication challenges. *Risk Analysis, 11*(2), 173-179.
Fisher, A. (2011, 1-Mar). Many not prepared for big earthquake. *The Press News, www.stuff.co.nz*.
Fisher, W. R. (1985a). Homo narrans the narrative paradigm: in the beginning. *Journal of Communication (pre-1986); New York, 35*, 74.
Fisher, W. R. (1985b). The narrative paradigm: an elaboration. *Communication Monographs, 52*, 347-367.
Fisher, W. R. (1988). The narrative paradigm and the interpretation and assessment of historical texts. *Journal of the American Forensic Association, 25*, 50-53.
Fleetwood, N., R. (2006). Failing narratives, initiating technologies: Hurricane Katrina and the production of a weather media event. *American Quarterly, 58*(3), 767-789.
Fluchter, W. (2011). The eastern Japan great earthquake disaster 2011 and the options of a risk society. *Geographische Rundschau, 63*(12), 52-59.
Fortin, I., & Pierre, Y.-F. (2011). Reform of the national police and building democracy in Haiti. *Canadian Journal of Development Studies, 32*(1), 64-78.
Fothergill, A. (2000). Knowledge transfer between researchers and practitioners. *Natural Hazards Review, 1*, 91-98.
Fox, A. (2011, 1-Mar). Earthquake stronger than building code. *Business Day, www.stuff.co.nz*.
Fox, M. (2011, 14-Mar). Return of Christchurch earthquake evacuees to stretch services. *Dominion Post News, www.stuff.co.nz*.
Frankelius, P. (2009). Questioning two myths in innovation literature. *Journal of High Technology Management Research, 20*, 40-51.
Franks, S. (2006). The CARMA report: western media coverage of humanitarian disasters. *The Political Quarterly, 77*(2), 282-284.
Freudenberg, W. R., Gramling, R., Laska, S., & Erikson, K., T. (2008). Organizing hazards, engineering disasters? Improving the recognition of political-economic factors in the creation of disasters. *Social Forces, 87*, 101538.
Freudenburg, W. R., Coleman, C., Gonzales, J., & Heigeland, C. (1996). Media coverage of hazard events: analyzing the assumptions. *Risk Analysis, 16*(1), 31-42.
Freudenburg, W. R., Frickel, S., & Gramling, R. (1995). Beyond the nature/society divide: learning to think about a mountain. *Sociological Forum, 10*(3), 361-392.
Frewer, L. J., Scholderer, J., & Bredahl, L. (2003). Communicating about the risks and benefits of genetically modified foods: the mediating role of trust. *Risk Analysis, 23*(6), 111733.
Frewer, L. J., & Shepherd, R. G. (1994). Attributing information to different sources: effects on the perceived qualities of information, on the perceived relevance of information and effects on attitude formation. *Public Understanding of Science, 3*, 385-401.
Friedman, S. M. (1994). The media, risk assessment and numbers: they don't add up. *Health, Safety & Environment, 5*(3), 203-212.
Friedman, S. M., Dunwoody, S., & Rogers, C. L. (1986). Introduction. In S. M. Friedman, S. Dunwoody, & C. L. Rogers (Eds.), *Scientists and journalists: reporting science as news* (pp. xi-xvii). New York: Free Press.
Fu, K., White, J., Chan, Y.-y., Zhou, L., Zhang, Q., & Lu, Q. (2010). Enabling the disabled: media use and communication needs of people with disabilities during and after the Sichuan earthquake in China. *International Joural of Emergency Management, 7*(1), 75-87.
Fu, K., Zhou, L., Zhang, Q., Chan, Y., & Burkhart, F. (2012). Newspaper coverage of emergency response and government responsibility in domestic natural disasters: China-US and within-China comparisons. *Health, Risk & Society, 14*(1), 71-85.

Fuchs, S., Birkmann, J., & Glade, T. (2012). Vulnerability assessment in natural hazard and risk analysis: current approaches and future challenges. *Natural Hazards, 64*(3), 1969-1975.

Funkhouser, G. R., & Maccoby, N. (1971). Communicating specialized science information to a lay audience. *Journal of Communication, 21*(1), 35-47.

Funkhouser, G. R., & Maccoby, N. (1974). An experimental study in communicating specialized science information to a lay audience. *Communication Research, 1*, 110-128.

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures, 25*, 739-755.

Furedi, F. (2007). From the narrative of the blitz to the rhetoric of vulnerability. *Cultural Sociology, 1*(235-254).

Futurescape-Global-Ltd. (2012). *Earthquake coverage: Presspass reader panel monthly survey prepared for The Press*. New Zealand, 49p.

Gabrielli, F., & Di Bucci, D. (2014). Comment on "Communicating earthquake risk to the public: the trial of the 'L'Aquila Seven'" by David E. Alexander. *Natural Hazards, 75*(1), 991-998.

Gaddy, G. D., & Tanjong, E. (1986). Earthquake coverage by the Western Press: Testing Geographical Bias in International News. *Journal of Communication, 36*(2), 1052.

Gall, M. (2012). A seismic shift: public participation in the legislative response to the Canterbury Earthquakes. *Canterbury Law Review, 12*, 232-243.

Gamper, C. D., & Turcanu, C. (2009). Can public participation help managing risks from natural hazards? *Safety Science, 47*(4), 522-528.

Gamson, W. A. (1989). News as framing: comments on Graber. *American Behavioural Scientist, 33*, 157-161.

Gamson, W. A., & Modigliani, A. (1989a). Media discourse and public opinion on nuclear power: a constructionist approach. *American Journal of Sociology, 95*, 1-37.

Gamson, W. A., & Modigliani, A. (1989b). Media discourse as a symbolic contest: a constructionist approach. *American Journal of Sociology, 95*, 1-37.

Gargiulo, T. L. (2005). *Strategic use of stories in organizational, communication learning*. Armonk, NY: M.E. Sharpe.

Garnett, J., & Kouzmin, A. (2009). Crisis communication post Katrina: what are we learning? *Public Organization Review, 9*, 385-398.

Garnett, J. D., & Moore, M. (2010). Enhancing disaster recovery: lessons from exemplary international disaster management practices. *Journal of Homeland Security and Emergency Management, 7*(1), 1-20.

Gascoigne, T. (2008). Science advocacy: challenging task, difficult pathways *D. Cheng et al (Eds). Communicating Science in Social Contexts* (pp. 227-241). Netherlands: Springer.

Gascoigne, T., Cheng, D., Claessens, M., Metcalfe, J., Schiele, B., & Shu, S. (2010). Is science communciation its own field? *Journal of Science Communication, 9*(3), C04.

Gastil, J. (2008). *Political communication and deliberation*. Thousand Oaks, CA: Sage Publications.

Gates, C. (2011a, 3-Jul). City rebuild will take 15 to 20 years. *The Press News, www.stuff.co.nz*.

Gates, C. (2011b, 4-Nov). Christ Church cathedral: scale of demolition uncertain. *The Press News, www.stuff.co.nz*.

Gates, C. (2011c, 19-Dec). Architects 'ignored' by council. *The Press News, www.stuff.co.nz*.

Gates, C., & Carville, O. (2011, 9-Sep). Earthquake-strengthening steel rods failed in Christchurch. *The Press News, www.stuff.co.nz*.

Geenen, E. M. (2008). Katastrophenvorsorge - Katastrophenmanagement. In C. Gentreff & T. Glade (Eds.), *Naturrisken und Socialkatastrophen* (pp. 225-239). Berlin und Heidelberg: Spektrum Akademischer Verlag.

Gelernter, J., & Mushegian, N. (2011). Geo-parsing messages from microtext. *Transactions in GIS, 15*(6), 753-773.

Gibb, J. (2011, 27 April). Science show now not likely to tour. *Otago Daily Times, www.odt.co.nz*.

Gilbert, J. (2011, 21-Mar). Skeptics take aim at Moon Man (in *Dominion Post* Moon Man's quake prediction no great shakes). *The Press News, www.stuff.co.nz*.

Gilbert, J., Hipkins, R., & Cooper, G. (2005). *Faction or fiction: using narrative pedagogy in school science education.* Paper presented at the Redesigning Pedagogy: Research, Policy, Practice, Nanyang University Institute of Education, Singapore.

Giles, D. C., & Shaw, R. L. (2009). The psychology of news influence and development of media framing analysis. *Social and Personality Psychology Compass, 3*(4), 375-393.
Gist, R., & Stolz, S. B. (1982). Mental health promotion and the media: community response to the Kansas City hotel disaster. *American Psychologist, 37*, 113639.
Gitlin, T. (1980). *The whole world is watching*. Berkeley and Los Angeles: University of California Press.
Glavovic, B. C. (2011). *Leading people post-earthquake: organisational effectiveness in times of seismic risk*. Lessons for Wellington forum Wellington 18 October 2011. As precised by Fran Wilde in summing up the forum; see http://thefaultlineforum.com/lessons-for-wellington? accessed: 14 January 2014.
Glavovic, B. C. (2012, 21-22 June 2012). *Disasters and the continental shelf: exploring new frontiers of risk.* Paper presented at the Proceedings of the 36th Annual Conference of the Law of the Sea and Ocean Policy, Halifax, Canada.
Glavovic, B. C., Saunders, W. S. A., & Becker, J. S. (2010). Land-use planning for natural hazards in New Zealand: the setting, barriers, 'burning issues' and priority actions. *Natural Hazards, 54*, 679-706.
Glik, D. C. (2007). Risk communication for public health emergencies. *Annual Review of Public Health, 28*(1), 33-54.
Godoy, P. (2011, 28-Aug). Mental health earthquake recovery can take time. *The Press News, www.stuff.co.nz*.
Godschalk, D., R., Brody, S., & Burby, R. (2003). Public participation in natural hazard mitigation policy formulation: challenges for comprehensive planning. *Journal of Environmental Planning and Management, 46*(5), 733-745.
Goffman, E. (1974). *Frame analysis*. New York: Harper & Row.
Golding, D., Krimsky, S., & Plough, A. (1992). Evaluating risk communication - narrative vs technical presentations of information about radon. *Risk Analysis, 12*, 27-35.
Goltz, J. D. (1984). Are the news media responsible for the disaster myths? A content analysis of emergency response imagery. *International Journal of Mass Emergencies and Disasters*, 345-367.
Goodwin, E. (2011, 07-Mar). 'People will die of this'. *Otago Daily Times, www.odt.co.nz*.
Gori, P. L. (1991). Communication between scientists and practioners; the important link in knowledge utilization. *Earthquake Spectra, 7*, 89-95.
Gorman, P. (2010, 26-Dec). The science behind the shakes. *Stuff National News, www.stuff.co.nz*.
Gorman, P. (2011a, 27-Jan). Whose fault is it anyway? The scientists remain divided (Earthquakes puzzle scientists). *The Press News, www.stuff.co.nz*.
Gorman, P. (2011b, 3-Mar). Christchurch fault risk 'crucial' to rebuild. *Stuff National News, www.stuff.co.nz*.
Gorman, P. (2011c, 12-Mar). What's next? *The Press News, www.stuff.co.nz*.
Gorman, P. (2011d, 17-Mar). Scientists see no reason not to rebuild city. *The Press News, www.stuff.co.nz*.
Gorman, P. (2011e, 23-Mar). Surging springs not a sign of volcanic activity. *The Press News, www.stuff.co.nz*.
Gorman, P. (2011f, 31-May). Big earthquake risk put at 23 per cent; Risk of big quake at 23 per cent. *Stuff National News, www.stuff.co.nz*.
Gorman, P. (2011g, 1-Jun). Public has 'right to know data'. *The Press News, www.stuff.co.nz*.
Gorman, P. (2011h, 4-Jun). New faults fail to dull optimism. *The Press News, www.stuff.co.nz*.
Gorman, P. (2011i, 4-Jun). When gossip fills the gap. *The Press News, www.stuff.co.nz*.
Gorman, P. (2011j, 21-Jun). Ecan rewrites regional planning policy. *The Press News, www.stuff.co.nz*.
Gorman, P. (2011k, 23-Jun). Lyttelton eruption 'not possible'. *Stuff National News, www.stuff.co.nz*.
Gorman, P. (2011l, 9-Aug). Port Hills residents' deputation over rockfall issues. *The Press News, www.stuff.co.nz*.
Gorman, P. (2011m, 2-Sep). Quake jolt for Canterbury University jobs (Canterbury University's earthquake-induced funding). *The Press News, www.stuff.co.nz*.

Gorman, P. (2011n, 25-Oct). Christchurch earthquake silt chokes rivers. *The Press News, www.stuff.co.nz*.
Gorman, P., & Heather, B. (2011, 19-Jul). Rubble disposal 'nothing to do with council'. *The Press News, www.stuff.co.nz*.
Greenberg, M. R., Sachsman, D. B., Sandman, P. M., & Salmone, K. L. (1989a). Network evening news coverage of environmental risk. *Risk Analysis 9*, 125.
Greenberg, M. R., Sachsman, D. B., Sandman, P. M., & Salmone, K. L. (1989b). Risk, drama and geography in coverage of environmental risk by network TV. *Journalism Quarterly, 66*, 267-276.
Greenhill, M., & Wright, M. (2011, 7-Sep). Owners fight red-zone buyout. *The Press News, www.stuff.co.nz*.
Gregory, G., Loveridge, A., & Gough, J. (1997). Social and cultural aspects of natural hazards perception and response. *New Zealand Geographer, 53*(1), 47-54.
Gregory, J., & Miller, S. (1998). *Science in public: communication, culture and credibility*. Cambridge: Basic Books.
Gribble, K. D. (2012). Media messages and the needs of infants and young children after Cyclone Nargis and the Wenchuan earthquake. *Disasters, 37*(1), 800.
Griffin, R. J., & Dunwoody, S. (1995). Impacts on information subsidies and community structure on local press coverage of environmental contamination. *Journalism and Mass Communication Quarterly, 72*, 271-284.
Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed model of relationship of risk information seeking and processing to the development of preventive behaviors. *Environmental Research, Section A, 80*, S230-S245.
Griffin, R. J., Sharon, D., & Zabala, F. (1998). Public reliance on risk communication channels in the wake of a cryptosporidium outbreak. *Risk Analysis, 18*, 367-375.
Griffin, R. J., Yang, J., ter Huurne, E., Boerner, F., Ortiz, S., & Dunwoody, S. (2008). After the flood: anger, attribution, and the seeking of information. *Science Communication, 29*(3), 285-315.
Griffin-Padgett, D. R., & Allison, D. (2010). Making a case for restorative rhetoric: Mayor Rudolph Giuliani and Mayor Ray Nagin's response to disaster. *Communication Monographs, 77*(3), 376-392.
Gros, J.-G. (2011). Anatomy of a Haitian tragedy: when the fury of nature meets the debility of the state. *Journal of Black Studies, 42*, 131-157.
Grothmann, T., & Reusswig, T. R. (2006). People at risk of flooding: why some residents take precautionary action while others do not. *Natural Hazards, 38*(1-2), 101-120.
Guobin, Y. (2008). Sichuan earthquakes and relief efforts: the power of the internet *EAI Background Brief No. 389* (pp. 9p).
Haas, J. E., & Mileti, D. S. (1977). Socioeconomic and political consequences of earthquake prediction. *Journal of Physics of the Earth, 25*, Supplement S283-S293.
Haberland, T., Heyer, A., & Schulz, L. (2010). Germany: a german approach to balance and complexity. *International Journal of the History of Sport, 27*(9), 1490-1500.
Habermas, J. (1989). *The structural transformation of the public sphere*. Cambridge: MIT Press.
Habermas, J. (2001). The public sphere: an encyclopedia article. In M. G. Durham & D. M. Kellner (Eds.), *Media and cultural studies: keywords* (pp. 1027). Malden, MA: Blackwell Publishers.
Hajer, M. A. (1995). *The politics of environmental discourse: ecological modernization and the policy process*. Oxford: Clarendon Press.
Hall, A. (2011). The rise of blame and recreancy in the United Kingdom: a cultural, political and scientific autopsy of the North Sea flood of 1953. *Environment and History 17*, 379-408.
Hall, S. C., Critcher, T., Jefferson, J. C., & Roberts, B. (1978). *Policing the crisis: Mugging, the State, and law and order*. London: The Macmillan Press.
Hallahan, K. (1999). Seven models of framing implications for public relations. *Journal of Public Relations Research, 1*(3), 205-242.
Halvorson , S., J., & Hamilton, J. P. (2010). In the aftermath of the Qa'yamat: the Kashmir earthqauke disaster in northern Pakistan. *Disasters, 34*(1), 184-204.

Hampel, J. (2006). Different concepts of risk: a challenge for risk communication. *International Journal of Medical Microbiology, 296*(S1), 5.
Hampton, G. (2009). Narrative policy analysis and the integration of public involvement in decision-making. *Policy Science, 42*, 227-242.
Hannigan, J. A. (1995). *Environmental sociology: a social constructionist perspective*. London: Rutledge Taylor Francis Group.
Hansen, A. (1991). The media and social construction of the environment. *Media Culture Society, 1991*(13), 443-458.
Hansen, A. (1993). The mass media and environmental issues. In A. Hansen (Ed.), *Studies in communication and society, 238p* (pp. xv-xxii). Leicester: Leicester University Press
Hanson, S., Vitek, J., & Hanson, P. (1979). Natural disaster: long range impact on human responses to future disaster events. *Environment and Behaviour, 11*, 268-284.
Hardy, C. (2004). Scaling up and bearing down in discourse analysis: questions regarding textual agencies and their context. *Organization, 11*(3), 415-425.
Harries, T. (2008). Feeling secure or being secure? Why it can seem better not to protect yourself against a natural hazard. *Health, Risk and Society, 10*(5), 479-490.
Hart, P. S., & Leiserowitz, A. A. (2009). Finding the teachable moment: an analysis of information-seeking behavior on global warming related websites during the release of The Day After Tomorrow. *Environmental Communication, 3*(3), 355-366.
Hartevelt, J. (2011a, 27-Sep). Big shocks yet to be felt. *The Press News, www.stuff.co.nz*.
Hartevelt, J. (2011b, 2-Nov). Quake decisions coming too slowly. *The Press News, www.stuff.co.nz*.
Hartevelt, J. (2011c, 02-Nov). Rebuild new PM's biggest challenge. *The Press News, www.stuff.co.nz*.
Harwell, E. (2000). Remote sensibilities: discourses of technology and the making of Indonesia's natural disaster. *Development and Change, 31*, 327-349.
Hastie, R., & Park, B. (1986). The relationship between memory and judgment depends on whether the task is memory-based or not. *Psychological Review, 93*, 258-268.
Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures, 1*(1), 77-89.
Haynes, K., Barclay, J., & Pidgeon, N. (2008). Whose reality counts? Factors affecting the perception of volcanic risk. *Journal of Volcanology and Geothermal Research, 172*(3-4), 259-272.
Heath, C., & Heath, D. (2007). *Made to stick: why some ideas survive and others die*: Random House.
Heath, R. L., Jaesub, L., & Lan, N. (2009). Crisis and risk approaches to emergency management planning and communication: the role of similarlity and sensitivity. *Journal of Public Relations Research, 2*(2), 123-141.
Heather, B. (2010a, 3-Dec). Poles option for dams in quake-hit suburbs. *The Press News, www.stuff.co.nz*.
Heather, B. (2010b, 25-Dec). Confusion over damage assessment. *The Press News, www.stuff.co.nz*.
Heather, B. (2011a, 26-Jan). EQC due to release reports. *The Press News, www.stuff.co.nz*.
Heather, B. (2011b, 4-Apr). Many lessons learnt, says post-quake boss. *The Press News, www.stuff.co.nz*.
Heather, B. (2011c, 11-Apr). Residents say silt dust a health risk. *Stuff National News, www.stuff.co.nz*.
Heather, B. (2011d, 2-Jun). Residents frustrated over lack of land reports. *The Press News, www.stuff.co.nz*.
Heather, B. (2011e, 11-Jun). Some areas 'simply not feasible to rebuild'. *Stuff National News, www.stuff.co.nz*.
Heather, B. (2011f, 21-Jul). Little interest in quake inquiry. *The Press News, www.stuff.co.nz*.
Heather, B. (2011g, 23-Jul). Christchurch aftershock worries insurers. *The Press News, www.stuff.co.nz*.
Heather, B. (2011h, 20-Oct). (GNS Science's) fault (research) funding bid failed. *The Press News, www.stuff.co.nz*.

Heather, B. (2011i, 4-Nov). Moderate quake probability jumps 50%. *The Press News, www.stuff.co.nz*.
Heather, B. (2011j, 15-Nov). EQC Canterbury Assesses Green-Blue Homes (Done red, orange, now feeling blue). *The Press News, www.stuff.co.nz*.
Heather, B. (2011k, 3-Dec). Liquefaction data ignored. *The Press News, www.stuff.co.nz*.
Heather, B. (2011l, 27-Dec). Flooded Christchurch area can't be fixed - expert. *The Press News, www.stuff.co.nz*.
Helweg-Larsen, M. (1999). (The lack of) optimistic bias in response to the 1994 Northridge earthquake: the role of personal experience. *Basic and Applied Social Psychology, 21*, 119-129.
Hendriks, C. (2005). Participatory storylines and their influence on deliberative forums. *Policy Sciences, 38*(1), 1-20.
Hilgartner, S., & Bosk, C. L. (1988). The rise and fall of social problems: a public arenas model. *American Journal of Sociology, 94*(1), 52-78.
Hiroi, O., Mikami, S., & Miyata, K. (1985). A study of mass media reporting in emergencies. *International Journal of Mass Media in Emergencies and Disasters, 3*, 21-49.
Hirose, H. (1986). The psychological impact of the Tokai Earthquake prediction: individual's responses and the mass media's coverage. *Japanese Psychological Research 28*, 64-76.
Hjorth, L., & Kim, K.-h. Y. (2011). The mourning after: a case study of social media in the 3.11 earthquake disaster in Japan. *Television & New Media, 12*(6), 552-559.
Ho, F., & Hallahan, K. (2004). Post-earthquake crisis communications in Taiwan: an examination of corporate advertising and strategy motives. *Journal of Communication Management, 8*(3), 291-306.
Hoffmann-Goetz, L., Gerlach, K., Marino, C., & Mills, S. (1997). Cancer coverage and tobacco advertising in African-American women's popular magazones. *Journal of Community Health, 22*(4), 261-270.
Hohenemser, C., Kates, R. W., & Slovic, P. (1983). The nature of technological hazard. *Science, 220*(4595), 378-384.
Holm, I. W. (2012). Earthquake in Haiti: Kleist and the birth of modern disaster discourse. *New German Critique 115, 39*(1), 49-66.
Holmes, S. F. (1995). *The role of the finance industry*. Paper presented at the Wellington after the quake; the challenge of rebuilding cities, Wellington, 27-29 March 1995. Earthquake Commission, Wellington and the Centre for Advanced Engineering, Christchurch, New Zealand. 263-270.
Hopkins, D., Bell, D., Benites, R., Burr, J., Hamilton, C., & Kotze, R. (2008). The Pisco (Peru) earthquake of 15 August 2007 NZSEE reconnaissance report, June 2008. *Bulletin of the New Zealand Society for Earthquake Engineering, 41*(3), 109-192.
Hopkins, S. (2011, 10-Aug). Aucklanders 'least prepared' for disaster: study. *Stuff National News, www.stuff.co.nz*.
Hornig Priest, S., Leu, J. J., Duhé, S., Klipstine, T., & Fisher, D. (2006). Disaster coverage does little to promote call for change. *Newspaper Research Journal, 27*(3), 52-65.
Hornig, S. (1990). Science stories: risk, power and perceived emphasis. *Journalism & Mass Communication Quarterly, 67*, 767-776.
Hornig, S. (1992). Framing risk audience and reader factors. *Jornalism Quaterly, 69*(3), 679-690.
Hornig, S. (1993). Reading risk: public response to print media accounts of technological risk. *Public Understanding of Science, 2*, 959.
Hornig, S., Walters, L., & Templin, J. (1991). Voices in the news: newspaper coverage of Hurricane Hugo and the Loma Prieta earthquake. *Newspaper Research Journal, Summer 1991*, 32-45.
Hornmoen, H. (2009). What researchers now can tell us - representing scientific uncertainty in journalism. *Obervatorio 3*(4), 740.
Hoskin, K., Day, T., & Elms, D. (2007). Listening, learning and evolving the process. In J. Tully (Ed.), *Challenging the future: connecting the words in risk communication* (pp. 1-6). Christchurch: New Zealand Centre for Advanced Engineering.
Hough, S., E. (2005). Earthquakes: predicting the unpredictable? *Geotimes, 50*(3).

Houston, J. B., Pfefferbaum, B., & Rosenholtz, C. E. (2012). Disaster news: framing and frame changing in coverage of major U.S. natural disasters 2000−2010. *Journalism & Mass Communication Quarterly, 89*, 606-623.

Huckin, T. (2002). Textual silence and the discourse of homelessness. *Discourse Society, 2002*(13), 347-372.

Hughes, E., Kitzinger, J., & Murdock, G. (2006). The media and risk. In P. Taylor-Gooby & J. Zinn (Eds.), *Risk in social science* (pp. 250-270). Oxford: Oxford University Press.

Hughes, P., White, P. B., & Cohen, E. (2007). Bushfires and the media: a cultural perspective. *Australian Journal of Emergency Management, 22*(4), 4-19.

Humphries, A. R. G., Mitchell, J., & McBride, S. K. (2011). Community resilience and the Christchurch earthquake: best laid plans or practice made perfect? Abstract A306 17th World Congress on Disaster and Emergency Medicine. *Prehospital and Disaster Medicine, 26*(S1), 86.

Ibrahim, F., Salman, A., Kee, C. P., Mustaffa, N., & Ahmad, F. (2012). Striking a balance between science and arts: mass media dilemma in reporting health and environmental issues. *Asian Social Science, 8*(5), 77-84.

ICSU. (2008). *A science plan for integrated research on disaster risk: addressing the challenge of natural and human-induced environmental hazards*. Paris: International Council for Science (ICSU).

IFRCRCS. (2005). *World disasters report 2005: focus on information in disasters*. International Federation of Red Cross and Red Crescent Societies. Bloomfield, CT: Kumarian Press Inc.

Inwood, H. (2011). Multimedia quake poetry: convergence culture after the Sichuan earthquake. *The China Quarterly, 208*, 932-950.

Inyang, H., Galvão, T. C. B., & Young, D. T. (2003). Integrating hazards control into sustainable development plans. *Natural Hazards Review, 4*, 57-58.

IPCC. (2010). *Cross working group meeting on consistent treatment of uncertainties, guidance note for lead authors of the IPCC Fifth Assessment Report on consistent treatement of uncertainties*. Retrieved from

Irwin, A. (2008). Risk, science and public communication, third-order thinking about scientific culture. In M. Bucchi & B. Trench (Eds.), *Handbook of public communication of science and technology* (pp. 199-212). London: Routledge.

Isubscribe. (2012). Webpage http://www.isubscribe.co.nz/Next-NZ-Magazine-Subscription.cf.m accessed July 2012.

Iwan, W. D., Cluff, L. S., Kimpel, J. F., Kunreuther, H., Masaki-Schatz, S. H., Nigg, J. M., . . . Thomas, F. H. (1999). Mitigation emerges as a major strategy for reducing losses by natural disasters. *Science & Education, 284*(5422), 1943-1947.

Iyengar, S. (1991). *Is anyone responsible? How television frames political issues*. Chicago, IL: University of Chicago Press.

Jackson, E. L. (1981). Response to earthquake hazard: the west coast of North America. *Environment & Behaviour, 13*, 387-416.

Jacob, B., Mawson, A., R., Payton, M., & Guignard, J. C. (2008). Disaster mythology and fact: Hurricane Katrina and social attachment. *Public Health Reports, 123*(5), 555-566.

Jacobi, D., Bergeron, A., & Malvesy, T. (1996). The popularization of plate tectonics: presenting the concepts of dynamics and time. *Public Understanding of Science, 7*, 750.

Jalali, R. (2002). Civil society and the state: Turkey after the earthquake. *Disasters, 26*(2), 120-139.

Jalayer, F., Asprone, D., Prota, A., & Manfredi, G. (2011). A decision support system for post-earthquake reliability assessment of structures subjected to aftershocks: an application to L'Aquila earthquake, 2009. *Bulletin of Earthquake Engineering, 9*(4), 997-1014.

Jasanoff, S. (1993). Bridging the two cultures of risk analysis. *Risk Analysis, 13*, 123-139.

Jasanoff, S. (1998). The political science of risk perception. *Reliability Engineering and System Safety, 59*(1), 91-99.

Jeanneret, Y. (2008). The epistemic jumble of sustainable development. In D. Cheng (Ed.), *Communicating science in social contexts* (pp. 275-287). B.V.: Springer.

Johnson, B. B. (1999). Ethical issues in risk communication: continuing the discussion. *Risk Analysis, 19*(3), 335-348.

Johnson, B. B. (2003). Further notes on public response to uncertainty in risks and science. *Risk Analysis, 23*(4), 781-789.

Johnson, B. B., Sandman, P., M., & Miller, P. (1992). Testing the role of technical information in public risk perception. *Risk, 3*, 341-.

Johnson, J. F., Bengston, D. N., & Fan, D. P. (2009). US policy response to the wildfire fuels management problem: an analysis of the news media debate about the healthy forests initiative and the Healthy Forests Restoration Act. *Journal of Environmental Policy & Planning, 11*(2), 129-142.

Johnson, K. (2011a, 16-Mar). PM's science advisor rubbishes Christchurch quake claim (Science advisor quashes quake predictions). *Dominion Post & Stuff National News, www.stuff.co.nz*.

Johnson, K. (2011b, 20-Mar). Reassurance after (earth)quake prediction. *Stuff National News, www.stuff.co.nz*.

Johnson, L. A., & Hiyashi, H. (2012). Synthesis efforts in disaster recovery research. *International Journal of Mass Emergencies and Disasters, 30*(2), 212-238.

Johnson-Cartee, K. D. (2005). *News narratives and news framing: constructing political reality*. Lanham, MD: Rowman and Littlefield.

Johnston, M. (2011, 28-Feb). Christchurch earthquake: Radar points to rupturing of single fault. *New Zealand Herald, www.nzherald.co.nz*.

Jones, D. (1993). Environmental hazards in the 1990s: problems, paradigms, and prospects. *Geography*, 161-165.

Jones, M. D., & McBeth, M., K. (2010). A narrative policy framework: clear enough to be wrong? *Policy Studies Journal, 38*(2), 329-353.

Jönsson, A. M. (2011). Framing environmental risks in the Baltic Sea: a news media analysis. *AMBIO: A Journal of the Human Environment, 40*(2), 121-132.

Joye, S. (2010). News media and the (de)construction of risk: how Flemish newspapers select and cover international disasters. *Catalan Journal of Communication and Cultural Studies, 2*(2), 253-266.

Kahan, D. (2010). Opinion: fixing the communications failure: people's grasp of scientific debates can improve if communicators build on the fact that cultural values influence what and whom we believe. *Nature, 463*(7279 Jan 21), 296-297.

Kajtazi, M., & Haftor, D. M. (2011). Exploring the notion of information: a proposal for a multifaced understanding. *TripleC - Cognition, Communication & Co-operation, 9*(2), 305-315.

Kalyango, Y., & Eckler, P. (2010). International journalists' expectations from the US media coverage of Hurricane Katrina. *Journalism, 11*(3), 277-292.

Kam, W. Y., & Pampanin, S. (2011). The seismic performance of RC buildings in the 22 February 2011 Christchurch earthquake. *Structural Concrete, 12*(4), 223-233.

Kanemitsu, K. (1995). *Kobe Presentation*. Paper presented at the Wellington after the quake; the challenge of rebuilding cities, Wellington, 27-29 March 1995. Earthquake Commission, Wellington and the Centre for Advanced Engineering, Christchurch, New Zealand. 201-204.

Kasapoğlu, A., & Ecevit, M. (2004). Comparative behavioural response to future earthquakes: the cases of Turkey and USA. *Social Behaviour and Personailty, 2004*(4), 373-382.

Kasperson, R. E. (1986). Six propositions on public participation and their relevance for risk communication. *Risk Analysis, 6*(3), 275-281.

Kasperson, R. E., Golding, D., & Tuler, S. (1992). Social distrust as a factor in siting hazardous facilities and communicating risks. *Journal of Social Issues, 48*(4), 161-187.

Keen, D., & Ryle, J. (1996). Editorial: the fate of information in the disaster zone. *Disasters, 20*(3), 169-172.

Keey, R. B. (2000). *Management of engineering risk*. Centre for Advanced Engineering, University of Canterbury.

Kellenberg, D. K., & Mobarak, A. M. (2008). Does rising income increase or decrease damage risk from natural disasters? *Journal of Urban Economics, 63*(3), 788-802.

Kellenberg, D. K., & Mobarak, A. M. (2011). The economics of natural disaster. *Annual Review of Resource Economics, 3*, 297-312.

Kellet, J., & Sparks, D. (2012). *Disaster risk reduction: spending where it should count*. Briefing Paper, Global Humanitarian Assistance, Somerset, UK, 36p.

Kendra, J. M., & Wachtendorf, T. (2006). Community innovation and disasters. In H. Q. Rodriguez, Enrico L.; Dynes, Russell (Ed.), *Handbook of disaster research* (pp. 316-334): Springer.

Kennedy, J., Ashmore, J., Babister, E., & Kelman, I. (2008). The meaning of 'build back better': evidence from post-tsunami Aceh and Sri Lanka. *Journal of Contingencies and Crisis Management, 16*(1), 24-36.

Kenny, C. (2009). *Why do people die in earthquakes: the costs, benefits and instiutions of disaster risk reduction in developing countries*. WPS4823. The World Bank; Sustainable Development Network, Finance Economics & Urban Department. Policy Research Working Paper 4823. 40p.

Kenny, K. (2011, 20-Oct). Mood-dampening rain opportunity to generate internal sunshine. *Otago Daily Times, www.odt.co.nz*.

Kerr, J., Nathan, S., Van Dissen, R., Webb, P., Brunsdon, D., & King, A. (2004). *Planning for development of land on or close to active faults: a guideline to assist resource management planners in New Zealand*. Retrieved from Wellington, NZ:

Kerr, R. A. (1981). Prediction of huge Peruvian quakes quashed. *Science, 211*, 808-809.

Kerr, R. A. (1991). The lessons of Dr Browning. *Science, 253*, 622-623.

Keselman, A., Slaughter, L., & Patel, V. L. (2005). Toward a framework for understanding lay public's comprehension of disaster and bioterrorism information. *Journal of Biomedial Infomatics, 38*, 331-344.

Keshishian, F. (1997). Political bias and nonpolitical news: a content analysis of an Armenian and Iran Earthquake in the New York Times and the Washington Post. *Critical Studies in Mass Communication, 14*(4), 332-343.

Kessler, L. (1989). Women's magazine coverage of smoking related health hazards. *Journalism Quarterly, 66*, 316-323.

Kinder, D. R. (2007). Curmudgeonly advice. *Journal of Communication, 57*, 155-162.

King, A., & Shelton, R. (2004). *New Zealand advances in performance based seismic design*. Paper presented at the 13th World Conference on Earthquake Engineering, Vancouver, Canada.

King, J. E. (2011). Who dat say (we) "too depraved to be saved"?: remembering Katrina/Haiti (and beyond): critical studyin' for human freedom. *Harvard Educational Review, 81*(2), 343-370.

Kirk, S. (2011a, 23-Feb). Expert says Canty will rebound. *Manawatu Standard www.stuff.co.nz*.

Kirk, S. (2011b, 6-May). Seismic study for lower North Island. *Manawatu Standard www.stuff.co.nz*.

Kirkis, E. J. (2006). A myth too tough to die: the dead of disasters cause epidemics of disease. *34*(6), 331-334.

Kitzinger, J. (1999). Researching risk and the media. *Health, Risk & Society, 1*(1), 55-69.

Kitzinger, J., & Reilly, J. (1997). The rise and fall of risk reporting: media coverage of human genetics research, 'false memory syndrome' and 'mad cow disease'. *European Journal of Communication, 12*, 319-350.

Kivikuru, U. (2006). Tsunami communication in Finland: revealing tensions in the sender-receiver relationship. *European Journal of Communication, 21*(4), 499-520.

Kizer, K. W. (2000). Lessons learned in public health emergency management: personal reflections *Prehospital and Disaster Medicine, 15*(4), 83-88.

Klassen, S. (2010). The relation of story structure to a model of conceptual change in science learning. *Science & Education, 19*, 305-317.

Klein, N. (2007). *Shock doctrine: the rise of disaster capitalism*. Toronto, Canada: Vintage Canada.

Knobloch-Westerwick, S., & Taylor, L. (2008). The blame game: elements of causal attribution and its impact on siding with agents in the news. *Communication Research, 35*, 723- 744.

Kodrich, K., & Laituri, M. (2005). The formation of a disaster community in cyberspace: the role of online news media after the 2001 Gujarat earthquake. *Convergence: The International Journal of Research into New Media Technologies, 11*, 40-56.

Kolbe, A. R., Hutson, R. A., Shannon, H., Trzcinski, E., Miles, B., Levitz, N., . . . Muggah, R. (2010). Mortality, crime and access to basic needs before and after the Haiti earthquake: a random survey of Port-au-Prince households. *Medicine, Conflict and Survival, 26*, 281-297.

Konagai, K., Johansson, J., Numata, A., Takatsu, S., & Ikeda, T. (2008). *Geological and microtremor survey, damage distribution, and reconstruction of Muzaffarabad and surroundings after the 2005 Kashmir earthquake*. Proceedings of the conference of Geotechnical Earthquake Engineering and Soil Dynamics IV: May 18-22 2008, Sacramento, California.

Kondo, S., Yamori, K., Atsumi, T., & Suzuki, I. (2012). How do "numbers" construct social reality in disaster-striken areas? A case of the 2008 Wenchuan earthquake in Sichuan, China. *Natural Hazards, 62*(1), 71-81.

Koolstra, C. M., Bos, M. J. W., & Vermeulen, I. E. (2006). Through which medium should science information professionals communicate with the public: television or the internet? *Journal of Science Communication, 5*(3).

Kornelis, M., J., De Jonge, L. J., Frewer, L. J., & Dagevos, H. (2007). Classifying consumer groups on the basis of their intended use of food safety information sources. *Risk Analysis, 27*(2), 327-325.

Kotarumalos, A. (2011, 15-Jul-2011). Volcano erupts in central Indonesia. *Stuff World News, www.stuff.co.nz*.

Kreps, G. A. (1980). *Research needs and policy issues on mass media disaster reporting.* Paper presented at the Disasters and the Mass Media Conference, February 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 35-74.

Kreps, G. A. (1989). Future directions in disaster research; the role of taxonomy. *International Journal of Mass Emergencies and Disaster, 7*(3), 215-241.

Krieghbaum, H. (1967). *Science and the mass media*. New York: New York University Press.

Kueneman, R. M., & Wright, J. E. (1975). New policies of broadcast stations for disturbances and disasters. *Journalism Quarterly, 52*, 670-677.

Kuttschreuter, M. (2006). Psychological determinants of reactions to food risk messages. *Risk Analysis, 26*(4), 104557.

Kuypers, J. A. (2009a). Framing analysis. In J. A. Kuypers (Ed.), *Rhetorical criticism: perspectives in action*: Lexington Books.

Kuypers, J. A. (2009b). *Rhetorical criticism: perspectives in action*: Lexington Books.

Kuypers, J. A., & King, A. (2009). What is rhetoric? In J. A. Kuypers (Ed.), *Rhetorical criticism: perspectives in action*: Lexington Books.

Lagorio, H. J. (1990). *Earthquakes: an architect's guide to nonstructural seismic hazards*. New York, NY: John Wiley & Sons.

Lahidji, R. (2004). Lessons learned. In Organisation for Economic Co-operation and Development (OECD) (Ed.), *Large-scale disasters: lessons learned* (pp. 9-23). France: OECD Publications Service.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.

Lamontagne, M., DuBerger, R., & Stevens, A. E. (1992). Seismologists can help attenuate some post-earth-quake vibrations among the public. *Earthquake Spectra, 8*(4), 573-594.

Lan, Y. (2009). Coverage of the Wenchuan earthquake: an overview. *The China Nonprofit Review, 1*(2), 221-245.

Lanza, T., & Negrete, A. (2007). From myth to earth education and science communication. *Geological Society, London, Special Publications 2007, 273*, 61-66.

Larson, J. F. (1980). *A review of the state of the art in mass media disaster reporting.* Paper presented at the Disasters and the Mass Media, February Conference, 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 75-126.

Laswell, H. (1948). The structure and function of communication in society. In L. Bryson (Ed.), *The communication of ideas*. New York: Harper and Row.

Latour, B. (1987). *Science in action*. Milton Keynes: Open University Press.

Latour, B. (1998). From the world of science to the world of research? *Science, New Series, 280*(5361), 208-209.
Lau, J. T. F., Lau, M., Kim, J. H., & Tsui, H. Y. (2006). Impacts of media coverage on the community stress level in Hong Kong after the tsunami on 26 December 2004. *Journal of Epidemiology: Community Health, 60*, 675-682.
Law, T. (2011, 19-Apr). No excuses for bad behaviour. *The Press News, www.stuff.co.nz*.
Law, T. (2012, 11-Apr). Big-fart book translates into city kids' fun. *The Press News, www.stuff.co.nz*.
Leach, M., Scoones, I., & Stirling, A. (2010). Governing epidemics in an age of complexity: Narratives, politics and pathways to sustainability. *Global Environmental Change, 20*, 369-377.
Lecheler, S., de Vreese, C., & Slothus, R. (2009). Issue importance as a moderator of framing effects. *Communciation Research, 36*, 400-425.
Ledingham, J. A., & Walters, L. M. (1985). Written on the wind: the media and Hurricane Alicia. *Newspaper Research Journal, 6, Winter*, 50-58.
Leff, M., & Sapir, J. D. (1977). The anatomy of metaphor. In J. D. Sapir (Ed.), *The social uses of metaphor: essays on the anthropology of rhetoric*. Philadelphia: University of Pennsylvania Press.
Lehman, D. R., & Taylor, S. E. (1987). Date with an earthquake. *Personality and Social Psychology Bulletin, 1987*, 13.
Leroy, S. A. G. (2006). From natural hazard to environmental catastrophe: past and present. *Quaternary International, 158*, 4-12.
Levy, L. A., Rokusek, C. F., Bragg, S. M., & Howell, J. T. (2009). Interdisciplinary approach to all-hazards preparedness: Are you ready? How do we know? *Journal of Public Health Management and Practice, 15*, S8.
Levy-Leblond, J. (1992). About misunderstandings about misunderstandings. *Public Understanding of Science, 1*(1), 17-21.
Lewandowsky, S., Stritzke, W. G., Oberauer, K., & Morales, M. (2005). Memory for fact, fiction, and misinformation: the Iraq War 2003. *Psychological Science, 16*(3), 190-195.
Lewis, J. (1979). The Tamil Nadu cyclone, November, 1977: a comparison of newspaper reports. *Disasters, 3*(2), 123-135.
Li, Y., Wen, J., Du, L., Gao, Z., Li, L., Chen, Q., . . . Ai, C. (2009). A comparative study on earthquake-related literature published in medical journals. *Journal of evidence-based medicine, 2*(4), 252-257.
Li, Y., Wu, Z., & Zhao, Y. (2011). Estimating the number of casualties in earthquakes from early field reports and improving the estimate with time. *Natural Hazards, 56*, 699-708.
Likens, G. E. (2010). The role of science in decision-making: does evidence-based science drive environmental policy? *Frontiers in Ecology & Environment, 8*(6), e1-e3.
Lindell, M. K., Arlikatti, S., & Prater, C. S. (2009). Why people do what they do to protect against earthquake risk: perceptions of hazard adjustment attributes. *Risk Analysis, 29*(8), 107288.
Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard: a review of research. *Environment & Behaviour, 32*, 590-630.
Lindell, M. K., & Perry, R. W. (2004). *Communicating environmental risk in multiethnic communities*. Thousand Oaks, London: Sage Publications.
Lindell, M. K., & Prater, C. S. (2002). Risk area residents' perceptions and adoption of seismic hazard adjustments. *Journal of Applied and Social Psychology, 32*(11), 2377-2392.
Lindell, M. K., & Whitney, D. J. (2000). Correlates of household seismic hazard adjustment adoption. *Risk Analysis, 20*(1), 13-25.
Little, K. (2010, 22-Sep). Geography's relevance hits home surely. *Otago Daily Times, www.odt.co.nz*.
Littlefield, R. S., & Quenette, A. M. (2007). Crisis leadership and Hurricane Katrina: the portrayal of authority by the media in natural disasters. *Journal of Applied Communication Research, 35*(1), 26-47.
Littlewood, M. (2011, 3-May). Fault lines 'no reason for panic'. *Stuff National News, www.stuff.co.nz*.

Liu, B. F. (2009). An analysis of US government and media disaster frames. *Communication Management, 13*, 268-283.
Liu, D. (2010). *A comparative look at the coverage of the Sichuan earthquake in Chinese and American newspapers.* University of Iowa Graduate thesis and dissertation. (Master of Science). Paper 11803.
Liu-Zeng, J., Wen, L., Sun, J., Zhang, Z., Hu, G., Xing, X., . . . Xu, Q. (2010). Surficial slip and rupture geometry on the Beichuan fault near Hongkou during the Mw 7.9 Wenchuan earthquake. *Bulletin Seismological Society America, 100*(5B), 2615-2650.
Liverman, D., Pereira, C., & Marker, B. (2008). *Communicating environmental geoscience*. London: The Geological Society of London.
Lobb, A., Mock, N., & Hutchinson, P. L. (2012). Traditional and social media coverage and charitable giving following the 2010 earthquake in Haiti. *Prehospital and Disaster Medicine, 27*(4), 320-324.
Lombard, M., Synder-Duch, J., & Bracken, C. C. (2006). Content analysis in mass communication assessment and reporting of intercoder reliability. *Human Communication Research, 28*(4), 587-604.
Lombardi, M. (1997). Media studies. *International Journal of Mass Emergencies and Disasters, 15*(1), 1036.
Lomovasky, B. J., Firstater, F. N., Salazar, A. G., Mendo, J., & Iribarne, O. O. (2011). Macro benthic community assemblage before and after the 2007 tsunami and earthquake at Paracas Bay, Peru. *Journal of Sea Research, 65*(2), 205-212.
Longstaff, P. H., & Yang, S. (2008). Communication management and trust: their role in building resilience to “surprises” such as natural disasters, pandemic flu, and terrorism. *Ecology and Society 13*(1).
López, M. M. (2009). Scientific mediation: on social processes, contexts and networks in which scientists are embedded. *Journal of Science Communication, 8*(4), C05.
Low, Y. S.-Y., Varughese, J., & Pang, A. (2011). Communicating crisis: how culture influences image repair in Western and Asian governments. *Corporate Communications: An International Journal, 16*(3), 218-242.
Lowrey, W., Evans, W., Gower, K. K., Robinson, J. A., Ginter, P. M., McCormick, L. C., & Abdolrasulnia, M. (2007). Effective media communication of disasters: pressing problems and recommendations. *BMC Public Health, 7*, 974.
Lu, Y., & Yang, D. (2011). Information exchange in virtual communities under extreme disaster conditions. *Decision Support Systems, 50*(2), 529-538.
Lubcheno, J. (1998). Entering the century of the environment: a new social contract for science. *Science, 279*(5350), 491-497.
Lumsden, J. (2003). Risk communication strategies. In J. Gough (Ed.), *Sharing the future: risk communication in practice* (pp. 57-72). Christchurch: Centre for Advanced Engineering, University of Canterbury.
Lundy, G. (2011). The Haiti earthquake of 2010: the politics of a natural disaster. *Journal of Black Studies, 42*(2), 127-130.
Lynch, K. (2011a, 7-Apr). After hours vets had to carry on. *The Press News, www.stuff.co.nz*.
Lynch, K. (2011b, 20-Aug). Early quake forecast faulted. *The Press News, www.stuff.co.nz*.
Mace, W. (2010, 10-Sep). Rating the quake coverage. *Stuff Business News www.stuff.co.nz*.
Mainka, S. A., & McNeely, J. (2011). Ecosystem considerations for postdisaster recovery: lessons from China, Pakistan, and elsewhere for recovery planning in Haiti. *Ecology and Society, 16*(1), 589-613.
Mairal, G. (2011). The history and the narrative of risk in the media. *Health, Risk & Society, 13*(1), 65-79.
Major, A. M. (1993). A test of situational communication theory: public response to the 1990 Browning earthquake prediction. *International Journal of Mass Emergencies and Disasters, 11*(3).
Major, A. M. (1998). The utility of situational theory of publics for assessing public response to a disaster prediction. *Public Relations Review, 24*(4), 489-508.

Major, A. M., & Atwood, L. E. (2004). Environmental risks in the news: issues, sources, problems, and values. *Public Understanding of Science, 13*, 295-308.
Malone, W. (1993). Research definitions and location of research: a user's view. *International Journal of Mass Emergencies and Disasters, 11*, 63-74.
Mamula-Seadon, L. (2009). CDEM, integrated planning and resilience. *Tephra: NZ Ministry of Civil Defence and Emergency Management Science and Education publication, 22*, 3-8.
Marincioni, F. (2007). Information technoogies and the sharing of disaster knowledge: the critical role of professional culture. *Disaster, 31*(4), 459-476.
Marincioni, F. (2012). Perception and communication of seismic risk: the 6 April 2009 L'Aquila earthquake case study. *Earthquake Spectra, 28*(9), 158-193.
Martin, W. E., Martin, I. M., & Kent, B. (2009). The role of risk perceptions in the risk mitigation process: the case of wildfire in high risk communities. *Journal of Environmental Management, 91*, 489-498.
Marx, S. M., Weber, E. U., Orlove, B. S., Leiserowitz, A., Krantz, D., Roncoli, C., & Philips, J. (2007). Communication and mental processes: experiential and analytic processing of uncertain climate information. *Global Environmental Change, 17*, 47-58.
Masel-Walters, L., & Hornig, S. (1993). Faces in the news: network television news coverage of Hurricane Hugo and the Loma Prieta earthquake. *Journal of Broadcast and Electronic Media, 219*, p219-232.
Maskrey, A. (2011). Revisiting community-based disaster risk management. *Environmental Hazards, 10*(1), 42-52.
Mason, C. L. (2011). Foreign aid as gift: the Canadian Broadcasting Corporation's response to the Haitian earthquake. *Critical Studies in Media Communication, 28*(2), 942.
Massey, K. B. (1995). Analyzing the uses and gratifications concept of audience activity with qualitative approach: media encounters during the 1989 Loma Prieta earthquake disaster. *Journal of Electronic Broadcasting and Media, 39*(3), 328-349.
Matthes, J., & Kohring, M. (2008). The content analysis of media frames: toward improving reliability and validity. *Journal of Communication, 58*, 258-279.
Matthews, P. (2010, 2-Oct). Quake paves way for fresh thinking. *The Press News, www.stuff.co.nz*.
Matthews, P. (2011, 6-Aug). Quakes many stories to go on the record. *The Press News, www.stuff.co.nz*.
Mazur, A. (1981). Media coverage and public opinion on scientific controversies. *Journal of Communication, 31*, 1065.
Mazzocchi, M., & Montini, A. (2001). Earthquake effects on tourism in Central Italy. *Annals of Tourism Research, 28*(4), 103146.
McAdoo, B. G., & Paravisini-Gebert, L. (2011). Not the earthquake's fault. *Nature Geoscience, 4*(4), 210-211.
McBeth, M. K., Shanahan, E. A., Arnell, R. J., & Hathaway, P. L. (2007). The intersection of narrative policy analysis and policy change theory. *Policy Studies Journal, 35*(1), 878.
McCarthy, M., Brennan, M., De Boer, M., & Ritson, C. (2008). Media risk communication - what was said by whom and how was it interpreted. *Journal of Risk Research, 11*(3), 375-394.
McCartney, M. (2011). Nuclear panic overshadows Japan's real plight. *British Medical Journal, 342*(d1845), 690.
McClure, J. (2006). Guidelines for encouraging householders' preparation for earthquakes in New Zealand. *Report for Building Research*, 31p. http://www.buildingresearch.org.nz/assets/pdfs/McClure.pdf.
McClure, J., Allen, M. W., & Walkey, F. (2001). Countering fatalism: causal information in news reports affects judgnents about earthquake damage. *Basic and Applied Social Psychology, 23*(2), 109-121.
McClure, J., Spittal, M. J., Fischer, R., & Charleson, A. (2014). Why do people take fewer damage mitigation actions than survival actions? Other factors outweigh cost. *Natural Hazards Review, 16*(2), 4014-4018.
McClure, J., Sutton, R., & Sibley, C. (2007). Listening to reporters or engineers? How instance-based messages about building design affect earthquake fatalism. *Journal of Applied Social Psychology, 39*(9), 1956-1973.

McClure, J., Sutton, R., & Wilson, M. (2007). How information about building design influences causal attributions for earthquake damage. *Asian Journal of Social Psychology, 20*, 233-242.
McClure, J., Walkey, F., & Allen, M. (1999). When earthquake damage is seen as preventable: attributions, locus of control and attitudes to risk. *Applied Psychology: An International Review, 48*(2), 239-256.
McClure, J., White, J., & Sibley, C. (2009). Framing effects on preparation intentions: distinguishing actions and outcomes. *Disaster Prevention and Management, 18*(2), 187-199.
McClure, J., Wills, C., Johnston, D. M., & Recker, C. (2011). New Zealanders' judgments of earthquake risk before and after the Canterbury earthquake: do they relate to preparedness? *New Zealand Journal of Psychology, 40*(4), 7.
McComas, K., & Shanahan, J. (1999). Telling stories about global climate change. Measuring the impact of narratives on issue cycles. *Communication Research, 26*(1), 30-57.
McComas, K. A. (2006). Defining moments in risk communication research 1996-2005. *Journal of Health Communication, 11*, 75-91.
McCombs, M. E., & Shaw, D. L. (1972). The agenda-setting function of mass media. *Public Opinion Quarterly, 36*, 176.
McCrone, J. (2011, 16-Apr). Can we fix it? *The Press News, www.stuff.co.nz*.
MCDEM. (2005a). *Focus on recovery; a holistic framework for recovery in New Zealand. Information for the CDEM sector [IS5/05]*. Wellington, NZ.
MCDEM. (2005b). *Recovery management. Director's guidelines for Civil Defence and Emergency Management (CDEM) Groups*. Wellington, New Zealand: Ministry of Civil Defenece and Emergency Management.
MCDEM. (2010). 'Triangle of life' advice resurfaces (again). Advice issued by the Ministry of Civil Defence & Emergency Management in March 2010, updated 09 September 2010 after the Darfield earthquake. http://resources.ccc.govt.nz/files/TriangleOfLifeMCDEM.pdf.
McDonald, F. J. (2011). Afterword to Volume 10 Environmental hazards: human and policy dimensions. *Environmental Hazards, 10*, 93-98.
McDonald, L. (2011, 6-Jul). Retrofitting buildings tricky. *The Press News, www.stuff.co.nz*.
McEntire, D. A. (1998). Pendulum policies and the need for relief and invulnerable development. *International Journal of Mass Emergencies and Disasters, 16*(2), 213-216.
McEntire, D. A. (1999). From sustainability to invulnerability development: justifications for a clear, comprehensive and appropriate disaster paradigm. *Disasters, 24*(1), 78-79.
McEntire, D. A. (2001). Triggering agents, vulnerabilities and disaster reduction: towards a holistic paradigm. *Disaster Prevention and Management, 10*(3), 189-196.
McEntire, D. A. (2011). Understanding and reducing vulnerability: from the approach of liabilities and capabilities. *Disaster Prevention and Management, 20*(3), 294-313.
McEntire, D. A., Fuller, C., Johnstone, C. W., & Weber, R. P. (2002). A comparison of disaster paradigms: the search for a holistic policy guide. *Public Administration Review, 62*(3), 276-291.
McIvor, D., & Paton, D. (2007). Preparing for natural hazards: normative and attitudinal influences. *Disaster Prevention and Management, 16*(1), 79-88.
McKay, J., M. (1983). Newspaper reporting of bushfire disaster in southeastern Australia - Ash Wednesday 1983. *Disasters, 7*, 283-290.
McKay, J., M. (1996). Reflecting the hazard or restating old views: newspapers and bushfires in Australia. *International Journal of Mass Emergencies and Disasters, 14*(3), 305-319.
McLeod, R. (2011, 17-Mar). We can never be adequately prepared for 'The Big One'. *The Press News, www.stuff.co.nz*.
Mcloughlin, D. (1985). A framework for integrated emergency management. *Public Administration Review, 45*, 165-172.
Mclvor, D., Paton, D., & Johnston, D. M. (2009). Modelling community preparation for natural hazards: understanding hazard cognitions. *Journal of Pacific Rim Psychology, 3*(2), 39-46.
McQuail, D., & Windahl, S. (1993). *Communication models for the study of mass communications*. London, New York: Longman.

McQuiggan, S. W., Rowe, J., P., Lee, S., & Lester, J. C. (2008). Story-based learning: the impact of narrative on learning experiences and outcomes *B. Woolf et al (Ed.) International Conference on Intelligent Tutoring System Conference* (Vol. 5091, pp. 530-539): Springer-Verlag Berlin Heidelberg.

Mellor, F. (2010). Negotiating uncertainty: asteroids, risk and the media. *Public Understanding of Science, 19*(1), 16-33.

Meltsner, A. J. (1978). Public support for seismic safety: where is it in California? *Mass Emergencies, 3*, 167-184.

Micangeli, A., & Esposto, S. (2010). Post-earthquake rehabilitation of the rural water systems in Kashmir's Jehlum Valley. *Disasters, 34*(3), 684-694.

Milch, K., Gorokhovich, Y., & Doocy, S. (2012). Effects of seismic intensity and socioeconomic status on injury and displacement after the 2007 Peru earthquake. *Disasters, 34*(4), 117182.

Miles, B., & Morse, S. (2007). The role of news media in natural disaster risk and recovery. *Ecological Economics, 63*(2-3), 365-373.

Mileti, D. S. (1982). Public perceptions of seismic hazards and critical facilities. *Bulletin of the Seismological Society of America, 72*, 13-18.

Mileti, D. S. (1993). Communicating public earthquake risk information. In J. Nemec, J. M. Nigg, & F. Siccardi (Eds.), *Prediction and perception of natural hazards*. The Netherlands: Kluwer Academic Publishers.

Mileti, D. S. (1999). *Disasters by design: a reassessment of natural hazards in the United States*. Washington DC: Joseph Henry Press.

Mileti, D. S., Bandy, R., Bourque, L., Johnson, A., Kano, M., Peek, L., . . . Wood, M. (2006). *Annotated bibliography for public risk communication on warnings for public protective actions response and public education*. 347p. Retrieved from http://www.colorado.edu/hazards/publications/informer/infrmr2/pubhazbibann.pdf 12 October 2010.

Mileti, D. S., & Beck, E. M. (1975). Communication in crisis. *Communication Research, 2*, 24.

Mileti, D. S., & Darlington, J. D. (1995). Societal response to revised earthquake probabilities in the San Francisco Bay area. *International Journal of Mass Emergencies and Disasters, 13*, 119-145.

Mileti, D. S., Drabek, T. E., & Haas, J. E. (1975). *Human systems in extreme environments: a sociological perspective*. Boulder, CO: Institute of Behavioral Science, The University of Colorado.

Mileti, D. S., & Fitzpatrick, C. (1992). The causal sequence of risk communication in the Parkfield earthquake prediction experiment. *Risk Analysis, 12*(3), 393-400.

Mileti, D. S., & Fitzpatrick, C. (1993). *The great earthquake experiment: risk communication and public action*. Boulder, CO: Westview Press.

Mileti, D. S., Fitzpatrick, C., & Farhar, B. C. (1992a). Fostering public preparations for natural hazards: lessons from the Parkfield earthquake prediction. *Environment, 34*(3), 16-20 & 36-39.

Mileti, D. S., Fitzpatrick, C., & Farhar, B. C. (1992b). Lessons from the Parkfield earthquake prediction. *Environment, 34*, 16-39.

Mileti, D. S., & O'Brien, P. W. (1992). Warnings during disaster: normalizing communicated risk. *Social Problems, 39*(1), 40-57.

Mileti, D. S., & Sorenson, J. H. (1987). Natural hazards and precautionary behaviour. In W. N. Weinstein (Ed.), *Taking care: understanding and encouraging self-protective behaviour*. New York: Cambridge University Press.

Miller, D. (1999). Risk, science and policy: definitional struggles, information management, the media and BSE. *Social Science & Medicine, 49*, 1239-1255.

Miller, S. (1997). Earthquakes: prediction and the media - a case study in the public understanding of science. *Geophysical Journal International, 131*, 530-533.

Miller, S. (2008). So where's the theory? On the relationship between science communication practice and research *D Cheng et al (Eds.) Communicating science in sicial contexts* (pp. 275-287). B.V.: Springer Science+Business Media.

Mitchell, J. T., Thomas, D. S. K., Hill, A. A., & Cutter, S. L. (2000). Catastrophe in reel life versus in real life: perpetuating disaster myth through Hollywood films. *International Journal of Mass Emergencies and Disasters, 18*, 383-402.
Moehle, J., Barkley, C., Bonowitz, D., Karlinsky, S., Maffei, J., & Poland, C. (2009). *The resilient city - a way of thinking about preparedness, mitigation and rebuilding*. Paper presented at the 2009 NZSEE Conference.
Moeller, S. D. (2006). "Regarding the pain of others": media bias and the coverage of international disasters. *Journal of International Affairs, 59*(2), 173-XVI.
Möllering, G. (2011). Conceptual openness and actor focus in research on international business relationships. In S. Schmid (Ed.), *Internationale Unternehmungen und das Management ausländischer Tochtergesellschaften* (pp. 333-353). Wiesbaden: Gabler.
Molotch, H., & Lester, M. (1974). News are purposive behaviour: on the strategic use of routine events, accidents and scandals. *American Sociological Review, 39*(1012).
Mooney, M., F., Paton, D., de Terte, I., Johal, S., Karancu, A. N., Gardener, D., . . . Johnston, D. M. (2011). Psychosocial recovery from disasters: a framework informed by evidence. *New Zealand Journal of Psychology, 40*(4), 26-38.
Moore, M., Burrows, S., Collins, M., & Roderer, N. (2011). Libraries and publishers respond to disaster with groundbreaking collaboration. *Journal of Electronic Resources in Medical Libraries, 8*, 54-62.
Morgan, M. G., & Lave, L. (1990). Ethical considerations in risk communication practice and reseach. *Risk Analysis, 10*(3), 355-358.
Morris, C. (2009, 10-Jan-2009). Protected building declared 'unsafe'. *Otago Daily Times, www.odt.co.nz*.
Moscovici, S. (1988). Notes towards a description of social representations. *European Journal of Social Psychology, 18*, 211-250.
Mualchin, L. (2011). History of modern earthquake hazard mapping and assessment in California using a deterministic or scenario approach. *Pure Applied Geophysics, 168*, 383-407.
Muhari, A., Imamura, F., Natawidjaja, D. H., Diposaptono, S., Latief, H., Post, J., & Ismail, F. A. (2010). Tsunami mitigation efforts with pTA in west Sumatra province, Indonesia. *Journal of Earthquake and Tsunami, 4*(4), 341-368.
Mulilis, J., & Duval, T. S. (1995). Negative threat appeals and earthquake preparedness: a person-relative-to-event PrE model of coping with threat. *Journal of Applied Social Psychology, 25*, 1319-1339.
Mulilis, J., Duval, T. S., & Lippa, R. (1990). The effects of a large destructive local earthquake on earthquake preparedness as assessed by an earthquake preparedness scale. *Natural Hazards, 3*, 357-371.
Mulilis, J., & Lippa, R. (1990). Behavioral change in earthquake preparedness due to negative threat appeals: a test of protection motivation theory. *Journal of Applied and Social Psychology, 20*(8, Pt 1), 619-638.
Mulkay, M. (1991). *Sociology of science*. Milton Keynes: Open University Press.
Murdoch, H. (2011, 7-Oct). Liquefaction risk tagged. *Nelson Mail, www.stuff.co.nz*.
Mussen, D. (2011, 20-Oct). Floating design allows building on faultlines. *The Press News, www.stuff.co.nz*.
Mythen, G. (2010). Reframing risk? Citizen journalism and the transformation of news. *Journal of Risk Research, 13*(1), 45-58.
Nacher, J. C., & Ochiai, T. (2011). Linking financial market dynamics and the impact of news. In T. E. Simos, G. Psihoyios, C. Tsitouras, & Z. Anastassi (Eds.), *AIP Conference Proceedings* (Vol. 1389, pp. 1906-1909).
Nagatomo, N., Otsuki, E., & Hirano, J. (2015). Economic analysis of investment in DRR measures. In I. Davis, K. Yanagisawa, & K. Georgieva (Eds.), *Disaster Risk Reduction for Economic Growth and Livelihood: Investing in resilience and development*. New York: Routledge.
Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *The Academy of Management Review, 23*(2), 242-266.
Napier, A. (2011, 2-Nov). Canterbury more prepared than ever. *The Press News, www.stuff.co.nz*.

Nara, Y. (2010). Risk experience, information and chance discovery: focusing on earthquakes in China. *International Journal of Advances Intelligence Paradigms, 2*(2/3), 159-179.
Needham, R. D. (1986). The cosmopolite-localite model: newspaper types and natural hazard information potentials. *Environmental Management, 10*(2), 271-284.
Needham, R. D., & Nelson, J. G. (1977). Newspaper response to flood and erosion hazards on the North Lake Erie Shore. *Environmental Management, 1*(6), 521-540.
Nehrlich, B. (2007). Media, metaphors and modelling: how the UK newspapers reported the epidemiological modelling controversy during the 2001 foot and mouth outbreak. *Science Technology Human Values, 32*, 432-457.
Nehrlich, B., & Halliday, C. (2007). Avian flu: the creation of expectations in the interplay between science and the media. *Sociology of Health and illness, 29*(1), 46-65.
Nelkin, D. (1995). *Selling science: how the press covers science and technology*. New York: WH Freeman and Company.
Nelson, T., & Willey, E. (2001). Issue frames that strike a value balance: a political psychology perspective. In S. Reese, O. J. Gandy, & A. Grant (Eds.), *Framing public life* (pp. 245-266). Mahwah, NJ: Lawrence Erlbaum.
Neresini, F., & Pellegrini, G. (2008). Evaluating public communication of science and technology. In M. Bucchi & B. Trench (Eds.), *Handbook of Public Communication of Science and Technology* (pp. 237-251). London: Routledge.
Neuendorf, K. A. (2002). *The content analysis guidebook*. Thousand Oaks, CA: Sage.
Neuwirth, K., Dunwoody, S., & Griffin, R. J. (2000). Protection motivation and risk communication. *Risk Analysis, 20*, 721-734.
Newhagen, J. E., & Lewenstein, M. (1992). Cultivation and exposure to television following the 1989 Loma Prieta earthquake. *Mass Communication Review, 19*, 49-56.
Newhall, C., Aramaki , S., Barberi, F., Blong, R., Calvache, M., Cheminee, J., . . . Tjetjep, W. (1999). Professional conduct of scientists during volcanic crises. *Bulletin of Volcanology, 60*, 323-334.
News, F. N. (2011, 8-Dec). Engineers dispute estimate. *The Press News, www.stuff.co.nz*.
Newton, K. (2011a, 3-Mar). Earthquake identification process much harder at home. *The Press News, www.stuff.co.nz*.
Newton, K. (2011b, 4-Mar). In an earthquake - drop, cover, hold. *Stuff National News, www.stuff.co.nz*.
Newton, K. (2011c, 16-Oct). $6m event centre to pioneer quake rods. *Dominion Post News, www.stuff.co.nz*.
Newton, K., & Steward, I. (2011, 07-Feb). Quake prophecy will come true ... eventually. *National News, The Dominion Post, www.stuff.co.nz*.
Nichols, L. (2011, 31-Oct). Quake-safe bill may fall to public. *Dominion Post News, www.stuff.co.nz*.
Nigg, J. M. (1982). Communication under conditions of uncertainty: understanding earthquake forecasting. *Journal of Communication, 32*(1), 27-36.
Nigg, J. M. (1987). Communication and behaviour: organizational and individual response to warnings. In R. R. Dynes, B. DeMarchi, & C. Pelanda (Eds.), *Sociology of Disaster* (pp. 1037). Milan, Italy: Franco Angeli Libri.
Nigg, J. M., & Eeri, M. (1985). The Borah Peak, Idaho earthquake of October 28, 1983 - societal response. *Earthquake Spectra, 2*(1), 17-22.
Nimmo, D. (1984). TV network news coverage of Three Mile Island: reporting disasters as technological fables. *International Journal of Mass Emergencies and Disasters, 2*(1), 115-145.
Nimmo, D., & Coombs, J. (1985). *Nightly horrors: crisis coverage in television network news*. Knoxvillle: University of Tennessee Press.
Nisbet, M. C. (2009). Communicating climate change: why frames matter for public engagement. *Environment, 51*(2), 12-23.
Nisbet, M. C. (2010). Framing science; a new paradigm in public engagement. In L. Kahlor & P. A. Stout (Eds.), *Communicating science: new agendas in communication* (pp. 41-67). New York: Routledge.

Nisbet, M. C., & Huge, M. (2006). Attention cycles and frames in the plant biotechnology debate: managing power and participation through the press/policy connection. *Harvard International Journal of Press/Politics 11*(2), 3-40.
Nisbet, M. C., & Mooney, C. (2007). Framing science. *Science: Policy Forum, 316*, 56.
Noda, T. (2000). Behavior of victims and information processing during the great Hanshin-Awaji earthquake. *International Journal of Japanese Sociology, 9*, 67-80.
Noggerath, J., Geller, R. J., & Gusiakov , V. K. (2011). Fukushima: the myth of safety, the reality of geoscience. *Bulletin of the Atomic Scientists, 67*(5), 37-46.
Noy, I. (2009). The macroeconomic consequences of disasters. *Journal of Development Economics, 88*, 221-231.
Noy, I., & duPont, W. (2016). *The long-term consequences of natural disasters - a summary of the literature*. School of Economics and Finance, Victoria Business School SEF Working Paper 02/2016. 25p.
NZPA. (2008, 03-Oct). Apparent tsunami sighting sparks panic in Canterbury. *Stuff National News, www.odt.co.nz*.
NZPA. (2009a, 1-Oct). Civil Defence review over tsunami warnings. *Stuff National News, www.stuff.co.nz*.
NZPA. (2009b, 01-Apr). Quakes 'no cause for worry'. *Stuff National News, www.stuff.co.nz*.
NZPA. (2010a, 25-Jan). Aftershocks of last year's Fiordland quake still felt. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010b, 03-Feb). Hundreds commemorate NZ's biggest disaster. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010c, 28-May). Fire Service admits it got it wrong over tsunami alert. *Stuff National News, www.stuff.co.nz*.
NZPA. (2010d, 16-Aug). Emergency planning DVD for deaf/hearing impaired. *Stuff National News, www.odt.co.nz*.
NZPA. (2010e, 04-Sep). Canterbury quake may have been on 'new' fault line. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010f, 04-Sep). NZ 'blessed' no one died: Civil Defence minister. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010g, 4-Sep). Why so few casualties in Canterbury quake / Why we're not Haiti. *The Press News, www.stuff.co.nz*.
NZPA. (2010h, 5-Sep). Officials scale back medical commitments. *The Press News, www.stuff.co.nz*.
NZPA. (2010i, 06-Sep). Christchurch earthquake-latest updates. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010j, 08-Sep). Quake bill may reach $4b. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010k, 13-Sep). Canterbury police urge stressed residents to seek help. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010l, 17-Sep). Canterbury quake 'not the big one'. *Stuff National News, www.stuff.co.nz*.
NZPA. (2010m, 06-Oct). Warning over contaminated whitebait. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010n, 05-Nov). Builders needed to fix quake damage. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2010o, 11-Nov). ETG funding for Canterbury. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2011a, 4-Mar). No big Wellington quake coming - seismologist. *Stuff National News, www.stuff.co.nz*.
NZPA. (2011b, 06-Mar). Police keeping a close watch for potential flooding. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2011c, 9-Mar). Christchurch earthquake: latest information - Wednesday. *Stuff National News, www.stuff.co.nz*.
NZPA. (2011d, 16-Mar). Scientists drill alpine fault for first time. *Stuff Science News, www.stuff.co.nz*.
NZPA. (2011e, 21-Mar). Business owners storm quake cordon. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2011f, 13-Jun-). Key - NZers feel Christchurch's pain. *Otago Daily Times, www.odt.co.nz*.
NZPA. (2011g, 15-Jun). Aftershocks raise risk of big quake. *Stuff National News, www.odt.co.nz*.

NZWW. (2014). New Zealand Women's Weekly webpage http://www.nzwomansweekly.co.nz accessed 01 December 2014. For reference list of articles see Appendix 16.8.
O'Brien, G., O'Keefe, P., Gadema, Z., & Swords, J. (2010). Approaching disaster management through social learning. *Disaster Prevention and Management, 4*, 498-508.
O'Connell, C., J., & Mills, A. J. (2003). Making sense of bad news: the media, sensemaking, and organizational crisis. *Canadian Journal of Communication 28*(3).
Oates, K., Pinkey-Drobnis, A., Reeves, J., Wilson, T. M., & Gravley, D. M. (2012). *Getting the message right: a measure of how well the media educated the public on geoscience during the 2010-2011 earthquake sequence in Christchurch, New Zealand.* Poster paper presented at GSA Annual Meeting Minneapolis. Retrieved from http://frontiersabroad.com/wp-content/uploads/2012/09/EQ_POSTEROatesPinkeyReeves.pdf
ODESC. (2007). National hazardscape report. Wellington, NZ: Officials' Committe for Domestic and External Security Coordination (ODESC), Department of the Prime Minister and Cabinet, 149p.
OECD. (2004). *Large-scale disasters: lessons learned*. France: Organisation for Economic Co-operation and Development Publications Service, 98p.
OECD. (2008). *Costs of inaction of environmental policy challenges report*. Environment Directorate, Environmental Policy Committte of the Organisation for Economic Co-operation and Development Meeting 28-29 April 2008, OECD Headquarters. ENV/EPOC(2007)17/REV2.
Ohta, H., & Kitao, A. (1977). Responses to earthquake prediction in Kawasaki city, Japan in 1974. *Journal of Physcis of the Earth, 25*, Supplement S273-S282.
Oki, S., & Nakayachi, K. (2012). Paradoxical effects of the record-high tsunamis caused by the 2011 Tohoku earthquake on public judgments of danger. *International Journal of Disaster Risk Reduction*.
Öktem, K. (2010). The natural, the political and the religious in the borderlands of Europe. *Journal of Multicultural Discourses, 5*(1), 21-25.
Olofsson, A. (2011). The Indian Ocean tsunami in Swedish newspapers: nationalism after catastrophe. *Disaster Prevention and Management, 20*(5), 557-569.
Olsen, G. R., Carstensen, N., & Høyen, K. (2003). Humanitarian crises: what determines the level of emergency assistance? *Disasters, 27*, 109-126.
Olson, R. A., & Olson, R. S. (2001). Socioeconomic reverberations of earthquake prediction: snapshot in time, Peru 1979-1981. *Natural Hazards Review, 2*, 124-131.
Olson, R. S. (2000). Towards a politics of disaster: losses, values, agendas, and blame. *International Journal of Mass Emergencies and Disasters, 18*(2), 265-287.
Olson, R. S., & Nilson, D. C. (1982). Public policy analysis and hazards research; natural complements. *Social Science Journal, 19*, 893.
Olson, R. S., Podesta, B., & Nigg, J. M. (1989). *The politics of earthquake prediction*. Princeton, NJ: Princeton University Press.
Oösterhof, L., Heuvelman, A., & Peters, O. (2009). Donation to disaster relief campaigns: underlying social cognitive factors exposed. *Evaluation and Program Planning, 32*, 148-157.
Orchiston, C. (2010). *Tourism and seismic risk: perceptions, preparedness and resilience in the zone of the Alpine Fault, Southern Alps, New Zealand.* (Unpublished PhD thesis), University of Otago, Dunedin.
Ordono, M. S. (1984). *Pinotepa Nacional: a case of a seismic pseudo-prediction; causes and effects*. Proceedings of the International Symposium on Earthquake Prediction. Paris, UNESCO, and Tokyo. Terra Scientific Publishing Co.
Otway, H. (1987). Experts, risk communication, and democracy. *Risk Analysis, 7*(2), 125-129.
Otway, H., & Wynne, B. (1989). Risk communication: paradigm and paradox. *Risk Analysis, 9*, 141-145.
Paek, H., Hilyard, K., Freimuth, V., Barge, J. K., & Mindlin, M. (2010). Theory-based approaches to understanding public emergency preparedness: implications for effective health and risk communication. *Jounal of Health Communication, 15*, 428-444.

Palen, L., Vieweg, S., & Anderson, K. M. (2011). Supporting "everyday analysts" in safety- and time- critical situations. *The Information Society: An International Journal, 27*(1), 52-62.
Palm, R. I. (1981). Public response to earthquake hazard information. *Annals of the Association of American Geographers, 71*(3), 389-399.
Palm, R. I. (1990). *Natural hazards: an integrative framework for research and planning*. Baltimore: Johns Hopkins University Press.
Palm, R. I. (1998). Urban earthquake hazards: the impacts of culture on perceived risk and response in the USA and Japan. *Applied Geography, 18*(1), 35-46.
Palttala, P. C., Boana, R. L., Kund, R., & Vos, M. (2012). Communication gaps in disaster management: perceptions by experts from governmental and non-governmental organizations. *Journal of Contingencies and Crisis Management, 20*(1), 2-12.
Panza, G. F., Irikura, K., Kouteva, M., Peresan, A., Wang, Z., & Saragoni, R. (2011). Advanced seismic hazard assessment. *Pure Applied Geophysics, 168*, 1-9.
Paradise, T. R. (2005). Perception of earthquake risk in Agadir, Morocco: a case study from a Muslim community. *Global Environmental Change Part B: Environmental Hazards, 6*(3), 167-180.
Park, J. (2003). Contrasts in the coverage of Korea and Japan by US television networks: a frame analysis. *Gazette: The International Journal for Communication Studies, 65*(2), 145-164.
Park, R. (1995). *The Great Hanshin earthquake*. Paper presented at the Wellington after the quake; the challenge of rebuilding cities Conference, Wellington, 27-29 March 1995. Earthquake Commission, Wellington and the Centre for Advanced Engineering, Christchurch, New Zealand. 205-208.
Park, R., & Paulay, T. (1975). *Reinforced concrete structures*: John Wiley & Sons.
Parker, E., C. (1980). *What is right and wrong with the media coverage of disaster?* Paper presented at the Disasters and the Mass Media Conference , February 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 237-240.
Pasquarè, F., & Oppizzi, P. (2012). How do the media affect public perception of climate change and geohazards? An Italian case study. *Global and Planetary Change, 90-91*(152-157).
Pasquarè, F., & Pozzetti, M. (2007). Geological hazards, disasters and the media: the Italian case study. *Quaternary International, 173-174*, 166-171.
Paton, D. (2005). *Community resilience: integrating hazard management and community engagement.* Paper presented at the International Conference on Engaging Communities 14-17 August, Brisbane, 21p.
Paton, D. (2006). Disaster resilience: integrating individual, community, institutional and environment perspectives. In D. Paton & D. Johnston (Eds.), *Disaster resilience. An integrated approach* (pp. 305-319): Charles C Thomas, Springfield.
Paton, D. (2007). *Measuring and monitoring resilience in Auckland*. GNS Science Report 2007/18, 88p.
Paton, D. (2008). Risk communication and natural hazard mitigation: how trust influences its effectiveness. *International Journal of Global Environmental Issues, 8*, 2-16.
Paton, D., Bajek, R., Okada, N., & McIvor, D. (2010). Predicting community earthquake preparedness: a cross-cultural comparison of Japan and New Zealand. *Natural Hazards, 54*(3), 765-781.
Paton, D., & Johnston, D. M. (2008). A means-end chain theory analysis of hazard cognitions and preparedness *GNS Science Report 2009/19*. Lower Hutt.
Paton, D., Johnston, D. M., & Houghton, B. (2001). Direct and vicarious experience of volcanic hazards: implications for risk perception and adjustment adoption. *The Australian Journal of Emergency Management, 15*, 58-63.
Paton, D., Sagala, S., Okada, N., Jang L-J, P.T., B., & Gregg, C. E. (2010). Making sense of natural hazard mitigation: personal, social and cultural influences. *Environmental Hazards, 9*, 183-196.
Paton, D., Smith, L., & Johnston, D. M. (2005). When good intentions turn bad: promoting natural hazard preparedness. *The Australian Journal of Emergency Management, 20*(1), 25-30.

Paton, D., Smith, L., Johnston, D. M., & Ronan, K. (2003). Developing a model to predict the adoption of natural hazard risk reduction and preparatory adjustments. Wellington, New Zealand Earthquake Commission EQC Report No. 1371.

Patt, A., G., & Dessai, S. (2004). Communicating uncertainty: lessons learned and suggestions for climate change assessment. *Comptes Rendu Geosciences, 337*, 425-441.

Paulay, T., & Priestly, M. J. N. (1992). *Seismic design of reinforced and masonry buildings*. NY: John Wiley & Sons.

Paulson, N., & Menjívar, C. (2012). Religion, the state and disaster relief in the United States and India. *International Journal of Sociology and Social Policy, 32*(3/4), 179-196.

Paveglio, T., Norton, T., & Carroll, M. S. (2011). Fanning the flames? Media coverage during wildfire events and its relation to broader societal understandings of the hazard. *Research in Human Ecology, 18*(1), 41-52.

Pechta, L. E., Brandenburh, D. C., & Seeger, M. W. (2010). Understanding the dynamics of emergency communication: propositions for a four- channel model. *Journal of Homeland Security and Emergency Management, 7*(1 Article 55), .

Peek, L. A., & Mileti, D. S. (2002). The history and future of disaster research. In R. B. Bechtel (Ed.), *Handbook of environmental psychology* (pp. 511-524). Hoboken NJ: Wiley.

Pelling, M., Özerdem, A., & Barakat, S. (2002). The macro-economic impact of disasters. *Progress in Development Studies, 2*(4), 282-305.

Pepperell, S. (2010, 4-Sep). Bigger earthquake predicted to come. *The Press News, www.stuff.co.nz*.

Perera, S. (2010). Tortuous dialogues: geographies of trauma and spaces of exception. *Journal of Media and Cultural Studies, 24*(1), 31-45.

Perez-Lugo, M. (2001). The mass media and disaster awareness in Puerto Rico. *Organization & Environment, 14*(1), 55-73.

Perez-Lugo, M. (2004). Media uses in disaster situations: a new focus on the impact phase. *Sociological Inquiry, 74*(2), 210-225.

Perry, D. K. (1988). Implications of a contextualist approach to media-effects research. *Communciation Research, 15*, 246-264.

Perry, R., W. (2006). What is a disaster? *Handbook of disaster research* (pp. 1-15). New York: Springer.

Perse, E. M. (2001). *Media effects and society*. New York: Lawrence Erlbaum.

Peters, H. P. (1994). Mass media as an information channel and public arena. *Risk Health, Safety & Environment, 241*, 241-250.

Peters, H. P. (2008). *Scientists as public experts*. London: Routledge.

Peters, H. P., Brossard, D., de Cheveigne, S., Dunwoody, S., Kallfass, M., Miller, S., & Tsuchida, S. (2008). Science communication: interactions with the mass media. *Science, 321*(5886), 204-205.

Peters, R. G., Covello, V. T., & McCallum, D. B. (1997). The determinants of trust and credibility in environmental tisk communication: an empirical study. *Risk Analysis, 17*(1), 43-54.

Petersen, I., Heinrichs, H., & Peters, H. P. (2010). Mass-mediated expertise as informal policy advice. *Science Technology Human Values, 35*, 865-883.

Petit, F., Fisher, R., Yaeger, J., & Collins, M. (2011). Capturing community influence on public preparedness. *WIT Transations on the Built Environment, 119*, 183-194.

Petty, R., E., & Cacioppo, J. T. (1986). *Communication and persuasion: central and peripheral routes to attitude change*. New York: Springer-Verlag.

Pfiel, J. (2000). Massnahmen des Katastrophenschutzes und Reaktionen der Bürger in Hochwassergebieten. Am Beispiel von Bonn und Köln. In W. Glass (Ed.), *Deutsched Komitee für Katastrophenversorge e.V. (DKKV)*.

Phillips, B. D. (1986). The media in disaster threat situations: some possible relationships between mass media reporting and voluntarism. *International Journal of Mass Emergencies and Disasters, 4*(3), 7-26.

Pidgeon, N. (1998). Risk assessment, risk values and the social science programme; why we do need risk perception research. *Reliability Engineering and System Safety, 59*(1), 5-15.

Pidgeon, N., & Henwood, K. (2004). Grounded theory. In M. Hardy & A. Bryman (Eds.), *Handbook of data analysis.* (pp. 625-648): Sage.

Pidgeon, N., Hood, C., Jones, D., Turner, B., & Gibson, R. (1992). Risk perception *Risk: Analysis, Perception and Management* (pp. 89-134). London: Royal Society.

Pidgeon, N., Kasperson, R. E., & Slovic, P. (2003). *The social amplification of risk*: Cambridge University Press.

Pimbert, M. (2001). Reclaiming our right to power: some conditions for deliberative democracy. *Participatory Learning and Action, 40*, 81-84.

Piotrowski, C., & Armstrong, T. R. (1998). Mass media preferences in disaster: a study of Hurricane Danny. *Social Behaviour and Personality, 26*(4), 341-346.

Platt, R. H. (1999). *Disasters and democracy: the politics of extreme natural events*. Washington, DC: Island Press.

Plough, A., & Krimsky, S. (1987). The emergence of risk comunication studies: social and political context. *Science, Technology & Human Values, 12*(3/4), 4.

Ploughman, P. (1995). The American print news media 'construction' of five natural disasters. *Disasters, 19*(4), 308-326.

Ploughman, P. (1997). Disasters, the media and social structures: a typology of credibility hierarchy persistence based in newspaper coverage of the Love Canal and six other disasters. *Disasters, 21*(2), 118-137.

Poliakoff, E., & Webb, T., L. (2007). What factors predict scientists' intentions to participate in public engagement of science activities? *Science Communication, 29*, 242-263.

Pomeroy, A. (2010). *Measuring progress in building community resilience to disasters*. Final draft best practice guideline for Ministry of Civil Defence and Emergency Management (MCDEM), New Zealand. August 2010, 45p.

Porteous, D. (2011, 25-Jun). Community patrollers meet. *Otago Daily Times, www.odt.co.nz*.

Porto, M. (2001). *Media framing and citizen competence: television and audiences' interpretation of politics in Brazil.* University of California, San Diego.

Porto, M. (2007a). Frame diversity and citizen competence: towards a critical approach to news quality. *Critical Studies in Media Communication, 24*, 303-321.

Porto, M. (2007b). Framing controversies: television and the 2002 presidential election in Brazil. *Political Communication, 24*, 19-36.

Potangaroa, R., Wilkinson, S., Zare, M., & Steinfort, P. (2011). The management of portable toilets in the eastern suburbs of Christchurch after the February 22, 2011 earthquake. *Australasian Journal of Disaster and Trauma Studies, 2011-02*, 35-48.

Potter, D. M., & Van Belle, D. A. (2004). News media coverage influence on Japan's foreign aid allocations. *Japanese Journal of Political Science, 5*(1), 113-135.

Potter, D. M., & Van Belle, D. A. (2009). News coverage and Japanese foreign disaster aid: a comparative example of bureaucratic responsiveness to the news media. *International Relations of the Asia-Pacific, 9*, 295-315.

Powell, F. (2010). Urban earthquake events and businesses: learning from the 2007 Gisborne earthquake in New Zealand. *Australian Journal of Emergency Management, 25*(3), 54-59.

Press Reporters. (2010, 4-Sep). Huge earthquake rocks Christchurch. *The Press News, www.stuff.co.nz*.

Price, V., Tewksbury, D., & Powers, E. (1997). Switching trains of thought: the impact of news frames on readers' cognitive responses. *Communication Research, 24*, 481-506.

Putnam, R. D. (2000). *Bowling alone: the collapse and revival of American community*. New York: Simon & Schuster

Quarantelli, E. L. (1975). *The command post point of view in the local mass communication system*. University of Delaware Disaster Research Centre Preliminary Paper 22, 18p.

Quarantelli, E. L. (1980). *Some research emphases for studies on mass communication systems and disasters.* Paper presented at the Disasters and the Mass Media, February Conference 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 293-300.

Quarantelli, E. L. (1981). The command post point of view in local mass media communication systems. *International Journal of Communications Research, 7*, 57-73.

Quarantelli, E. L. (1985). Realities and mythologies in disaster films. *Communications, 11*(1), 31-44.

Quarantelli, E. L. (1988). Disaster crisis management: a summary of research findings. *Journal of Management Studies, 25*(4), 373-385.

Quarantelli, E. L. (1991). *Lessons from research: findings on mass communication system behaviour in the pre, trans and post-impact periods of disasters* University of Delaware Disaster Research Centre. Preliminary Paper 60. 60p.

Quarantelli, E. L. (1996a). Basic themes derived from survey findings on human behaviour in the Mexico City earthquake. *International Sociology, 11*, 481-499.

Quarantelli, E. L. (1996b). The future is not the past repeated: projecting disasters in the 21st century from current trends. *Journal of Contingencies and Crisis Management, 4*(4), 228-240.

Quarantelli, E. L. (1996c). Local mass media operations in disasters in the USA. *Disaster Prevention and Management, 5*(5), 5.

Quarantelli, E. L. (1999). *The disaster recovery process: what we know and do not know from research*. University of Delaware Disaster Research Centre Prelimiary Paper 286. 18p.

Quarantelli, E. L., Wenger, D. E., Mikami, S., & Hiroi, O. (1993). *The reporting of news in disaster: a comparitive study of japanese and american communities*. Retrieved from

Quigley, M. (2012). *Calm and assured on the outside: communicating earthquake science*. Presentation at Science Communicators Association of New Zealand Conference (SCANZ 2012), 23 February 2012, Te Papa, Wellington.

Radford, T., & Wisner, B. (2012). Media, communications and disaster. In B. Wisner, J. Gaillard, & I. Kelman (Eds.), *The Routledge Handbook of Hazards and Disaster Risk Reduction* (pp. 761-771). London: Routledge.

RADIX. (2013-2016). Internet discussion group. Personal communications through. https://http://www.jiscmail.ac.uk/cgi-bin/webadmin?A0=RADIX.

Rappaport, J. (2000). Community narratives: tales of terror and joy. *American Journal of Community Psychology, 28*(1), 1-24.

Rashid, H. (2011). Interpreting flood disasters and flood hazard perceptions from newspaper discourse: tale of two floods in the Red River valley, Manitoba, Canada. *Applied Geography, 31*, 35-45.

Rasmussen, A. M. (2005). Tsunami research and resources: media responses to the tsunami. *NIAS Nytt, 2*, 18-20.

Rattien, S. (1990a). *Communication when it is needed most: how new technology could help in sudden disasters.* Paper presented at the International Conference on Disaster Communications, Geneva.

Rattien, S. (1990b). The role of the media in hazard mitigation and disaster management. *Disasters, 14*(1), 36-45.

Ravetz, J. R. (2003). Models as metaphors. In B. Kasemi, J. Jäger, C. C. Jaeger, & M. T. Gardner (Eds.), *Public participation in sustainability science: a handbook*. Cambridge, UK: Cambridge University Press.

Reder, L. M. (1982). Elaborations: when do they help and when do they hurt? *Text, 2*, 211-224.

Renn, O. (1998a). The role of risk communication and public dialogue for improving risk management. *Risk Decision and Policy, 3*(1), 5-30.

Renn, O. (1998b). The role of risk perception for risk management. *Reliability Engineering and System Safety, 59*(1), 49-62.

Renn, O. (2006). Risk communciation - consumers between information and irritation. *Journal of Risk Research, 9*(8), 833-849.

Renn, O., & Levine, D. (1991). Credibility and trust in risk communication. In R. Kasperson & P. Stallen (Eds.), *Communicating risks to the public* (pp. 175-218). Kluwer, Dortrecht.

Renzulli, D. R., Mebane, F., & Sieff, E. (2006). News coverage analyses of mental health services immediately after September 11, 2001. *Psychiatric Services, 57*, 1339-1341.

Reuters. (2008a, 16-May). Rumours fly as China quake victims seek news. *WorldlNews, www.stuff.co.nz*.

Reuters. (2008b, 17-May). China teacher sacked for running from quake school. *World News, www.stuff.co.nz*.

Reuters. (2008c, 30-May-2008). China angry over Sharon Stone's karma remark.

Reuters. (2009a, 07-Apr). Scientist muzzled for Italy quake warnings. *World News, www.stuff.co.nz*.
Reuters. (2009b, 08-Apr). Scientists dismiss prediction. *World News, www.stuff.co.nz*.
Reuters. (2010a, 20-Apr). Scanty clothing causes – earthquakes - cleric. *World News, www.stuff.co.nz*.
Reuters. (2010b, 22-Apr). 'Evacuate Tehran' says Ahmadinejad. *World News, www.stuff.co.nz*.
Reuters. (2011, 9-May). Romans flee predicted quake. *World News, www.stuff.co.nz*.
Reynolds, B., & Seeger, M. (2005). Crisis and emergency risk communication as an integrative model. *Journal of Health Communication, 10*(1), 43-55.
Richardson, J. E. (2007). *Analysing newspapers: an approach from critical discourse analysis*. New York: Palgrave Macmillan.
Ricketts, M., Shanteau, J., McSpadden, B., & Fernandez-Medina, K. M. (2010). Using stories to battle unintentional injuries: narratives in safety and health communication. *Social Science & Medicine, 70*(9), 1441-1449.
Riffe, D., Lacy, S., & Fico, F. G. (1998). *Analyzing media messages: using quantitative content analysis in research*. Mahwah, NJ: Lawrence Erlbaum Associates.
Rioux, J.-S., & Van Belle, D. A. (2005). The influence of Le Monde coverage on French foreign aid allocations. *International Studies Quarterly, 49*(3), 481-502.
Risk, L. (2011, 01 March). Nowhere's safe says expert. *Waikato Times (www.stuff.co.nz)*.
Risk, L. N. (2011, 1-Mar). Scientists weigh danger of more earthquakes. *The Press News, www.stuff.co.nz*.
Rittel, H. W. J., & Weber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*, 155-169.
Robinson, J. P., & Levy, M., R. (1986). Interpersonal communication and news comprehension. *Public Opinion Quarterly, 50*(1), 160-175.
Robinson, S. (2009a). 'If you had been with us': mainstream press and citizen journalists jockey for authority over the collective memory of Hurricane Katrina. *New Media & Society, 11*, 795-814.
Robinson, S. (2009b). 'We were all there': remembering America in the anniversary coverage of Hurricane Katrina. *Memory Studies, 2*, 235-253.
Robinson, V. (2011, 25-Feb). Cantabrians urged to keep up hygiene. *The Press News, www.stuff.co.nz*.
Rodrigue, C., M. (2004). *Hazard vulnerability, media construction of disaster and risk management*. Paper presented at the Education and Training in Disaster Medicine and Major Incident Management Conference; an international working conference of the World Association of Disaster and Emergency Medicine, 29 October-1 November 2004, Brussels.
Rodríguez, H., Díaz, W., & Aguirre, B. (2004). *Communicating risk and warnings: an integrated and Interdisciplinary research approach*. University of Delaware Disaster Research Centre Preliminary Paper 337.
Rodríguez, H., Díaz, W., Santos, J. M., & Aguirre, B. E. (2006). Communicating risk and uncertainty: science, technology, and disasters at the crossroads. In H. Rodríguez, E. L. Quarantelli, & R. Dynes (Eds.), *Handbook of disaster research* (pp. 476-488). New York: Springer.
Rodríguez, H., & Dynes, R. (2006). *Finding and framing Katrina: the social construction of disaster*. Retrieved from http://understandingkatrina.ssrc.org/Dynes_Rodriguez/ November, 2011.
Roe, E. (1994). *Narrative policy analysis. Theory and practice*. Durham and London: Duke University Press.
Rogers, E. M. (1990). The mass media and disasters. *Earthquakes & Volcanoes, 22*(4), 176-178.
Rogers, E. M., & Sood, R. S. (1980). *Mass media communication and disasters: a content analysis of media coverage of the Andhra Pradesh cyclone and the Sahel drought.* Paper presented at the Disasters and the Mass Media Conference , February 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 139-157.

Rohrmann, B. (2003a). Perception of risk: research, results, relevance. In J. Gough (Ed.), *Sharing the future: risk communication in practice* (pp. 21-45). Christchurch: Centre for Advanced Engineering, University of Canterbury.

Rohrmann, B. (2003b). The role of risk communication processes in disaster preparedness. In J. Gough (Ed.), *Sharing the future: risk communication in practice* (pp. 85-104). Christchurch: Centre for Advanced Engineering, University of Canterbury.

Rojecki, A. (2009). Political culture and disaster response: the great floods of 1927 and 2005 *Media, Culture and Society, 31*, 957-976.

Rolfe, J., & Britton, N. R. (1995). *Organisation, government and legislation: who coordinates recovery?* Paper presented at the 'Wellington after the quake; the challenge of rebuilding cities' Conference 27-29 March 1995, Wellington, 27-29 March 1995. Earthquake Commission, Wellington and the Centre for Advanced Engineering, Christchurch, New Zealand, p. 23-24.

Ronan, K. R., Johnston, D. M., & Paton, D. (2001). *Communities' understanding of earthquake risk in the Hawke's Bay and Manawatu-Wanganui regions, New Zealand.* Paper presented at the New Zealand Society of Earthquake Engineering Conference 2001.

Rosengren, K. E. (1970). International news: intra and extra media data. *Acta Sociologica, 3*(2), 96-109.

Ross, K., E.K., & Shuell, T., J. (1993). Children's belief's about earthquakes. *Science Education, 77*(2), 191-205.

Rotimi, J. A., Le Masurier, J., & Wilkinson, S. (2006). *The regulatory framework for effective post-disaster reconstruction in New Zealand*. Paper presented at the third international conference on Post-disaster Reconstruction: Meeting Stakeholder Interests, Florence, Italy.

Rotimi, J. A., Wilkinson, S., Zuo, K., & Myburgh, D. (2009). Legislation for effective post-disaster reconstruction. *International Journal of Strategic Property Management, 13*(2), 143-152.

Rovai, E., & Rodrigue, C. M. (1998). The "Northridge" and "Ferndale" earthquakes: spatial inequities in media attention and recovery. *National Social Science Journal 11*(2), 109-120.

Rowan, K., E. (1994a). The technical and democratic approaches to risk situations: their appeal limitations, and rhetorical alternative. *Argumentation, 8*, 391-409.

Rowan, K., E. (1994b). Why rules for risk communication are not enough: a problem-solving approach to risk communication. *Risk Analysis, 14*(3), 365-372.

Rowley, J. (2007). The wisdom hierarchy: representations of the DIKW hierarchy. *Journal of Information and Communication Science, 33*(2), 163-180.

Royal Commission. (2012a). *Final report volume 1: seismicity, soils and the seismic design of buildings*. Retrieved from New Zealand:

Royal Commission. (2012b). Summary and recommendations - Volumes 5-7 (pp. 18). New Zealand: Royal Commission of Inquiry into Building Failure Caused by the Canterbury Earthquakes, Final Report Part 3: Volume 5 Section 1, 18.

Rudd, A. (2012, 07-Dec). Dogs get a sniff of remedy. *Otago Daily Times, www.odt.co.nz*.

Russell, L. A., Goltz, J. D., & Bourque, L., B. (1995). Preparedness and hazard mitigation actions before and after two earthquakes. *Environment and Behaviour, 27*.

Rutherford, H. (2011, 23-Feb). Quake may give brutal shock to NZ economy. *Business Day, www.stuff.co.nz*.

Sachdeva, S. (2010, 8-Nov). Quake planting plan takes root. *Stuff National News, www.stuff.co.nz*.

Sachdeva, S. (2011a, 11-Mar). Eerily accurate warnings ignored/Quake doco warned of danger (Documentary warned of Christchurch earthquake danger). *Stuff National News, www.stuff.co.nz*.

Sachdeva, S. (2011b, 18-Jul). Drifting debris lands on harbour beaches. *The Press News, www.stuff.co.nz*.

Sachdeva, S. (2011c, 14-Oct). Christison's dedicated to Christchurch. *The Press www.stuff.co.nz*.

Sachdeva, S., & Mathewson, N. (2011, 11-Aug). Plan to build a 'city in a garden'. *The Press News, www.stuff.co.nz*.

Sachsman, D., B., Simon, J., & Valenti, J. M. (2004). Risk and the environment reporters: a four-region analysis. *Public Understanding of Science, 13*, 399-416.

Sakamoto, K., Minamidate, Y., & Nagai, T. (2011). Messages from a medical library in the earthquake-prone zone. *Tohoku Journal of Experimental Medicine, 225*, 77-80.
Samuelson, P. A., & Nordhaus, W. D. (2004). *Economics (18th edn)* (Vol. 18th edition). Boston: McGraw Hill.
Sandman, P. M. (1994). Mass media and environmental risk: seven principles. *Risk: Health, Safety & Environment, 5*(3), 251.
Sandman, P. M. (2003). Four kinds of risk communication. *Synergist, April*, 26-17.
Sandman, P. M., Miller, P. M., Johnson, B. B., & Weinstein, N. D. (1993). Agency communication, community outrage, and perception of risk: three simulation experiments. *Risk Analysis, 13*, 585-598.
Sandman, P. M., Sachsman, D. B., Greenberg, M. R., & Gochfeld, M. (1987). *Environmental risk and the press*. New Brunswick, NJ: Transaction Books.
Santamaria, A. (2010, 01-Sep). 10 Great reasons to visit Christchurch. *Next Magazine, New Zealand*.
Sarewitz, D., & Pielke, R., Jr. (2001). Extreme events: a research and policy framework for disasters in context. *International Geology Review, 43*(5), 406-418.
Sarewitz, V. (2004). How science makes environmental controversies worse. *Environmental Science Policy, 7*, 385-403.
Saunders, W. S. A., Forsyth, J., Johnston, D. M., & Becker, J. S. (2009). Strengthening linkages between land-use planning and emergency management in New Zealand. *Australian Journal of Emergency Management, 22*(1), 36-43.
Savage, J. C. (1993). The Parkfield prediction fallacy. *Bulletin of the Seismological Society of America, 83*, 1-6.
Scanlon, J. (1980). *The media and the 1978 Terrace Floods: an initial test of hypothesis.* Paper presented at the Disasters and the Mass Media Conference, February 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 254-263.
Scanlon, J. (2006). Unwelcome irritant or useful ally? The mass media in emergencies. In H. Rodriguez, E. L. Quarantelli, & R. Dynes (Eds.), *Handbook of disaster research* (pp. 413-429): Springer.
Scanlon, J. (2011). Research about the mass media and disaster: never (well hardly ever) the twain shall meet. In J. R. Detrani (Ed.), *Journalism Theory and Practice* (pp. 233-269): Apple Academic Press.
Scanlon, J., & Alldred, S. (1982). Media coverage of disasters: the same old story. *Emergency Planning Digest, Oct-Dec*, 13-19.
Scanlon, J., Luukko, R., & Morton, G. (1978). Media coverage of crises. Better than reported, worse than necessary. *Journalism Quarterly, 55*(1), 68-72.
Schäfer, M. S. (2009). From public understanding to public engagement: an empirical assessment of changes in science coverage. *Science Communciation, 30*(4), 475-505.
Schanne, M., & Meier, W. (1992). Media coverage of risk: results from content analysis. In J. Durant (Ed.), *Biotechnology in public: a review of recent research*: (pp. 142-169), London: Science Museum for the European Federation of Biotechnology.
Schencking, J. C. (2008). The Great Kanto earthquake and the culture of catastrophe and reconstruction in 1920s Japan. *Journal of Japanese Studies, 34*(2), 295-331.
Scheufele, B. (2006). Frames, schemata, and news reporting. *Communications, 31*(1), 65-83.
Scheufele, D. A. (2000). Agenda-setting, priming and framing revisited: another look at cognitive effects of political communication. *Mass Communication & Society, 3*, 297-316.
Scheufele, D. A. (2014). Science communication as political communication. *Proceedings of the National Academy of Sciences, 111*(4), 13585–13592.
Schilderman, T., & Lyons, M. (2011). Resilient dwellings or resilient people? Towards people-centred reconstruction. *Environmental Hazards, 10*(3-4), 218-231.
Schlehe, J. (2010). Anthropology of religion: disasters and the representations of tradition and modernity. *Religion, 40*(2), 112-120.
Schmierbach, M. (2005). Method matters; the influence of methodology on journalists assessments of social science research. *Science Communication, 26*, 269-297.

Schön, D., A., & Rein, M. (1994). *Frame reflection. Towards the resolution of intractable policy controversies*. New York: Basic Books.
Schramm, W., & Wade, S. (1969). The mass media as sources of public affairs, science and health knowledge. *Public Opinion Quarterly, 33*, 197-209.
Schulz, C. (2011, 01-Mar). John Campbell 'sorry' for Ken Ring interview. *Stuff Entertainment www.stuff.co.nz*.
Scraton, P. (2004). Reporting of disasters. In D. H. Johnston, L. García, & D. Abrahamson (Eds.), *Encyclopedia of International Media and Communications* (pp. 419-429). Maryland Heights, MO: Academic Press.
Seeger, M. (2006). Best practices in crisis communication: an expert panel process. *Journal of Applied Communciation Research, 34*(3), 232-244.
Seid-Aliyeva, D. (2006). *Role of mass media in the disaster preparedness and sustainable development of society*. A. Ismail-Zadeh (Ed.). Proceedings of the International Workshop on Recent Geodynamics, Georisk and Sustainable Development in the Black Sea to Caspian Sea Region, 79-83.
Sellnow, T. L., Ulmer, R. R., Seeger, M. W., & Littlefield, R. (2009). *Effective risk communication: a message centred approach*. New York, NY: Springer Science and Business Media.
Semetko, H. A., & Valkenburg, P. M. (2000). Framing European politics: a content analysis of press and television news. *Journal of Communication, 50*, 939.
Seo, M., Sun, S., Merolla, A. J., & Zhang, S. (2011). Willingness to help following the Sichuan earthquake: modelling the effects of media involvement, stress, trust, and relational resources. *Communication Research, 39*(3), 3-25.
Serra-Llobet, A., Tabar, J. D., & Sauri, D. (2013). The Tous dam disaster of 1982 and the origins of integrated flood risk management in Spain. *Natural Hazards, 65*, 1981-1998.
Seville, E. (2009). Resilience: great concept ... but what does it mean for organisations? *Tephra, 22 - Community Resilience: research planning and civil defence emergency management*, 9-14.
Seville, E., Vargo, J., Stevenson, J., & Stephenson, A. (2011). *Making the case for resilience investments*. Paper presented at the Applications of Statistics and Probability in Civil Engineering - Proceedings of the 11th International Conference on Applications of Statistics and Probability in Civil Engineering; 2215-2221.
Seydlitz, R., Spencer, J. W., Laska, S., & Triche, E. (1991). The effects of newspaper reports on response to a natural hazard. *International Journal of Mass Emergencies and Disasters, 9*(1), 5-29.
Shackley, S., & Wynne, B. (1996). Representing uncertainty in global climate change science and policy: boundary-ordering devices and authority. *Science Technology, & Human Values, 21*(3), 275-302.
Shanahan, M. (2010). Changing the meaning of peer-to-peer? Exploring online comment spaces as sites of negotiated expertise. *Journal of Science Communication, 9*(1), A01.
Shannon, R., Hope, M., & McCloskey, J. (2011). The Bengkulu premonition: cultural pluralism and hybridity in disaster risk reduction. *Area, 43*(4), 449-455.
Sharpe, M. (2010, 15-Sep). Unrealistic optimism' bounces back. *The Press News, www.stuff.co.nz*.
Sharpe, M. (2011, 26-Mar). What Napier can teach Christchurch about earthquake recovery. *The Press News, www.stuff.co.nz*.
Shaw, R., & Goda, K. (2004). From disaster to sustainable civil society: the Kobe experience. *Disasters, 28*(1), 16-40.
Shaw, R., Shiwaku, K., Kobayashi, H., & Kobayashi, M. (2004). Linking experience, education, perception and earthquake preparedness. *Disaster Prevention and Management, 13*(1), 39-49.
Shepherd, R. G. (1981). Selectivity of sources: reporting the marijuana controversy. *Journal of Communication, 31*, 129-138.
Shepherd, R. G., & Goode, E. (1987). Scientists in the popular press. *New Scientist, 24*(Nov), 482-484.
Shipman, M., Fowler, G., & Russ, S. (1993). Media coverage of the Browning prediction, whose fault was it? An analysis of newspaper coverage of Iben Browning's New Madrid Fault

earthquake prediction. *International Journal of Mass Emergencies and Disasters, 11*(3), 379-389.
Showalter, P. S. (1993). Prognostication of doom: an earthquake prediction's effect on four small communities. *International Journal of Mass Emergencies and Disasters, 11*, 279-292.
Siebert, F. S., Patterson, T., & Schramm, W. (1956). *Four theories of the press*. Urbana: University of Illinois Press.
Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: the role of social trust and knowledge. *Risk Analysis, 20*(5), 713-719.
Siegrist, M., & Gutscher, H. (2008). Natural hazards and motivation for mitigation behavior: People cannot predict the affect evoked by a severe flood. *Risk Analysis, 28*(3), 771-778.
Silverstone, R. (1991). Communciating science to the public. *Science, Technology & Human Values, 16*, 1060.
Simon, A. F. (1997). Television news and international earthquake relief. *Journal of Communication, 47*(3), 82-92.
Sims, J. H., & Baumann, D., D. (1983). Educational programs and human response to natural hazards. *Environment and Behaviour, 15*, 165-189.
Singer, E. (1990). A question of accuracy: how journalists and scientists report research on hazards. *Journal of Communication, 40*(4), 1026.
Singer, E., & Endreny, P. M. (1987). Reporting hazards: their benefits and costs. *Journal of Communication, 37*, 11-26.
Singer, E., & Endreny, P. M. (1994). Reporting on risk: how the mass media portray diseases, disasters and other hazards *Working paper series. University of Michigan, Institute for Social Research* (pp. 261-270). Michigan: Ann Arbour.
Sjöberg, L. (1998). Risk perception: experts and the public. *European Psychologist, 3*, 1-12.
Slone, I. (2011). Fashion statement: Vogue magazine's depiction of oil-slick fashion represents environmental exploitation to some, but daring social commentary to others. *Alternatives Journal, 37*(1), 32.
Slovic, P. (1987). Perception of risk. *Science, 236*, 280-285.
Slovic, P. (1999). Trust, emotion, sex, politics, and science: surveying the risk-assessment battlefield. *Risk Analysis, 19*, 689-701.
Slovic, P., Fischhoff, B., Lichtenstein, S., Corrigan, B., & Combs, B. (2000). Preference for insuring against probable small losses: insurance implications. In S. P. (Ed.), *The perception of risk* (pp. 51-72). London: Earthscan.
Slovic, P., & Weber, E. (2002). *Perception of risk posed by extreme events*. Paper presented at the Conference on Risk Management Strategies in an Uncertain World, New York, NY.
Smallman, C. (1997). Read all about it - risk trends in the media: a research note. *Disaster Prevention and Management 6*(3), 160-164.
Smelik, A. (2010). Mediating memories. *International Journal of Literary Studies*, 307-325.
Smillie, L., & Blisset, A. (2010). A model for developing risk communication strategy. *Journal of Risk Research, 13*(1), 115-134.
Smith, C. (1996). Reporters, news sources and scientific intervention: the New Madrid earthquake prediction. *Public Understanding of Science, 5*(2), 205-216.
Smith, K. (1993). *Environmental hazards: assessing risk and reducing disaster*. London: Routledge.
Smith, R. (2009). Research, science and emergency management. *Tephra: NZ Ministry of Civil Defence and Emergency Management Science and Education publication, 22*, 71-78.
Sol, A., & Turan, H. (2004). The ethics of earthquake prediction. *Science and Engineering Ethics, 10*(4), 655-666.
Solana, M. C., Kilburn, C. R. J., & Rolandi, G. (2008). Communicating eruption and hazard forecasts on Vesuvius, Southern Italy. *Journal of Volcanology and Geothermal Research, 172*(3-4), 308-314.
Solberg, C., Rosetto, T., & Joffe, H. (2010). The social psychology of seismic hazard adjustement: re-evaluating the international literature. *Natural Hazards and Earth Systems Science, 10*, 1663-1677.

Song, B. (2010). New perspective of urban disaster prevention and mitigation: integration of part and whole, scientific planning, and adaptation to the characteristics of modern urban disaster. *Tumu Gongcheng Xuebao/China Civil Engineering Journal, 43*(5), 142-148.

Sood, R., Stockdale, G., & Rogers, E. M. (1987). How the news media operate in natural disasters. *Journal of Communication, 37*(3), 27-41.

Southern, R. L. (2009). Chapter 7. In G. J. Holland (Ed.), *Global guide to tropical cyclone forecasting*. Melbourne, Victoria, Australia: Bureau of Meteorology Research Centre, The Centre for Australian Weather and Climate Research.

Souza, D., & Martínez, V. (2011). The intervention of TV in the Chilean earthquake. *Scientific Journal of Media Literacy, 36*(XVIII), 69-76.

Sparks, R. S. J. (2003). Forecasting volcanic eruptions. *Earth and Planetary Science Letters, 210*(1-2), 1-15.

Spee, K. (2008). Community recovery after the 2005 Matata disaster: long-term psychological and social impacts': GNS Science Report 2008/12, 40p.

Spence, P. R., Lachlan, K. A., & Burke, J. (2008). Crisis preparation, media use, and information seeking: patterns across Katrina evacuees and lessons learned for crisis communication. *Journal of Emergency Management, 6*(1), 11-23.

Spence, P. R., Lachlan, K. A., & Burke, J., A. (2011). Differences in crisis knowledge across age, race, and socioeconomic status during Hurricane Ike: a field test and extension of the knowledge gap hypothesis. *Communication Theory, 21*, 261-278.

Spence, P. R., Lachlan, K. A., Burke, J., M., & Seeger, M. W. (2007). Media use and information needs of the disabled during a natural disaster. *Journal of Health Care for the Poor and Undeserved, 18*(2), 394-404.

Spence, P. R., Lachlan, K. A., & McIntyre, J. J. (2009). Serving the public interest in a crisis: radio and its unique role. *Journal of Radio and Audio Media, 16*, 144-149.

Spence, P. R., Lachlan, K. A., & Ray, S. (2008). Hazard, outrage, and pre-disaster crisis communication messages *National Communication Association* (Vol. 1, pp. 26).

Spencer, J. W., Seydlitz, R., Laska, S., & Triche, E. (1992). The different influences of newspaper and television reports of a natural hazard on response behaviour. *Communication Research, 19*, 299-324.

Spencer, J. W., & Triche, E. (1994). Media constructions of risk and safety - differential framings of hazard events. *Sociological Inquiry, 64*(2), 199-213.

Spittal, M. J., McClure, J., Siegert, R. J., & Walkey, F. H. (2008). Predictors of two types of earthquake preparation: survival activites and mitigation activities. *Environment and Behaviour, 2008*(40), 798-817.

Spittal, M. J., Walkey, F. H., McClure, J., Siegert, R. J., & Ballantyne, K. (2006). The earthquake readiness scale: the development of a valid and reliable unifactorial measure. *Natural Hazards, 39*, 15-29.

Squires, S. (2010, 17-Oct). Seismic lessons. *The Press News, www.stuff.co.nz*.

Stallings, R. A. (1990). Media discourse and the social construction of risk. *Social Problems, 37*(1), 80-95.

Starks, J. (2010, 12-Oct). Tremors in equity. *Stuff Business News www.stuff.co.nz*.

Steelman, T. A., & McCaffrey, S. (2013). Best practices in risk and crisis communication: implications for natural hazards management. *Natural Hazards, 65*(1), 683-705.

Steeman, m. (2011, 28-Jun). Quakes affect two-thirds of NZ businesses. *The Press News, www.stuff.co.nz*.

Stefanovic, I. L. (2003). The contribution of philosophy to hazards assessment and decision-making. *Natural Hazards, 28*, 229-247.

Stein, S., & Okal, E. A. (2011). The size of the 2011 Tohoku earthquake need not have been a surprise. *EOS, 92*(227), 227-228.

Steinberg, L. J., & Cruz, A. M. (2004). When natural and technological disasters collide: lessons from the Turkey earthquake of August 17, 1999. *Natural Hazards Review, 5*(3), 121-130.

Steinberg, T. (2000). *Acts of god: the unnatural history of natural disaster in America*. New York: Oxford University Press, Inc.

Steinberg, T. (2001). The secret history of natural disaster. *Global Environmental Change Part B: Environmental Hazards, 3*(1), 31-35.
Stenekes, N., Colebatch, H., K., Waite, T. D., & Ashbolt, N. J. (2006). Risk and governance in water recycling: public governance revisited. *Science, Technology and Human Values, 31*(2), 107-134.
Stevens, J. (1993). The impact of the Browning prediction on institutions: an association of circumstance: the 1990 Browning earthquake prediction and the Centre for Earthquake Research and Information. *International Journal of Mass Emergencies and Disasters, 11*(3), 405-420.
Steward, I. (2010, 9-Sep-10). Earthquake email advice 'dangerous'. *The Press News www.stuff.co.nz*.
Stewart, C. O. (2005). A rhetorical approach to news discourse: media representations of a controversial study on 'reparative therapy'. *Western Journal of Communication 69*(2), 147-166.
Stewart, M. (2010, 27-Sep). Engineers flat out in Christchurch. *Otago Daily Times, www.odt.co.nz*.
Stewart, T. (2011, 31-Aug). Christchurch rebuild predicted to run 15 years (Christchurch rebuild may suffer from Japan fallout). *The Press News, www.stuff.co.nz*.
Stiff, J. B., & Mongeau, P. A. (2003). *Persuasive communication*. New York: The Guilford Press.
Stirling, A. (2007). *Framing complexity and resilience: towards more reflexive socio- ecologies of sustainability*. Paper presented at the Conference of the European Society for Ecological Economics on Integrating Natural and Social Sciences for Sustainability, Leipzig (Vol 8).
Stirling, A. (2008a). "Opening up" and "closing down": power, participation and pluralism in the social appraisal of tchnology. *Science, Technology & Human Vaues, 33*(2), 262-294.
Stirling, A. (2008b). Science, precaution, and the politics of technological risk. *Annals of the New York Academy of Sciences, 1128*, 95-110.
Stirling, A., & Scoones, I. (2009). From risk assessment to knowledge mapping: science, precaution, and participation in disease ecology. *Ecology and Society, 14*(2), 14.
Stirling, M., McVerry, G., Berryman, K., McGinty, P., Villamor, P., Van Dissen, R., . . . Sutherland, R. (2000). *Probabilistic seismic hazard assessment of New Zealand; new active fault data, seismicity data, attentuation relationships and methods*. Retrieved from
Stirling, M., Yetton, M., Pettinga, J., Berryman, K., & Downes, G. (1999). *Probabailistic seismic hazard assessment and earthquake scenarios for the Canterbury region, and historic earthquakes in Christchurch. Stage 1 (Part B) of Canterbury Regional Council's earthquake hazard and risk assessment study*. Retrieved from
Stock, P., V. (2007). Katrina and anarchy: a content analysis of a new disaster myth. *Sociological Spectrum: Mid-South Sociological Association, 27*(6), 705-726.
Stocking, H. S. (1999). How journalists deal with scientific uncertainty. In S. M. Friedman, C. L. Dunwoody, & C. L. Rogers (Eds.), *Communicating uncertainty. Media coverage of new, controversial science*. Mahwah: Lawrence Erlbaum Associates.
Stocklmayer, S., Gore, M., & Bryant, C. (2005). Science communication for scientists: reshaping a culture. In M. Keen, B. V.A., & R. Dyball (Eds.), *Social learning in environmental management* (pp. 207-223). London: Earthscan.
Stramondo, S., Kyriakopoulos, C., Bignami, C., Chini, M., Melini, D., Moro, M., . . . Boschi, E. (2011). Did the September 2010 (Darfield) earthquake trigger the February 2011 (Christchurch) event? *Scientific Reports, 1*(98), 1-7.
Stylianou, G. (2011a, 1-Dec). Health boss recognised for quake effort. *The Press News, www.stuff.co.nz*.
Stylianou, G. (2011b, 4-May). Micronutrients effective. *The Press News, www.stuff.co.nz*.
Su, C. (2012). One earthquake, two tales: narrative analysis of the tenth anniversary coverage of the 921 Earthquake in Taiwan. *Media, Culture & Society, 34*(3), 280-295.
Su, G., Zong-jin, M., Wang, R., Wang, Y., Dai, B., Zhang, S., . . . Zhang, S. (2008). General features and their disaster-reduction education implications of the earthquake disaster cognition and responses of the social public in Ms 8.0 Wenchuan earthquake-hit area: a case study from Deyang prefecture-level city, Sichuan Province. *Dìzhèn dìzhì, 30*(4), 877-894 (English Abstract 893-894).

Sun, S., Zhao, Y., & Li, R. (2009). Sustainable design strategy of anti-seismic building for post-Wenchuan earthquake reconstruction. *Journal of Harbin Institute of Technology, 16*(2), 124-126.

Susman, P., O'Keefe, P., & Wisner, B. (1983). Global disasters, a radical interpretation. In K. Hewitt (Ed.), *Interpretations of calamity* (pp. 263-283). Boston, London, and Sydney: Allen and Unwin.

Tagle, E. L., & Nazarit, P. S. (2011). The 2010 earthquake in Chile: the response of the health system and international cooperation. *Revista Panamericana de Salud Publica - Pan American Journal of Public Health, 30*(2), 160-166.

Takeuchi, K. (2011). Rebuilding from the Great Eastern Japan earthquake: a message from the Editor-in-Chief. *Sustainability Science, 6*, 1178.

Takeuchi, Y., & Shaw, R. (2011). Possible risk communication framework in typhoon affected areas of Taiwan. *Asian Journal of Environment and Disaster management, 3*(2), 163-175.

Talciani, H. C. (2010). Liability in the construction of buildings. Discussion about the different legal paths to recover damages caused by Chile's earthquake of February 27. *Revista Chilena de Derrecho, 37*(3), 459-475.

Tamlyn, S. (2011, 25-Jun). Businesses unite to keep Christchurch alive. *Stuff Business Day, www.stuff.co.nz*.

Tanabe, S., & Subramanian, A. (2010). Great Eastern Japan Earthquake - Possible marine environmental contamination by toxic pollutants. *Marine Pollution, 65*(2), 883-884.

Tanaka, K. (2005). The impact of disaster education on public preparation and mitigation of eartquakes: a cross-country comparison between Fukui, Japan and the San Francisco Are California USA. *Applied Geography, 25*, 201-225.

Tanaka, Y. (2012). Disaster policy and education changes over 15 Years in Japan. *Journal of Comparative Policy Analysis: Research and Practice, 14*(3), 245-253.

Tannen, D. (1993). Framing in discourse. New York: Oxford University Press.

Tansey, J. (2004). Risk as politics, culture as power. *Journal of Risk Research, 7*(1), 17-32.

Taylor, D. E. (2000). The rise of the environmental justice paradigm. *American Behavioural Scientist, 43*(4), 508-580.

Tekeli-Yeşil, S., Dedoğlu, N., Braun-Fahrlaender, C., & Tanner, M. (2010). Factors motivating individuals to take precautionary action for an expected earthquake in Istanbul. *Risk Analysis, 30*(8), 118195.

ter Huurne, E. F. J., & Gutteling, J. M. (2009). How to trust? The importance of self-efficacy and social trust in public responses to industrial risks. *Journal of Risk Research, 12*(6), 809-824.

The Dominion Post. (2008a, Jan). Quake rumour rattles Gisborne residents. *The Dominion Post, www.stuff.co.nz*.

The Dominion Post. (2008b, 8 Jun). Quake residents 'right to flee city'. *Stuff National News www.stuff.co.nz*.

The Press. (2008, 6 Jun). Earthquake advice a bit shaky. *The Christchurch Press and Stuff and National News, www.stuff.co.nz*.

The Press. (2010, 26-Sep). The next one. *The Press News, www.stuff.co.nz*.

The Press & Stuff. (2011, 12-Jun). Powerful earthquakes rock Christchurch. *Stuff National News, www.stuff.co.nz*.

The Press Dominion Post & NZPA. (2010, 6-Sep). 7.1 Canterbury earthquake: State of emergency extended. *Waikato Times www.stuff.co.nz*.

ThePress. (2008, 26-Jun-2008). Earthquake advice a bit shaky. *www.stuff.co.nz*.

Thomasella, F., Downing, T., Spanger-Seigfried, E., Han, G., & Rockström, J. (2006). Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation. *Disasters, 30*(1), 39-48.

Thompson, P. B. (2012). Ethics and science communication. *Science Communciation, 34*(618), 618-641.

Tichenor, P. J., Donohue, A., & Olien, C. N. (1970). Mass media flow and differential growth in knowledge. *Public Opinion Quarterly, 34*, 159-170.

Tichenor, P. J., Olien, C. N., Harrison, A., & Donohue, A. (1970). Mass communication systems and communication accuracy in science news reporting. *Journalism Quarterly, 47*, 673-683.
Tierney, K. (1989). Improving theory and research on hazard mitigation: political economy and organizational perspectives. *International Journal of Mass Emergencies and Disasters, 7*(3), 367-396.
Tierney, K. (1993). *Making sense of collective preoccupations: lessons from research on the Iben Browning earthquake prediction*. University of Delaware Research Centre, Preliminary Paper 194.
Tierney, K. (2007). From the margins to the mainstream? Disaster research at the crossroads. *Annual Sociological Review, 33*, 503-525.
Tierney, K., Bevc, C., & Kuligowski, E. (2006). Metaphors matter: disaster myths, media frames, and their consequences in Hurricane Katrina. *The Annals of the American Academy of Political and Social Science, 604*, 57-81.
Tinker, T. L., Zook, E., & Chapel, T. J. (2001). Key challenges and concepts in health risk communication. *Health Management Practice, 7*(1), 67-75.
Todd, R., & Chug, K. (2011, 1-Mar). Christchurch water may be chlorinated after quake. *The Press News, www.stuff.co.nz*.
Torgerson, D. (2003). Democracy through policy discourse. In M. A. Hajer & H. Wagenaar (Eds.), *Deliberative policy analysis: understanding governance in the network society*. Cambridge: Cambridge University Press.
Trachtman, L. (1981). The public understanding of science effort: a critique. *Science, Technology & Human Values, 36*, 10-15.
Trench, B. (2008). Towards an analytical framework of science communication models *D. Cheng et al (Eds). Communicating Science in Social Contexts* (pp. 119-135). Netherlands: Springer.
Trench, B., & Bucchi, M. (2010). Science communication, an emerging discipline. *Journal of Science Communication, 9*(3), Comment.
Trim, P. R. J. (2004). An integrative approach to disaster management and planning. *Disaster Prevention and Management, 13*, 218-225.
Trotter, C. (2011, 21-Jun). Where is leadership? *The Press News, www.stuff.co.nz*.
Trumbo, C. W., & McComas, K. A. (2003). The function of credibility in information processing for risk perception. *Risk analysis, 23*(2), 343-353.
Tsang, H. (2011). Should we design buildings for lower-probability earthquake motion? *Natural Hazards, 58*(3), 853-857.
TTAC-Limited, Taig, T., & GNS-Science. (2012). *A risk framework for earthquake prone building policy*. New Zealand Ministry of Business, Innovation and Employment, Wellington. TTAC Report Ref n132, 69p.
Tuchman, G. (1978). *Making news: a study in the construction of reality*. New York: The Free Press.
Tucker, W. T., & Ferson, S. (2008a). Evolved altruism, strong reciprocity, and perception of risk. *Annals of the New York Academy of Science, 1128*, 111-120.
Tucker, W. T., & Ferson, S. (2008b). Strategies for risk communication: evolution, evidence, experience. *Annals of the New York Academy of Science, 11289*, ix-xii.
Tully, J. (2007a). *Challenging the future: connecting the words in risk communication* (J. Tully Ed.). Christchurch: New Zealand Centre for Advanced Engineering.
Tully, J. (2007b). What is risk communication? *Challenging the future: connecting the words in risk communication* (pp. 1-6). Christchurch: New Zealand Centre for Advanced Engineering.
Turner, R. H. (1980a). Earthquake prediction and economic recession: a red herring? *Hazard Monthly, 1*(1), 5, 15.
Turner, R. H. (1980b). *The mass media and preparation for natural disaster.* Paper presented at the Disasters and the Mass Media, February Conference 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences, 281-292.

Turner, R. H. (1982). Media in crisis: blowing hot and cold. *Bulletin of the Seismological Society of America, 72*, S19-S28.
Turner, R. H. (1993). Special essay: reflections on the past and future of social research on earthquake warnings. *International Journal of Mass Emergencies and Disasters, 11*(3), 453-468.
Turner, R. H., Nigg, J., M., Paz, D. H., & Young, B. S. (1979). *Earthquake threat: the human response in Southern California*. The Institute for Social Science Research, University of California. Los Angeles.
Turner, R. H., Nigg, J. M., & Paz, D. (1986). *Waiting for disaster: earthquake watch in California*. Berkeley: University of California Press.
Turner, R. H., & Paz, D. (1986). The mass media in earthquake warning. In S. J. Ball-Rokeach & M. G. Cantor (Eds.), *The mass media in earthquake warning*. Newbury Park, CA: Sage Publications, 995p.
TV1. (2008-12-20). *Slow progress in Gisborne quake repairs*. 01:45. Screened on 20 December 2008, Television New Zealand. http//www.tvnz.co.nz.
TV1. (2009-01-29). *US scientists head for the depths*. 02:01. Screened on 29 January 2009, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2009-04-08). *Most Kiwis ill-prepared for major quake*. 03:49. Screened on 08 April 2009, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2009-09-18). *Research halves risk of big quake hitting Wgtn*. 01:42: Screened 09 September 2009, Screened on Television New Zealand, http://www.tvnz.co.nz.
TV1. (2009-10-30). *Media did Civil Defence's job on tsunami*. 01:59. Screened on 30 October 2009, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-01-14). *Professor Warwick Murray profiles Haiti:* 06:12. Screened on 14 January 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-02-28). *Professor Warwick Murray on Chilean tragedy:* 05:12. Screened on 28 February 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-09-06). *Earthquake Investigators*. 05:26. Screened on 06 September 2010, Television New Zealand http://www.tvnz.co.nz.
TV1. (2010-09-07). *Aftershocks add to engineers difficulties.* 03:25. Screened on 07 September 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-09-08a). *270 aftershocks and counting*. 04:00. Screened on 08 September 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-09-08b). *"Do not paper over the cracks", residents advised.* 07:02. Screened on 08 September 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-09-09). *School routine good for children.* 01:05. Screened on 09 September 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-09-12). *Sunday Extra - Seismologist Euan Smith.* 09:04. Screened on 12 September 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-09-24a). Breakfast for Canterbury - How the donations are distributed. 02:03. Screened on 24 September 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-09-24b). *Quake-hit homeowners await decision.* 01:47. Screened on 24 September 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-10-03). *Quake - Unanswered questions one month on.* 03:58. Screened on 03 October 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-10-04). *Fate of heritage buildings still up in the air.* 01:44. Screened on 04 October 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-10-29). *More bad news for Christchurch.* 05:15. Screened on 29 October 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-11-07). *International praise for earthquake response.* 01:56. Screened on 07 November 2010, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2010-12-01). *EQC CEO on repairing quake properties.* 04:36. Screened on Television New Zealand, 01 December 2010, http://www.tvnz.co.nz.
TV1. (2011-01-27). *Geologists drill for answers.* 05:33. Screened on 27 February 2011, Television New Zealand, http://www.tvnz.co.nz.

TV1. (2011-02-22). *Severity of quake stuns experts.* 04:07. Screened on 22 February 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-02-23a). *GNS expert on quake dynamics.* 02:05. Screened on 23 February 2011,Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-02-23b). *Google creates a person finder for quake affected*. 01:39. Screened 23 Feb 2011, http://www.tvnz.co.nz.
TV1. (2011-02-23c). *Liquefaction across Christchurch.* 02:23. Screened on 23 February 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-02-26). *Structural engineer says a third of CBD will need demolishing.* 04:53. Screened on 26 February 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-02). *How safe are NZs buildings?* 13:55. Screened on 02 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-07). *Solar flares what do they mean?* 04:07. Screened on 07 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-08). *Chch we will rebuild you John Key.* 04:14. Screened on 03 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-17). *US quake predictor Jim Berkland.* 03:38. Screened on 17 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-19a). *Niwa looking at Canterbury quakes.* 01:49. Screened on 19 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-19b). *Quake trampoline effect.* 00:43. Screened on 19 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-28). *Preparing for a tsunami.* 06:49. Screened on 28 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-03-29). *One of New Zealands toughest jobs.* 05:36. Screened on 29 March 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-04-18). *Jock Matthews on quake stress.* 05:51. Screened on 18 April 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-05-03). *Technology being used to map Chch post quake.* 04:57. Screened on 03 May 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-05-11). *Cutting edge NASA technology helps Chch.* 01:43. Screened on 11 May 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-05-31a). *Parker upset at quake data headlines.* 01:59. Screened on 31 May 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-05-31b). *Quake threat causes alarm.* 01:48. Screened on 31 May 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-03). *Unknown faultlines discovered in Canterbury.* 01:59. Screened on 03 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-13). *Aftershocks in Chch Gerry Brownlee talks to TVNZ News at 8.* 07:06. Screened on 13 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-15). *Farmy army to help with silt struggle.* 02:54. Screened on 15 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-19). *Q + A Earthquake Recovery Minister Gerry Brownlee.* 11:59. Screened on 19 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-23a). *Brownlee explains Chch zones.* 09:32. Screened on 23 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-23b). *Brownlee faces Chch residents*, 01:56. Screened on 23 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-23c). *Critical land report details.* 03:24. Screened on 23 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-23d). *PMs full Chch announcement.* 09:11. Screened on 23 June 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-06-23e). *Questions linger after land report revealed.* 08:02. Screened on 23 June 2011, Television New Zealand, http://www.tvnz.co.nz.

TV1. (2011-07-08). *A new low in quake thefts*. 01:12. Screened on 08 July 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-07-13). *The science of earthquakes.* 05:35. Screened on 13 July 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-08-21). *What happened at CTV?* 18:17. Screened on 21 August 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-08-22). *CTV building an issue for many years.* 04:06. Screened on 22 August 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-09-02). *Bracing Chch's vulnerable buildings.* 01:52. Screened on 02 September 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-09-03). *Huge job ahead a year on from quake.* 04:13. Screened on 03 September 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-09-30). *Urgent warnings for building owners.* 01:59. Screened on 30 September 2011, Television New Zealand, http://www.tvnz.co.nz.
TV1. (2011-11-01). *Chch residents unimpressed by quake simulation.* 01:57. Screened on 01 November 2011, Television New Zealand, http://www.tvnz.co.nz.
Twigg, J. (1999). The age of accountability? Future community involvement in disaster reduction. *Australian Journal of Emergency Management, 14*, 51-58.
Tyler, T., R., & Cook, F. L. (1984). The mass media and judgments of risk: distinguishing impact on personal and societal level judgments. *Journal of Personality and Social Psychology, 47*, 693-708.
Tyler, V. (2011, 21-Mar). City's spirit lives on. *New Zealand Women's Weekly, New Zealand*.
Unattributed. (2010a, 07-Sep). Improvement in sight for St Clair. *Otago Daily Times, www.odt.co.nz*.
Unattributed. (2010b, 24-Oct). WSPA responds to natural disasters. *Otago Daily Times, www.odt.co.nz*.
Unattributed. (2011a, 25-Feb). Christchurch quake/ latest info. *National News, www.stuff.co.nz*.
Unattributed. (2011b, 05-Apr). Rally legend raising funds for quake victim. *Otago Daily Times, www.odt.co.nz*.
Unattributed. (2011c, 26-Apr). Over the top? *The Press News, www.stuff.co.nz*.
Unattributed. (2011d, 22-Jul). Christchurch red zone reopens following aftershock. *NZ Herald*.
UNDP. (2004). *Reducing disaster risk: a challenge for development*. United Nations Development Programme - Bureau for Crisis Prevention and Recovery.
UNESCO-IOC. (2009). *International tsunami survey team interim report of field survey, 14-21 October 2009* UNESCO Intergovernmental Oceanographic Commission report presented to the Government of Samoa 26 Oct 2009.
UNISDR. (2005). *Hyogo Framework for Action 2005-2015: building the resilience of nations and communities to disasters*: United Nations International Strategy for Disaster Reduction World Conference on Disaster Reduction, Kobe, Japan, 22p.
UNISDR. (2009a). *Reducing disaster risks through science: issues and actions; the full report of the ISDR Scientific and Technical Committee 2009*. Geneva: United Nations International Strategy for Disaster Reduction Secretariat, 23p.
UNISDR. (2009b). *UNISDR terminology on disaster risk reduction*. Geneva: United Nations International Strategy for Disaster Reduction Secretariat, 30p.
UNISDR. (2011a). *Disaster through a different lens: behind every effect, there is a cause*. Geneva: United Nations International Strategy for Disaster Reduction Secretariat, 190p.
UNISDR. (2011b). *Hyogo Framework for Action 2005-2015 Mid-Term Review*. Geneva: United Nations International Strategy for Disaster Reduction Secretariat, 107p.
UNISDR. (2012). *4th International disaster and risk conference IDRC Davos 2012*. Webpage http://www.unisdr.org/we/inform/events/16465 accessed 04 August 2012.
UNISDR. (2015). *Sendai framework for disaster risk reduction 2015-2030*. Geneva: United Nations International Strategy for Disaster Reduction Secretariat, 37p.
Valenti, J. (1998). Ethical decision making in environmental communication. *Journal of Mass Media Ethics, 13*, 219-231.

Valenti, J., & Wilkins, L. (1995). An ethical risk communication protocol for science and mass communication. *Public Understanding of Science, 18*, 177-194.
Valkenburg, P. M., Semetko, H. A., & Vreese, C. H. (1999). The effects of news frames on readers' thoughts and recall. *Communication Research, 26*, 550-569.
Vallance, S. (2011, 17-Mar). 'Quaking' is not a condition we must live with. *The Press News, www.stuff.co.nz*.
Van Belle, D. A. (1999). Race, news media coverage and US foreign disaster aid. *International Journal of Mass Emergencies and Disasters, 17 (November): 339–365., 17*, 339-365.
Van Belle, D. A. (2000). New York Times and network TV news coverage of foreign disasters: the significance of the insignificant variables. *Journalism and Mass Communication Quarterly, 77*(1), 50-70.
Van Belle, D. A. (2003). Bureaucratic responsiveness to the news media: comparing the influence of New York Times and network television news coverage on U.S. foreign aid allocations'. *Political Communication, 20*, 263-285.
Van Belle, D. A., & Hook, S. W. (2000). Greasing the squeaky wheel: news media coverage and US foreign aid'. *International Interactions, 26*(3), 321-346.
van Beynen, M., Stylianou, G., & Mathewson, N. (2011, 29-Mar). Recovery plan in nine months. *The Press News, www.stuff.co.nz*.
Van Dijk, T. (2000). New(s) racism: a discourse analytical approach. In S. Cottle (Ed.), *Ethnic minorities and the media* (pp. 33-49). Philadelphia: Open University.
Van Dissen, R. (2015). *It's our fault: defining earthquake risk in Wellington: a decade of improved hazard and risk estimation in Wellington, and lessons to learn from Christchurch.* Paper presented at the Property Institute Conference; 4 June, 2015 , New Zealand.
van Ginkel, H. (2005). *Introductory speech to the expert workshop 'Measuring Vulnerability' January 2005, Kobe. UNU-EHS Working Paper 1. Bonn. p23-24*.
Van Gorp, B. (2007). The constructionist approach to framing: bringing culture back in. *Journal of Communication, 57*, 60-78.
Van Leeuwen, T. (1996). The representation of social actors. In C. R. Caldas-Coulthard & M. Coulthard (Eds.), *Text and Practices: readings in critical discourse analysis* (pp. 32-70). London: Routledge.
van Stiphout, T., Wiemer, S., & Marzocchi, W. (2010). Are short-term evacuations warranted? Case of the 2009 L'Aquila earthquake. *Geophysical Research Letters, 37*(6), 5.
Vasterman, P. L. M., & Ruigrok, N. (2013). Pandemic alarm in the Dutch media: media coverage of the 2009 influenza A (H1N1) pandemic and the role of the expert sources. *European Journal of Communication, 28*, 436-453.
Vasterman, P. L. M., Yzermas, C. J., & Dirkwager, A. J. E. (2005). The role of the media and media hypes in the aftermath of disasters. *Epidemiological Reviews, 27*, 1074.
Veneu, F., Amorim, L. H., & Massarani, L. (2008). Science journalism in Latin America: how the scientific information from a scientific source is accomodated when it is transformed into a journalistic story. *Journal of Science Communication, 7*(1).
Vergara, C. (2010). Esthetics of a tragic event: design strategies in the representation of the earthquake in Chile. *Revista 180*(25), 6.
Vignial-Denain, C. (2004). An insurance perspective on disaster management & compensation issues. In O. f. E. C.-o. a. D. OECD (Ed.), *Large-scale disasters: lessons learned* (pp. 45-62). France: OECD Publications service.
Vogel, C., Moser, S., C., Kasperson, R. E., & Dabelko, G. D. (2007). Linking vulnerability, adaptation, and resilience science to practice: pathways, players and partnerships. *Global Environmental Change, 17*, 349-364.
Voorhees, C. C. W., Vick, J., & Perkins, D. D. (2007). 'Came hell and high water': the intersection of Hurricane Katrina, and the news media, race and poverty. *Journal of Community & Applied Social Psychology, 17*, 415-429.
Wåhlberg, A. A. F., & Sjöberg, L. (2000). Risk perception and the media. *Journal of Risk Research, 3*(1), 31-50.
Wakefield, S. E. L., & Elliot, S. J. (2003). Constructing the news: the role of local newspapers in environmental risk communication. *The Professional Geographer, 55*(2), 216-226.

Wall, T. (2010, 26-Sep). Quake-hit residents may sue council. *Stuff National News, www.stuff.co.nz*.
Walters, G., & Mair, J. (2012). The effectiveness of post-disaster recovery marketing messages - the case of the 2009 Australian Bushfires. *Journal of Travel & Tourism Marketing, 29*(1), 873.
Wang, J. (2010). Beyond information: the socio-cultural role of the internet in the 2008 Sichuan earthquake. *Journal of Comparative Asian Development, 9*(2), 243-292.
Wang, R. B., & Xiao, L. B. (2010). *On relationship between sports and Wenchuan earthquake from the perspective of catastrophology*.
Wang, X. (2008). Risk communication and risky choice in context; ambiguity and ambivalence hypothesis. *Annals of the New York Academy of Sciences, 1128*, 78-89.
Wardle, P. (2010a, 07-Sep). Big earthquake due to rock Marlborough. *Marlborough Express, www.stuff.co.nz*.
Wardle, P. (2010b, 10-Sep). Earthquake alters water levels. *Marlborough Express, www.stuff.co.nz*.
Watson, M. (2009, 30-Jun). More quakes hit evacuated Waihi Village. *Dominion Post www.stuff.co.nz*.
Waxman, J. J. (1973). Local broadcast gatekeeping during natural disasters. *Journalism Quarterly 50*, 751-758.
Waymer, D., & Heath, R. L. (2007). Emergent agents: the forgotten publics in crisis communication and issues management research. *Journal of Applied Communication Research, 35*(1), 888.
Webb, G., Wachtendorf, T., & Eyre, A. (2000). Bringing culture back in: exploring the cultural dimensions of disaster. *International Journal of Mass Emergencies and Disasters, 18*, 5-19.
Weber, J., R., & Word, C. S. (2001). The communication process as evaluative context: what do nonscientists hear when scientists speak. *Bioscience, 51*(6), 487-495.
Weber, R. P. (1990). *Basic content analysis* (2nd ed.). Newbury Park, CA: Sage.
Weichselgartner, J., & Kasperson, R. (2010). Barriers in the science-policy-practice interface: toward a knowledge-action-system in global environmental change research. *Global Environmental Change, 20*(2), 266-277.
Weick, K. (1995). *Sense-making in organizations*. London: Sage.
Weiner, B. (1986). *An attributional model of motivation and emotion*. New York: Springer-Verlag.
Weingart, P., Engels, A., & Pansegrau, P. (2000). Risks of communication: discourses on climate change in science, politics and the mass media. *Public Understanding of Science, 9*(3), 261-283.
Weingart, P., & Pansegrau, P. (2003). Introduction: perception and representation of science in literature and fiction film. *Public Understanding of Science, 12*, 227-228.
Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology, 39*, 806-820.
Weinstein, N. D. (1989). Effects of personal experience on self-protective behavior. *Psychological Bulletin, 105*(1), 31-50.
Weir, J. (2011, 18-Mar). Earthquake rattles consumer confidence. *Stuff Business Day, www.stuff.co.nz*.
Weiss, C. H., Singer, E., & Endreny, P. (1988). *Reporting of social science in the national media*. New York: Russell Sage Foundation.
Wellington, J. (1999). Newspaper science, school science: friends or enemies. *International Journal of Science Education, 13*, 363-372.
Wellman, B., & Berkowitz, S. D. (1988). Introduction: studying social structures. In B. Wellman & S. D. Berkowitz (Eds.), *Social structures: a network approach*. Cambridge: Cambridge University Press.
Wenger, D. E. (1980). *A few empirical observations concerning the relationship between the mass media and disaster knowledge: a research report.* Paper presented at the Disasters and the Mass Media Conference, February 1979, Washington D.C., National Research Council Committee on Disasters and the Mass Media, National Academy of Sciences.
Wenger, D. E., Dykes, J. D., & Sebok, T., D. (1975). It's a matter of myths: an empirical examination of individual insight into disaster response. *Mass Emergencies, 1*, 33-46.
Wenger, D. E., & Friedman, B. (1986). Local and national media coverage of disaster: a content analysis of the print media's treatment of disaster myths. *International Journal of Mass Emergencies and Disasters, 4*, 27-50.

Wenger, D. E., James, T., & Faupel, C. (1980). *Disaster beliefs and emergency planning*. Delaware: Newark.
Wenger, D. E., & Quarantelli, E. L. (1989). *Local mass media operations, problems and products in disasters*. Retrieved from
Wenger, D. E., Sebok, T. D., & Neff, J. L. (1980). It's a matter of myths: an empirical examination of individual insight into disaster response. In M. D. Pugh (Ed.), *Collective behaviour: a source book*. New York: West Publishing Co.
Westefeld, J. S. (1996). Severe weather phobia: an exploratory study. *Journal of Clinical Psychology, 52*(5), 509-515.
Westerman, D., Spence, P. R., & Lachlan, K. A. (2009). Telepresence and the exemplification effects of disaster news. *Communication Studies, 60*(5), 542-557.
Wetzel, C., G., Hettinger, E., McMillan, R., Rayburn, M., & Nix, A. (1993). Methodological issues in studying response to the Browning prediction of a New Madrid earthquake: a researcher's cautionary tale. *International Journal of Mass Emergencies and Disasters, 11*(3), 430-452.
White, F. G., Kates, R. W., & Burton, I. (2001). Knowing better and losing even more: the use of knowledge in hazards management. *Global Environmental Change Part B: Environmental Hazards, 3*, 81-92.
White, J., & King-Wa, F. (2012). Who do you trust? Comparing people-centred communications in disaster situations in the United States and China. *Journal of Comparitive Policy Analysis: Research and Practice, 14*(2), 126-142.
Whitney, D. J., Lindell, M. K., & Nguyen, H. H. D. (2004). Earthquake beliefs and adoption of seismic hazard adjustments. *Risk Analysis, 24*(1), 872.
WHO. (2005). *Effective media communication during public health emergencies*. World Health Organization, Geneva.
Wiegman, O., Gutteling, J. M., Boer, H., & Houwen, R. J. (1989). Newspaper coverage of hazards and reactions of readers. *Journalism Quarterly*, 846-863.
Wijkman, A., & Timberlake, L. (1988). *Natural disasters: acts of god or acts of man?* Philadelphia, PA: New Society Publishers.
Wikipaedia-NZWW. (2014). New Zealand Women's Weekly. Retrieved from (http://en.wikipedia.org/wiki/New_Zealand_Woman's_Weekly)
Wildavsky, A. (1979). *Speaking the truth to power: the art and craft of policy analysis*. Boston: Little Brown.
Wilkins, L. (1985). Television and newspaper coverage of a blizzard: is the message helplessness? *Newspaper Research Journal 6*, 51-65.
Wilkins, L. (1986). Media coverage of the Bhopal disaster: a cultural myth in the making. *International Journal of Mass Emergencies and Disasters 4*, 7-27.
Wilkins, L., & Patterson, P. (1987). Risk analysis and the construction of news. *Journal of Communication, 37*(3), 80-92.
Wilkinson, I. (2001). Social theories of risk perception: at once indispensable and insufficient. *Current Sociology, 49*(1).
Wilkinson, I. (2010). Grasping the point of unfathomable complexity: the new media research and risk analysis. *Journal of Risk Research, 13*(1), 19-28.
Williams, D. (2010a, 9-Sep). Conservation damage light. *National News, www.stuff.co.nz*.
Williams, D. (2010b, 29-Oct). $100000 for liquefaction study. *The Press News, www.stuff.co.nz*.
Williams, D. (2011a, 17-May). E.coli counts take off in polluted city rivers. *The Press News, www.stuff.co.nz*.
Williams, D. (2011b, 25-Jul). Orange zone puts futures on hold. *The Press News, www.stuff.co.nz*.
Williams, D. (2011c-a, 13-Sep). Birdlife flocks to estuary despite liquefaction fears. *The Press News, www.stuff.co.nz*.
Williams, D. (2011c-b, 25-Aug). Brownlee refuses to release papers. *The Press News, www.stuff.co.nz*.
Williams, S. N. (2008). Rethinking the nature of disaster: from failed instruments of learning to a post-social understanding. *Social Forces, 87*(2), 1115-1138.
Wilson, J. (1973). *Introduction to social movements*: New York Basic Books.

Winfield, N. (2011, 21-Sep). Scientists on trial over earthquake deaths. *Stuff World News, www.stuff.co.nz*.

Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (2004). *At risk: natural hazards, people's vulnerability and disasters* (2nd ed.). London: Routledge.

Witt, D. L., Young, Y. L., & Yim, S. C. (2011). Field investigation of tsunami impact on coral reefs and coastal sandy slopes. *Marine Geology, 289*, 159-163.

Witte, K. (1994). Fear control and danger control: a test of the extended parallel process model. *Communication Monographs, 61*(2), 113-134.

Witte, K. (1995). Generating effective risk messages: how scary should your risk communication be? *Communication Yearbook, 18*, 229-254.

Witte, K., & Allen, M. (2000). A meta-analysis of fear appeals: implications for effective public health campaigns. *Health Education & Behavior, 27*(5), 591-615.

Wood, A. (2011, 23-Sep). Christchurch economy might boom like Napier. *Stuff Business Day, www.stuff.co.nz*.

Wood, P. (2010, 8-Sep). Resilience puts city on a fast track back to solid ground. *The Press News, www.stuff.co.nz*.

Woods, S., & Johnson, K. (2011, 17-Mar). Ken Ring's Christchurch earthquake claims 'terrifying' people. *The Press News, www.stuff.co.nz*.

Wrathall, J. E. (1988). Natural hazard reporting in the UK press. *Disasters, 12*(2), 177-182.

Wright, K., Becker, J. S., & Saunders, W. (2009). Recovery planning for natural hazards. *Tephra: NZ Ministry of Civil Defence and Emergency Management Science and Education Publication, 22*, 49-54.

Wright, M. (2011a, 16-Jun). Kaiapoi rebuild put on hold. *The Press News, www.stuff.co.nz*.

Wright, M. (2011b, 28-Jul). Kairaki residents seek data under act. *The Press News, www.stuff.co.nz*.

Wright, M. (2011c, 21-Aug). Questions over CTV building construction (CTV building vulnerable). *The Press News, www.stuff.co.nz*.

Wright, M. (2011d-a, 10-Nov). Costly hi-tech systems vital to sewer rebuild. *The Press News, www.stuff.co.nz*.

Wright, M. (2011d-b, 30-Aug). Redcliffs may be green. *The Press News, www.stuff.co.nz*.

Wu, D. D., & Xu, J. (2009). Review of emergency management related to the Wenchuan earthquake: a special section. *International Journal of Emergency Management, 6*, 208-214.

Wynne, B. (1991). Knowledges in context. *Science, Technology & Human Values, 16*(1), 111-121.

Wynne, B. (1992). Misunderstood misunderstanding: social identities and public uptake of science. *Public Understanding of Science, 1*, 281-304.

Wynne, B. (2006). Public engagement as a means of restoring public trust in science – hitting the notes, but missing the music? *Community Genetics, 9*, 211-220.

Wyss, M. (2012). The earthquake closet: rendering early-warning useful. *Natural Hazards, 63*, 761-768.

Xiao, J., & Li, H. (2012). Online discussion of Sharon Stone's karma comment on China earthquake: the intercultural communication of media events in the age of media convergence. *Chinese Media Research, 8*(1), 25-39.

Xu, J., Gong, A., & Li, J. (2008). An understanding of international cooperation in disaster reduction in view of great Wenchuan earthquake. *Journal of Natural Disasters, 17*(6), 139-141.

Yanev, P. I. (1995). *Handling risk and claims after a catastrophe - an engineer's perspective*. Paper presented at the Wellington after the Quake; The Challenge of Rebuilding Cities, Wellington, 27-29 March 1995. Earthquake Commission, Wellington and the Centre for Advanced Engineering, Christchurch, New Zealand. 217-226 & 271.

Yang, A. (2008). *Chinese media in change: a comparison of chinese media framing of the 2003 SARS crisis and the 2008 Sichuan earthquake*. Paper presented at the International Communication Association; 2009 Annual Meeting.

Yang, X., Wu, Z., & Li, Y. (2011). Using internet reports for early estimates of the final death toll of earthquake-generated tsunami: the March 11, 2011, Tohoku, Japan, earthquake. *Annals of Geophysics, 54*(6: Citizen empowered seismology), 674-679.

Yang, Y., Chen, Y., Chotani, R. A., LaPorte, R., Ardalan, A., Shubnikov, E., . . . Huang, J. (2010). Chinese disasters and just-in-time education. *Prehospital and Disaster Medicine, 25*(5), 477-481.

Yin, L., & Wang, H. (2010). People-centred myth: representation of the Wenchuan earthquake in China Daily. *Discourse & Communciation, 4*, 383-398.

Yin, R. K. (2009). *Case study research, design and methods* (4th ed.). Thousand Oaks, California: Sage Publications.

Yoshii, H. (1990). Social impacts of earthquake prediction in Greece. *Disaster Management, 3*, 3-7.

Yoshii, H. (1993). Social impacts of earthquake prediction in Greece. *Tectonophysics, 224*, 251-255.

Yukutake, Y., Honda, R., Harada, M., Aketagawa, T., Ito, H., & Yoshida, A. (2011). Remotely-triggered seismicity in the Hakone volcano following the 2011 off the Pacific coast of Tohoku Earthquake. *Earth, Planets and Space, 63*(7), 737-740.

Zahn, F. A. (2011). Damage suffered by buildings in the February 22, 2011, M 6.3 earthquake in Christchurch, New Zealand. *Bautechnik, 88*(12), 836-846.

Zahran, S., Peek, L., Snodgrass, J., G., Weiler, S., & Hempel, L. (2001). Economics of disaster risk, social vulnerability, and mental health resilience. *Risk Analysis, 31*(7), 1107-1119.

Zaksek, M., & Arvai, J. L. (2004). Toward improved communication about wildland fire: mental models research to identify needs for natural resource management. *Risk Analysis, 24*(6), 1503-1514.

Zehr, S. (1999). Scientist's representations of uncertainty. In S. M. Friedman, S. Dunwoody, & C. L. Rodgers (Eds.), *Communicating uncertainty: media coverage of new and controversial science* (pp. 3-21). Mahwah, NJ: Lawrence Erlbaum Associates.

Zeng, F., Chen, X., & Liu, Z. (2008). *Establishing social learning mechanism to reduce the vulnerability of the public.* Paper presented at the Proceedings of the 5th International Conference on Innovation & Management.

Zhang, Q., & Wang, E. (2010). Local political trust: the antecedents and effects on earthquake victims' choice for allocation of resources. *Social Behavior and Personality, 38*(7), 929-940.

Zhao, Y. Z., Wu, Z. L., & Li , Y. T. (2008). *Casualty in earthquake and tsunami disasters: internet-based monitoring and early estimation of the final death toll. Paper ID 09-01-0044*. Paper presented at the 14th World Conference on Earthquake Engineering (WCEE) - October 12–17, 2008, Beijing.

Zheng, X.-F., Yao, Z.-X., Liang, J.-H., & Zheng, J. (2010). The role played and opportunities provided by IGP DMC of China National Seismic Network in Wenchuan earthquake disaster relief and researches. *100, 5B*, 2866-2872.

Zhong, W., & Zhao, J. (2009). An economics of earthquake prediction. *Transition Studies Review, 16*(2), 388-403.

Zhou, H., Wang, J., Wan, J., & Jia, H. (2010). Resilience to natural hazards: a geographic perspective. *Natural Hazards, 53*(1), 21-41.

Zhu, D., Xie, X., & Gan, Y. (2011). Information source and valence: how information credibility influences earthquake risk perception. *Journal of Environmental Psychology, 31*, 129-136.

Ziman, J. (1992). Not knowing, needing to know and wanting to know. In B. Lewenstein (Ed.), *When Science Meets the Public* (pp. 13-20.). Washington, DC: American Association for the Advancement of Science.

Zimmermann, M. N., & Issa, S. S. (2009). Risk-conscious reconstruction in Pakistan-administered Kashmir: a case study of the Chakhama Valley. *Mountain Research and Development, 29*(3), 202-210.

Zoller, H. M. (2006). Health activism: communication theory and action for social change. *Communication Theory, 15*(4), 341-364.

# Appendices

**List of Appendices**

-blank-

# Appendix 1: Glossaries

Terms are arranged in alphabetical order within the following topic groupings:



## Glossary Group 1: Terms related to science communication models

*Deficit Models* - Models of communication associated with ‘science literacy’ are ‘linear’, ‘transmission’, ‘conduit’ or ‘dissemination’ models. These are often referred to as ‘deficit *models*’ as they imply deficit, ignorance, passivity or even hostility on the part of the audience (Bucchi, 2008; Dornan, 1990; McQuail & Windahl, 1993; Schiele, 2008; Wynne, 2006; Ziman, 1992) Such models are conceptualised as transferring data, information and knowledge without significant alteration from one group to another (Bucchi, 2008). Irwin (2008) refers to these as ‘first order’ approaches to risk communication (see Table 2.3 and discussion in Irwin, 2008).

*Scientific literacy* is concerned with a citizen’s science knowledge deficit or an ‘*ignorant public’*. There are assumptions that knowledge in general and scientific literacy in particular are low in the population. It is perceived that cultural and socioeconomic factors may exacerbate this, for example particularly in the populations most vulnerable to disasters (Lachlan, Spence, & Eith, 2007; Miller, 2001; Spence, Lachlan, & Burke, 2011).

*Public understanding of science*, while also concerned with deficit, aims for provision of the right kind of information for individual citizens and different citizen groups (Bauer et al. 2007). This style of communication is often referred to as contextual (Brossard & Lewenstein, 2010).

*Science in society* - In contrast science communication efforts with ‘science and society’ goals aim to involve citizens in the research and policy and decision-making process (Bauer et al, 2007; Bucchi, 2008; Trench 2008).

## Glossary Group 2: DRR terms related to reduction equation 6

*Adaptation* is a broad concept sourced from UNFCC (see UNISDR, 2009b, p. 9) defined as "*the adjustment in natural or human systems*" - a response that moderates a harm, or exploits beneficial opportunities. The term adaptation as used in this thesis relates to references made to choices to change DRR measures adopted, changes at a household, business, institutional or government level to their normal routines and practices (cf. Djalante et al., 2011; Kendra & Wachtendorf, 2006). This is akin to 'evolution' that (Sarewitz & Pielke, 2001) listed as a way to reduce social vulnerability. Social knowledge, coping strategies and expertise gained through repeated exposure to and experience of hazard events are an important part of DRR (Shannon et al., 2011). These may be immediate adaptive reactions or response to disaster. Also included are adaptations in recovery (Berke et al., 1993; Schilderman & Lyons, 2011). Other adaptations may include references to a willingness to make changes, or changes already made in contingency planning, land use planning and development choices, decision to build capacity, or changes to emergency management or communication practice.

*Avoidance* is also known as prevention. Options in DRR may be said to fall into two groups, avoidance and mitigation. While prevention is *"the outright avoidance of adverse impacts of hazards and related disasters", mitigation is "the lessening or limitation of the adverse impacts of hazards and related disasters"* (UNISDR, 2009b, p. 22). Earthquakes are a phenomenon whose potentially cascading disastrous effects can be reduced by humans through DRR. In most instances complete avoidance of earthquakes such as living in an aseismic region, is not feasible. While hazards may not always be able to be mitigated, risks can be reduced (Panza et al., 2011) by reducing exposure, or vulnerabilities.

*Communication* about DRR has been established in the introduction as a critical component of DRR. Natural hazards and disasters highlight, often graphically, our social dependence on one another (Eiser et al., 2012). Social interactions are highly dependent on communication. Risk communication was shown in Figure 2.3 as central to a risk identification, assessment and risk management process.

*Duplication* - Two risk management possibilities listed as *'treatment'* options in the Australian/New Zealand Risk Management Standard are *duplication* and *transformation* (for brief description see Keey, 2000, p. 109). *Duplication* is a valuable component in DRR (Kanemitsu, 1995). Duplication may be achieved by implementing a wide range of DRR options, i.e. from a range of disciplinary approaches. Transformation is akin to adaptation.

*Education,* knowledge at all levels of society is important. DRR may be advocated for, implemented and studied at all levels from individual, household, organizational, community and different levels of government including international (K. Tanaka, 2005; Y. Tanaka, 2012; Tierney, 1989). DRR measures adopted to avoid or mitigate risks will be based upon the prevailing societal knowledge of the time. Decisions based on DRR 'best-practice' will reduce vulnerabilities, while incomplete knowledge leads to poor decision-making and DRR policies that exacerbate existing vulnerabilities (D. Sarewitz & Pielke, 2001). Education about DRR relates to building understanding about background concepts in all disciplinary areas as taught from pre- and primary school through to post-graduate tertiary levels. While education and communication have historically been terms used interchangeably they have not been in this research.

*Incentivisation* includes policy or legislative measures at a government or institutions to encourage risk reducing behaviours. An example is reduction of excesses and premiums by insurance companies (Yanev, 1995).

*Innovation* is not a term found in the UNISDR 2009 definitions but is being increasingly used in DRR literature (e.g. Djalante et al., 2011; Lan, 2009). A definition of innovation derived from extensive review albeit outside the DRR literature is that innovation relates to things "*1) new with high-level of originality, 2) in whatever area 3) that also breaks in to (or obtains a foothold in) society, often via the market, and 4) mean something revolutionary [better] for people.*" (Frankelius, 2009, p. 49). The term innovation is used in this thesis to encompass the engineering, design and technological advancements that contribute to the mitigation of disasters (e.g. construction materials, seismic strengthening methods, early warning systems, seismological and medical instrumentation). An example of a recent earthquake innovation is the earthquake closet, which it is suggested would render evacuation unnecessary, and make early-warning useful (Wyss, 2012). As with communication, innovation may apply to all parts of the DRR cycle. Lan's (2009) reference to 'institutional innovation' in the form of policy changes is a form of social, rather than structural, or physical innovation. Kendra and Wachtendorf (2006) discussed community innovation in the context of disasters. So that a distinction may be made between technological or physical innovation and social innovation the latter innovations are referred to in this research as adaptations. Innovation is achieved through the integration of scientific data with value and other forms of knowledge. Adaptation links to resilience, as described in section 2.2.7.

*Legislation* includes any legislative or policy measures including land-use planning, building codes, seismic strengthening policy, provision of emergency services, and overarching systems of government including economic choices. Prohibiting settlement in high-risk zones to some degree prevents the experience of some hazard effects for example liquefaction in an earthquake (Burby et al., 1999). Legislative measures include recovery legislation) (Rolfe & Britton, 1995) or improvements to governance in general or policies on an international scale to increase equity and reduce poverty (F. G. White et al., 2001). The option of transfer of seismic risk through insurance (Vignial-Denain, 2004) which (Lindell & Whitney, 2000) described as redistributing the financial impact of damage is another example of a legislative measure. In New Zealand earthquake insurance is compulsorily imposed on those who hold property insurance (H. Cowan & Simpson, 2011). Legislation includes *incentivisation* and grants for insurance and sustainable practices (Eiser et al., 2012; McClure et al., 2011; Yanev, 1995).

*Participation* is a concept that was introduced in the introductory chapter and as is discussed in various sections throughout this chapter is also gaining favour in discussions of vulnerability reduction, resilience building and sustainability (K. Wright et al., 2009). As just further one example (Tagle & Nazarit, 2011) refers to *'participatory health mitigation'* in DRR. Scientific participation is elaborated on in the following section where the importance of integration of science knowledge and collaboration to achieve DRR are discussed.

*Preparation* includes those things necessary for survival activities (Mulilis & Lippa, 1990; Spittal et al., 2008). Preparedness is said to minimise risk of injury and damage and facilitate the capacity to cope with disruptions (Paton et al., 2005). Emergency preparedness is an example of a passive protection at time of impact, supporting active response (Lindell & Whitney, 2000) or recovery. Preparation is most frequently referred to in terms of preparedness for response to disaster events, but in the interests of the best results in DRR should, arguably also be considered in terms of preparedness for recovery (Rotimi et al., 2006). Preparation as defined by the UNISDR is *"contingency planning, early warning systems, stockpiling of equipment and supplies; the ability to quickly and appropriately respond when required"* (UNISDR, 2009b, p. 21).. Mulilis, Duval, and Lippa (1990) and Spittal et al. (2008) discuss earthquake-related survival actions that minimise the risk of injury.

The term *preparation* as applied in this thesis relates to the activities and actions as defined for preparedness in UNISDR (2009b) occurring during the response phase of the DRR cycle.

*Preparedness* as defined by the UNISDR is:

> *the knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.*
>
> (UNISDR, 2009b, p. 20)

Preparedness is said to be based on:

> *"sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities."*
>
> (UNISDR, 2009b, p. 21)

*Leadership* (including responsibility for recovery) under New Zealand legislation involves a number of agencies and departments (K. Wright et al., 2009) thus requiring collaboration (linkages). Leadership must also be mindful of the need for localisation (local community participation and collaborative communities) and legitimacy, as these are also key in building resilient communities as well as in helping communities recover from disasters (Glavovic, 2011; Hobfoll et al., 2007; Mileti, 1999).

*Structural mitigation* means physical activities such as securing contents, fastening bookshelves or strengthening buildings (Russell, Goltz, & Bourque, 1995). Tierney (Tierney, 1989), citing Drabek et al. (1983) refers to mitigation as policies as well as action. For the purposes of this research physical avoidance and mitigation actions were separated from planning and organizing functions such as legislation, insurance and preparatory actions such as stocking of supplies by individuals.

In contrast, seismic engineering designs that ensure the survival and function of buildings under specified risk criteria are dependent on the accuracy of risk assessment, and although they do not completely eliminate effects, have saved many lives and reduced much loss. Such efforts are termed mitigation measures. "*Mitigation measures encompass engineering techniques, hazard-resistant construction as well as improved environmental policies and public awareness*" (UNISDR, 2009b, p. 20).

## Glossary Group 3: Terms relating to coping appraisal

*Action coping* tendencies and abilities influence preparedness (Paton, 2007; Paton et al, 2003). Research has shown that coping perceptions are a better indicator of preparation than perceptions about hazards (Lindell & Perry, 2000; Mulilis & Duval, 1995; Paton et al., 2003). In the absence of much information about DRR citizens will set their achievement levels in relation to others so that it is vitally important to portray others' achievements (Nara, 2010). In the absence of much information that deprivation is associated with self-evaluation of risk coping.

*Outcome expectancy* relates both to beliefs about the outcome (such as the perceived severity of consequences or vulnerability), and one's ability to execute the behaviour (Bandura, 1977; Neuwirth, Dunwoody, & Griffin, 2000). Citizens show a continuum of responses to prepare based on information about DRR options, efficacy and constraints such as time or cost (Eiser et al., 2012). However citizens are more likely to engage in DRR when they hold strong expectations of positive outcomes and low expectations of negative outcomes. Negative outcome expectancy is that earthquake consequence are too catastrophic for personal action to make any difference to people's safety (Paton et al. 2005). However the belief that specific risk reduction behaviours are effective impacts positively on the degree to which those behaviours are acted upon (Martin, Martin, & Kent, 2009).

*Response efficacy* - There are two types of efficacy referred to in the literature, 'response efficacy' and 'self-efficacy'. According to Neuwirth et al. (2000) response efficacy is the belief of the adequacy of things that may be done about the risk. Note that response efficacy is efficacy of any response, and should not be confused with efficacy in the Response period of a disaster.

*Self–efficacy* is an individual's ability assessment or confidence in their competence in performing actions to achieve the desired outcome. To DeMan and Simpson-Housley (1987) self-efficacy relates to the resources individuals have for example for coping with the threat of earthquake. Both response efficacy and self-efficacy are reduced by 'barriers' such as cost, time and effort (Eiser et al., 2012; Neuwirth et al., 2000).

Research showing that beliefs about outcomes and efficacy of preparations better predict preparation actions for seismic events than beliefs about hazards includes (Lindell & Perry, 2000; Mulilis & Duval, 1995; Paton et al., 2003; ter Huurne & Gutteling, 2009).

Further elements of coping appraisal discussed as part of work on understanding resilience (Paton, 2006) include social trust, empowerment, community participation and leadership. It is only fairly recently that references to resilience information, and social capacity, or social-capital-building in relation to DRR have begun to emerge (D.A. McEntire et al., 2002). The inclusion of these concepts as part of discussions of science-, risk-, or DRR-communication is, however far from widespread.

## Glossary Group 4: Terms relating to risk assessment

*Risk acceptability* – whether all potentially impacted are willing to accept the risk assuming there are no changes to risk management. While 'risk acceptability' or 'risk tolerability' and risk management involve scientific evidence about, and technical estimations of 'real' risk from science, they always contain value judgments at the same time (Pidgeon, 1988). After the trade-offs have been made and any risk reduction measures applied the level of risk that remains is termed 'residual risk'.

*Risk tolerability* – whether risk can be lived with so as to secure certain net benefits. To achieve this the risk will not be negligible or able to be ignored and must be kept under review so that it may be reduced further if possible.

Residual risk – The risk that remains once risk assessment trade-offs have been (Pidgeon, 1988). Ideally 'residual risk' is 'acceptable risk' to the community in question (ECAN, 2008).

## Glossary Group 5: Terms relating to reactions to risk

*Confirmation bias* – This is a trait mentioned in relation to seismic risk-related media communication (John McClure, 2006). Confirmation bias is when individuals reach a viewpoint and then choose to ignore additional information (Nickerson, 1998).

*Denial* - At the extreme end of reaction is full 'denial'. Lehman (1987) has shown that some people use 'denial coping' when faced with increased risk (for example if they live in seismically vulnerable building). Such individuals question their vulnerability, the validity of expert judgment, or both. This is particularly relevant to any discussion of risk-related science communication. Review of the DRR-related media research literature suggests that portrayal of denial coping has not been studied.

*Depersonalization* of possible risk or loss is also termed 'optimistic bias' (Mileti, 1982). Some citizens believe that disasters will not happen to them, even if they live in high-risk (e.g. seismically active) zones. Citizen failure to personalize seismic risk, even if they live in high risk areas, and even if they have experienced earthquake events have been reported and discussed (Burton & Kates, 1964; Dooley, Catalano, Mishra, & Serxner, 1992; Kunreuther et al., 1978; Mileti, 1982; Mileti & Darlington, 1995; Mileti & Fitzpatrick, 1993; Russell et al., 1995; Rüstemli & Karanci, 1999; Simpson-Housley & Curtis, 1983; Tanaka, 2005; Weinstein, 1989; White & Haas, 1975; Wilkinson, 2001).

Failure to personalise risk may include downplaying the threat, denying the likelihood of damage, or discounting exposure to risk, or discounting their vulnerability (Burton, Kates, & White, 1978; Crozier, McClure, Vercoe, & Wilson, 2006; DeMan & Simpson-Housley, 1987; Lehman & Taylor, 1987; Millet & O'Brien, 1992; Solberg, Rosetto, & Joffe, 2010). Some people do not like to discuss the possibility of disaster or need to prepare (Becker, Paton, Johnston, & Ronan, 2012; Gregory, Loveridge, & Gough, 1997). Others consider the possibility of small–scale disaster events but do not think about major ones (Gregory et al., 1997), or vice-versa.

*Impersonal impact* is a form of denial, or optimistic bias that harm or loss will happen to others or to society generally, not to an individual themselves (Mileti, 1982; T. Tyler, R. & Cook, 1984).

*Optimistic bias* - discounting of exposure to risk, or discounting their vulnerability (Burton et al., 1978; Crozier et al., 2006; DeMan & Simpson-Housley, 1987; Lehman & Taylor, 1987; Millet & O'Brien, 1992; Solberg et al., 2010).

# Appendix 2: Extended table of contents showing subsection headings

## Table of contents

-blank-

# Appendix 3: Characteristics and consequences of earthquakes

This Appendix contains information about:

- earthquake characteristics and consequences (including secondary and tertiary hazards) generally (Appendix 3.1, p. 613);
- and more specifically about New Zealand earthquakes (Appendix 3.2 p. 615).

-blank-

## Appendix 3.1 Characterising earthquakes and their consequences

There are many ways in which one might categorise the characteristics and effects or consequences of earthquakes. Some of the more common ones ways that earth scientists measure and describe different aspects of earthquakes and faults are given in Appendix Table 3.1 below.

**Appendix Table 3.1: Ways academics describe earthquakes and faults**

| Earthquakes | Faults |
|---|---|
| Magnitude – energy released | the length of fault rupture |
| focal depth – the distance from the point source (the focus) of the earthquake to a point on the earth's surface directly above it (the epicentre) | the area of rupture |
| epicentral location | vertical displacement (typically greatest) |
| amount of energy released during a seismic event | horizontal displacement (typically greatest) |
| the maximum amplitude (vertical motion) of the ground at the surface | direction and type of movement (e.g. strike-slip, transform) |
| the maximum amplitude acceleration of the ground at the surface – peak ground acceleration (PGA) | |
| the duration of shaking felt at a particular point | |

Earthquakes are an example of a 'natural' or geological hazard. Earthquakes are caused by geological processes that release energy in wave-like vertical and horizontal ground motions at the Earth's surface and may cause the ground to shake. Seismographs are machines that can detect even small earthquakes, undetectable to humans. A distinction is made throughout this thesis between earthquake-related disasters and earthquake occurrences that are hazard events that have not caused harm to humans, for example large-magnitude earthquake events that cause no damage to the built environment, because they occur far from a human community..

Seismic hazards include a range of phenomena associated with earthquakes that can cause harm (Appendix Table 3.2).

As an earthquake occurs released energy ripples out from the focus, causing wave-like vertical and horizontal ground motions at the Earth's surface. Where the energy release is small humans are not able to sense the earthquakes, however they are detectable using machines called seismographs. Larger seismic events, particularly when they occur near to population centres may cause sudden and sometimes violent disruptions to everyday human life. It is because of their potential to cause damage, disruption and distress that earthquakes are considered a hazard.

While the seismic energy release of an earthquake is the triggering hazard, there are a variety of separate phenomena that occur as a consequence of earthquakes and themselves become hazards; these are primary and secondary (natural) earthquake hazards (see Appendix Table 3.2 below). These hazards may in turn cause flow-on technological and health hazards.

**Appendix Table 3.2: Natural earthquake hazards; primary and secondary**

| Primary Earthquake Hazards | Secondary Earthquake Hazards |
|---|---|
| **SURFACE RUPTURE** | |
| **On land** | Aftershocks |
| Vertical displacements | |
| Horizontal offsets | |
| cracking | |
| **Offshore** – sea-floor | Displaces ocean which creates **tsunami** |
| **GROUND MOTION - SHAKING** | |
| Liquefaction (heavy particles in loose soil and sediment settle expelling silt and water to surface | Flooding |
| Seiche (sloshing of lakes) | Flooding |
| Rock falls | |
| Landslides (from disrupted through coherent to lateral spreads and flows) | Landslide dam formation<br>Aggradation of rivers<br>Avulsion of rivers |

Some of the above hazards may result in another, for example shaking may trigger landslides, seiche waves or liquefaction. Offshore vertical displacements may create the oceanic hazard called 'tsunami', while on-land shaking may contribute to building damage and a cascade of technological hazards (sometimes termed 'tertiary effects') such as fires or nuclear reactor failure (for example as occurred in the Japanese earthquake of March 11, 2011). For more details about these hazards as understood by earth scientists see ECAN (2007a), ECAN (2007b), ECAN (2008a, pp. 2-3), ECAN (2008b, pp. 7-9), and (Sol & Turan, 2004).

The consequences of earthquakes are not only natural phenomena listed above in Appendix Table 1.2. Earthquakes may be and are also measured and described in relation to their social and economic consequences, their effects on human communities and social objects - for example the degree of damage to the built environment (buildings and infrastructure) caused by the event, the economic cost of repairing damage, the death toll, physical health (injury and illness) the degree of disruption to routines, and psychological and behavioural effects (Quarantelli, 2000).

## Appendix 3.2: Characteristics about New Zealand earthquakes

*"On average, New Zealand had about 330 earthquakes of magnitude 4.0 to 4.9 each year, 26 of 5.0 to 5.9, two of 6.0 to 6.9 a year and one of 7.0 to 7.9 every three years, Quigley said."*

(Gorman, 2011b)

The islands of New Zealand lie astride the boundary between two tectonic plates on a small segment of the 'Ring of Fire', a geological phenomenon encompassing the Pacific Ocean in which 80% of all earthquakes occur (Bolt, 2004). As a result of its' highly active tectonic environment New Zealand experiences around 13,000 detectable earthquakes every year (H. Anderson & Webb, 1994). Most are too small to feel. According to New Zealand Hazardscape – "Ten to fifteen thousand earthquakes are recorded each year in and around New Zealand, but only about 150 of these are felt" (ODESC, 2007).

Since European settlement (post 1840) eighteen significant earthquakes (magnitude > 7) have resulted in a total of 297 deaths (Dowrick & Roades 2005). Nine earthquakes in the period 1845 to 2010 account for 289 deaths (G. Gregory et al., 1997). Notable New Zealand earthquakes are included in the timeline in Table 5.7a. While there has typically been at least one M7 recorded in New Zealand each year, the Darfield earthquake was the first to seriously affect a large urban centre since large shallow earthquakes affected the central North Island in the period 1929-1942 (see Table 5.7b). Notable New Zealand earthquakes in more recent times are listed in Table 5.7c. Most recent were an MX in Gisborne with minor damage affecting 7025 people in December 2007, and an M7.9 in remote Fiordland in 2009.

The three most severe New Zealand earthquake events in terms of numbers of people affected are the Canterbury February 2011 and September 2010 events and 3 Feb 1931 Napier (CRED, 2012). CRED lists the 1987 Gisborne earthquake, with 7025 affected persons as the fourth most severe event. However it is assumed that this is because the Wellington and Wairarapa events of the late 19th and early 20th century have not been included.

-blank-

# Appendix 4: Background to New Zealand governance and research approach to DRR and its communication

This Appendix (4) introduces New Zealand's legislative and policy framework for DRR before discussing the country's research approach to DRR, and finally outlining key features of New Zealand's DRR-related communication policy and research. Many of the government agencies, institutions and experts and decision-makers (officials) within them might be represented in the media (see Chapter 5 for discussion of results of this research).

Legislation in New Zealand related to natural hazards and their management includes the Resource Management Act 1991 (RMA), the Civil Defence and Emergency Management (CDEM) Act 2002 and the Building Act 1991 (and subsequent amendments). Julia S. Becker and Johnston (2000) and ODESC (2007) provides further details of the New Zealand legislative environment. The Civil Defence and Emergency Management (CDEM) Act (2002), and Resource Management Act (RMA) (1991) mandate territorial authorities (TAs), regional and district Councils to consider and investigate natural hazards, and avoid or mitigate their effects. Refer to relevant sections that mention improving awareness (i.e. communication).

New Zealand is recognized as being a world-wide centre of excellence in earthquake-related research, engineering design and construction, and whilst not as advanced as Japan in aspects of earthquake-related DRR, is certainly still at the forefront of legislative and insurance DRR measures, as well as having relatively well-established emergency management plans and procedures in comparison to other nations of it's size. At the time of the Canterbury earthquakes in 2010 the government in New Zealand had life-safety as the basis of its policy on earthquake prone buildings (DBH, 2005).

J. Cowan et al. (2002) attribute large early advances in DRR in New Zealand to the period between 1929 and 1942 when a series of large shallow earthquakes occurred repeatedly in different parts of New Zealand. Cowan also refers to the emergence of a research culture through government laboratories and universities during the 1930s and 1940s. A national building code, adopting principles of seismic design developed in the United States and Japan, was introduced in 1935, four years after the 1931 Napier earthquake. In 1944 a compulsory insurance scheme that insures homes and their contents and land against damage from earthquake was established. The building code was last updated in 2008, when the standards for public buildings (large buildings housing large numbers of people such as school, hospitals and town halls) were increased to cater for higher levels of shaking (A. Fox, 2011).

New Zealand has a ‘no fault’ insurance (H. Cowan et al., 2009). According to those authors New Zealand insurance for commercial properties is said to have equivalence with perceived risk. However a New Zealand home-owner of a brick home pays no more than modern wooden home that is likely to suffer less damage in an earthquake. Through being compulsory the insurance scheme administered by the Earthquake Commission (EQC) is said to foster solidarity and avoid vulnerabilities through non-insurance (www.eqc.govt.nz - Earthquake Commission Act 1993 (ECA) sections 5(1)(a) and (e)).

An expression of the government’s intention of attribution of responsibility for DRR was expressed in 1995 as:

> *I cannot stress highly enough the importance that this government places on individuals, business and local authorities playing their part and taking prime responsibility for disaster management. They must be encouraged and empowered to minimise, mitigate and manage disaster. … Central government … cannot be expected to carry the full burden of coping with disaster and nor is it best placed to do so. … Every New Zealander must play a part in managing the risk that a major earthquake may occur in their lifetime. This risk management works best for all when it is shared by all. This, and only this, is the route to a swift return to a normally functioning community after a disaster has occurred. … The individuals in local communities have more cause, more incentive and a greater ability to direct and implement a recovery after the quake. It is government’s job to encourage, co-ordinate and empower them. The Hon Bruce Cliffe, Minister of Finance address to Wellington After the Quake; The Challenge of Rebuilding Cities Conference*
>
> (EQC & CAENZ, 1995, p. 195)

New Zealand was said to have had an integrated risk management focus for at least a decade before the Canterbury earthquakes (Mamula-Seadon (2009) citing paper from Department of Prime Minister and Cabinet dated 2001, and an earthquake engineering conference presentation by Britton and Clark, 2000). Not only is the New Zealand statutory framework for risk management an integrative one, that acknowledges risks in complex environments including recovery (Rotimi et al., 2006) but New Zealand is today a country where government-funded institutional and academic researchers recognize the need for integrated planning to achieve resilience (Finnis, 2004; Mamula-Seadon, 2009) and a comprehensive risk management approach in addressing the consequences of hazards, across the four elements.. reduction, readiness, response and recovery (MCDEM, 2005b; R. Smith, 2009). Building disaster risk resilience relies on us understanding a complex set of dynamic factors within the natural, social, economic and built environments, and applying cost-effective and sustainable solutions (Smith, 2009). On the ‘downside’ it is a country where competitive science-finding works in opposition to some key factors in building research-based knowledge - nurturing long-term goals, cross-organisation and inter-disciplinary collaboration and coordination and therefore in delivering strategic outcomes (Seville, 2009). There is an intention, at least, in New Zealand for ‘government co-ordination’ on both the establishment of institutional DRR arrangements, and risk communications, to ensure that risk issues are considered interdepartmentally (Tully, 2007b, p. 4).

The links between the gathering of evidence-based information through scientific research and DRR are well recognized in New Zealand (e.g R. Smith, 2009).

At a governmental level policy research related to planning, responding to, and to a lesser extent recovery from disasters occurred within MCDEM, the Department of Building and Housing (DBH – formerly within the Ministry of Housing at the time of the earthquakes, now part of the Building, Resources and Markets group at the Ministry for Business Innovation and Employment (MBIE)), and the Earthquake Commission (EQC), the Ministry of Health, and Ministry for Social Welfare. The Department of Building and Housing (DBH) and EQC both provided research funding outside their perhaps publicly perceived specialisations of engineering, and insurance, respectively. DBH funded part of the Natural Hazards Programme, while EQC provided other multi-disciplinary research funding,

DRR-related research in New Zealand prior to the Canterbury earthquakes focussed on a) hazard identification and characterisation b) design and materials innovation and structural mitigation, and c) social psychology, risk perception and household preparedness.

Hazard identification and characterisation in New Zealand occurs through Crown Research Institutes (CRIs) and the geology and earth science programmes at all of the major universities. The Institute of Geological and Nuclear Sciences (GNS Science or GNS), the National Institute of Weather and Atmospheric Science (NIWA), and Environmental Science (ESRI) are examples of CRIs engaging in hazard identification and characterisation research that are funded by the government through the Natural Hazards Platform. The GeoNet project is a collaboration between the Earthquake Commission and GNS; its main funder is EQC, but it is operated by GNS. The on-call GeoNet duty officer is responsible for locating potential felt earthquakes and to act as the primary contact with the media.

Individuals and role titles within these organisations for those who were media sources in 2010 and 2011 are to be found in the list of scientists in Appendix 11.

Seismic or ‘base’ isolation and foundation design and performance began with research in seismic isolation (e.g. Skinner et al 1993) and capacity design for reinforced concrete structures (e.g. Park & Paulay, 1975; Paulay & Priestley, 1992). Design and materials innovation and structural mitigation, in New Zealand has a focus on foundation design, including base isolation, through the post-graduate programme in Earthquake Engineering at the University of Canterbury, and through structural engineers at the University of Auckland, GNS Science, and within BRANZ (part of the former Ministry for Building and Housing). As a result there is a worldwide perception, within and outside engineering itself that New Zealand is amongst the world leaders in earthquake resistant construction (Holmes, 1995; Zahn, 2011).

Social psychology, risk perception and household preparedness research occurs primarily through the Schools of Psychology at Massey University and Victoria University. Much risk perception literature originates from New Zealand (Solberg et al., 2010). Some of this research makes generalised comment about implications for risk communication.

Other, often multi-disciplinary research and research-to-practice efforts in DRR have been undertaken throughout New Zealand. This has occurred in particular through the Joint Centre for Disaster Research (JCDR) and Resilient Organisations (a group of researchers from throughout New Zealand, but particularly at the Universities of Canterbury and Auckland, funded by the Natural Hazards Platform) who are concerned with pre-disaster organization planning and its influence on response and recovery. JCDR is a collaboration between Massey University and GNS Science (GNS) designed to integrate social science perspectives with those GNS Science makes in geophysical research (Editor's note, 2011).

Other multi-disciplinary research has occurred through the post-graduate Hazard and Disaster Management post-graduate programme at the University of Canterbury. There had also been an Earthquake Hazard Centre at Victoria University in Wellington for some years. Under- and post-graduate courses and research in Emergency Management were available either though the private Emergency Management Training Centre established by Environment Canterbury in 2000 or through Massey University’s Emergency Management Programme in Wellington.

Much of the aforementioned research was funded either by the Earthquake Commission or by the Natural Hazards Research Platform. The platform is partially funded by the Ministry of Housing (now Ministry for Business and Innovation MBIE). In addition to its insurance function EQC also has a mandate to facilitate research and education about matters relevant to natural disaster damage and methods of reducing or preventing such damage. EQC invests in geophysical monitoring and data management through GeoNet and faculty positions at four New Zealand universities to assess and mitigate geological risk. The EQC also funds knowledge dissemination - communication (H. Cowan et al., 2009)).

The Natural Hazards Research Platform is a collaborative research arrangement with an annual budget set at $14 million for 10 years, launched by the New Zealand government in 2009. The intention was to bring together research into causes and mechanisms of natural hazards, physical, social and economic consequences and examine how communities can build resilience to deal with them - and suggest strategies to provide this. Another science research funding arm of DRR-related research that is also involved in matters relating to the role of science and it's communication in society is the Royal Society of New Zealand (RSNZ). Conferences and international collaboration into various aspects of DRR is ongoing; an early example is the Wellington after the Quake – conference in 1995 discussing earthquake recovery in the event of a large Wellington earthquake, using international, national and local insights.

In terms of research to practice significant collaborative academic and practitioner input had gone into lifelines mitigation in New Zealand (e.g. Christchurch Engineering Lifelines Group 1997) . Territorial authorities have commissioned what are termed Lifeline reports that comment on the likely impact of a natural disaster on essential infrastructure and services (lifelines); water supply, energy, transport networks, telecommunications, and waste disposal. These reports highlight vulnerabilities, and make recommendations to improve resilience of these systems and services (Brundson & Evans, 2003). Warning sirens for tsunamis were installed in some locations after the post 2004 Asian tsunami, and spurred by the Canterbury event and 2011 Japanese tsunami. New Zealand relies on a combination of international and local expertise for tsunami warnings, from the Pacific Tsunami Warning Center the NOAA Centre for Tsunami Research, the Australian Bureau of Meteorology GNS Science in New Zealand, and other New Zealand academics. However New Zealand has not been active in the development or installation of advanced warning and associated shut-off technologies.

There has also been research and policy integration in preparation and land use planning policies for earthquake hazards in New Zealand (Julia S. Becker & Johnston, 2000). This includes planning for development of land on or close to active faults (Glavovic, Saunders, & Becker, 2010; J. Kerr et al., 2004; Saunders, Forsyth, Johnston, & Becker, 2009). Land use planning in New Zealand based on shaking hazard is a function of terrain conditions (soil sediment and basement rock, topography and ground-water conditions). The characteristics of different earthquake scenarios are assumed and the probability of occurrence determined, and expected shaking intensities assigned to create shaking susceptibility microzones (Crozier et al., 2006).

Several countries, including New Zealand base legislation on disaster reduction measures on active fault data (Kiyomine & Atsuki, 2011). This includes land use planning. New Zealand utilises probabilistic seismic hazard assessment models - PSHA-based models (NZ Seismic Hazard Model (1998-2000).

Probabilistic Seismic Hazard Assessments (PSHA) had been undertaken by GNS and scenarios envisaged for New Zealand and Canterbury (for ECAN) (M. Stirling et al., 2000; M. Stirling, Yetton, Pettinga, Berryman, & Downes, 1999). The Alpine Fault was known to be a source of potential strong shaking for the Christchurch and Waimakariri areas. Liquefaction hazard evaluation had in some instances been applied in the urban planning of, and mitigation options explored in relation to some developments, e.g. the Pegasus development in the Waimakariri District of Canterbury (C. Anderson & McMorran, 2003) although not having been successfully applied in others prior to that time.

The New Zealand Society for Earthquake Engineering (NZSEE) is a professional body that provides a forum for technical debate, promotes reconnaissance of local and overseas earthquakes, is involved in the evolution of relevant legislation and regulations, and contributes to planning for, response to, and recovery from, earthquakes (http://www.nzsee.org.nz/about-us/who-we-are/). The NZSEE typically leads field-based research teams to international earthquake disasters looking at performance of built environment and lifelines (H. Cowan et al., 2011; D. Hopkins et al., 2008).

District Health Boards had involvement in ‘preparedness’ programmes at a regional and local level that enhance awareness of a range of physical and environmental hazards of such general disease risk. The Ministry of Health and Health Boards are also involved in planning for the provision of the emergency medical services in disaster – e.g. 2007 Ministry of Health – National Health Emergency Plan: planning for individual and community recovery in an emergency event. Under the Health Act, Medical Officers of Health have a legislative role to play in all emergencies and have powers that can invoke (not as part of a District Health Board, but delegated through the Director General of Health (I008 - Humphreys 2011).

As introduced in chapter 1 the importance of DRR communication is embedded in policy and legislation from UN to local levels in New Zealand. Governments are seen as having responsibility to communicate risk identified on behalf of citizens by science programmes funded with public monies, and to inform residents about planning and preparedness measures (Basolo et al., 2009). In New Zealand the legislative requirements for DRR and its communication are through Regional and District Plans (Julia S. Becker & Johnston, 2000; H. Cowan & Simpson, 2011)p2.

Emergency managers in New Zealand within TAs strongly advocate for household preparedness (Ronan & Johnston, 2005). New Zealand Ministry of Civil Defence and Emergency Management (MCDEM) also actively engages in 'preparedness motivation strategies' (Finnis, 2004). MCDEM has both public information and public education managers (from MCDEM organizational chart)

A New Zealand strategy Working from the same page has been developed by CDEM (CDEM, 2010). Campaign-based 'intervention programmes' or public education approaches to improve householder preparation have also been supported by EQC e.g. EQC Fix Fasten and forget programme in 2001 (for more details see McClure 2006). Other campaigns listed somewhere else. (Spittal et al., 2006) in comparing websites promoting preparedness measures reflects that the New Zealand Earthquake Commission's suggestions place more emphasis than international sites on structural changes to dwellings to enhance damage protection.

New Zealand university-based DRR-related communication research and related publications has included those by CAENZ (theoretical engineering approaches to risk communication). There has also been research on how people make meaning of hazard information when preparing for disaster (Julia S. Becker et al., 2012; J. S. Becker, Saunders, Hopkins, & Wright, 2009). Dohaney, Brogt, Kennedy, and Wilson (2015) has looked at skills and confidence of earth scientists in communicating their science, and Doyle et al. (2011) at the communication of probability and uncertainty.

Research conducted in New Zealand that touches on aspects of mass media communication of natural hazards, risks and disasters includes that of McClure refs McClure papers, and Douglas van Belle - variations in the content of news media coverage of disasters might be used to address questions of race, image and governmental practices, in particular foreign aid (Van Belle, 2000).

MCDEM and incumbent head in 2010-2011 John Hamilton was charged with the emergency management role in the wake of the Canterbury earthquakes of 2010-2011.

# Appendix 5: Survey and interview information

This appendix contains the following details:

-blank-

# Appendix 5.1: Survey questionnaire

12/032 April 2012

## Communicating Earthquake-related Science
## INFORMATION SHEET FOR SURVEY PARTICIPANTS

*Thank you for showing an interest in this project.*
*Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.*

**What is the Aim of the Project?**
This project is being undertaken as part of the requirements for a PhD.
The PhD looks at how aspects of earthquake-related disasters and ways of minimising them are being communicated in the mass media and whether this is serving people's information needs. The questions asked of participants relate to their opinions about how earthquake-related information, and how to minimise disasters, is communicated.

**What Type of Participants are being sought?**
The aim is to achieve as wide a group of participants as possible.
Participants include persons over 16 years of age and will include 'general public' who have various degrees of direct or indirect experience of the Canterbury earthquakes as well as scientists, policy- and decision-makers and advocates of disaster risk reduction. While it is anticipated that most respondents will reside in NZ, your living overseas does not preclude your participation.

**What will Participants be Asked to Do?**
Should you agree to take part in this project, you will be asked to answer 9 survey questions. You may choose to self-complete a paper- or email copy of the survey, complete the survey on-line, or have your verbal responses recorded by the researcher. Completing the survey is likely to take between 10 and 20 minutes depending on the detail of the answers given.

You may decide not to take part in the project without any disadvantage to yourself of any kind.

**What Data or Information will be Collected and What Use will be Made of it?**
You are invited to look at the questions before deciding to take part in the survey or interview. The survey is anonymous - no personally identifying information is being asked, or will be recorded. The data collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. Data obtained as a result of the research will be retained for at least 5 years in secure storage. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand).

**Can Participants Change their Mind and Withdraw from the Project?**
You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

**What if Participants have any Questions?**
If you have any questions about our project, either now or in the future, please feel free to contact either:-

| | | |
|---|---|---|
| *Vivienne Bryner* | or | *Prof. Jean Fleming* |
| Centre for Science Communication | | Centre for Science Communication |
| University Ph Number: + 643 479 9465 | | University Ph Number: +643 479 7848 |

*This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.*

## Survey - Communicating Earthquake-related Science

**1. How well has mass media communication about earthquakes since the first Canterbury earthquake improved your understanding of: (Please circle one number on each line).**

| | Not at all | | | Neither | | | | | A lot |
|---|---|---|---|---|---|---|---|---|---|
| a) the science of earthquakes | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| b) earthquake risk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| c) minimizing earthquake-related disasters | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

**2. What do you believe people need to know about earthquakes and ways of minimising earthquake-related disaster? Why?**

| What people need to know | Why |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

3. What do you think could have been better explained about earthquakes, or minimising earthquake-related disasters, than it was before or during the Canterbury earthquakes?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

4. Are you or have you been involved in planning, managing or advocating for minimising the effects of natural hazard events

| | |
|---|---|
| at home? | Yes/No |
| at your place of work? | Yes/No |
| through your work? | Yes/No |
| in the community? | Yes/No |

5. Are you any of the following?

| | |
|---|---|
| Civil Defence volunteer | Yes/No |
| Emergency Services (volunteer) | Yes/No |
| Other community volunteer (please give details below) | Yes/No |
| Emergency Services (paid employment) | Yes/No |
| EQC (please note your role below - eg assesor) | Yes/No |
| Risk assessor (please give details below) | Yes/No |
| Building inspector | Yes/No |
| Planner or policy maker at local or regional government level | Yes/No |
| Planner or policy-maker at national government level | Yes/No |
| Politician (national government level) | Yes/No |
| Elected representative at local or regional government level | Yes/No |
| Geoscientist | Yes/No |
| Geotechnical engineer | Yes/No |
| Engineer - construction design, materials | Yes/No |
| Environmental scientist | Yes/No |
| Social scientist | Yes/No |
| Health or medical scientist or professional | Yes/No |
| Mathematician or statistician | Yes/No |
| Other scientist (please give details below) | Yes/No |
| Provide office or administrative support to any of the above | Yes/No |

Please give brief details relevant to your 'Yes' answers:______________________________

________________________________________________________________________

6. Were you involved in the Canterbury earthquakes in any of the roles in Question 5

(Please circle as appropriate)

| | | | |
|---|---|---|---|
| as a community volunteer? | Yes, in response | Yes, in recovery | No |
| as a scientist ? | Yes, in response | Yes, in recovery | No |
| in another paid capacity? | Yes, in response | Yes, in recovery | No |

7. Please give details about any ways you are or were affected by, or associated with the Canterbury earthquakes.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

8. Please rank the following ways to inform people about earthquakes, earthquake-related disasters and how to minimise them:

Television news ☐

Television ad ☐

Television documentary ☐

Printed newspaper ☐

Online News ☐

Magazine article ☐

Radio interview ☐

School-age education ☐

Websites ☐

Movie ☐

Social media (eg Twitter, Facebook) ☐

Community Meetings ☐

Other (please specify)____________________________________________

9. Please check all boxes that apply to you:

a)
- am male ☐
- am female ☐

b)
- am aged 16- 25 ☐
- am aged 26-55 ☐
- am 56 or older ☐

c)
- at school or didn't complete secondary school ☐
- have completed secondary schooling ☐
- am tertiary educated ☐
- hold a post-graduate qualification ☐

d)
- don't live in NZ ☐
- live in Northland or Auckland ☐
- live in Waikato or Coromandel regions ☐
- live in central North Island or Taranaki ☐
- live in Bay of Plenty, East Cape or Hawkes Bay ☐
- live in lower North Island but not Wellington ☐
- live in Wellington region ☐
- live in the upper South Island ☐
- live in the Canterbury region ☐
- live on the West Coast of the South Island ☐
- live in Otago ☐
- live in Southland ☐

e) I belong to the following ethnic group(s)
- New Zealand European ☐
- Samoan ☐
- Cook Island Maori ☐
- Niuean ☐
- Maori ☐
- Chinese ☐
- Indian ☐
- Tongan ☐
- Other, such as Dutch, Japanese Tokelauan ☐

(Identify which if you wish)________________

(Identify iwi & hapu if you wish)____________________________

*Thank you for completing this survey*

-blank-

## Appendix 5.2: Background to web-based snowball and face-to face surveys

The first emails inviting participation in the web-based survey were sent out in July 2012. No follow-up reminders were sent. The web-based survey remained ‘open’ until January 2013. Perusal of the demographics showed few responses from politicians, and or journalists. A few emails were sent to try to achieve more responses from these groups. This initiative had limited success, and the survey was closed so that results could be analysed.

As this was a snow-ball survey the response rate cannot be calculated. One hundred and eighty of 241 respondents who started the web-based survey completed the survey. Most who did not complete gave up at the first open question. The two open questions were completed by 191 respondents. Most completed the survey within 12 to 19 minutes. Before considering the responses in detail the dataset was checked for duplicated IP addresses. Of those responses identical IP addresses the few where demographic data or response wording was judged to be questionably similar, were not analysed twice.

Face-to-face surveys were conducted in Auckland in December 2012. Prospective respondents were approached at a variety of public locations. Those who agreed to participate (over 90% of those approached) typically self-completed paper copies of the survey. On a few occasions the responses were recorded for the respondent; for example if the respondent was nursing a young child. Many of the face-to-face surveys of the public were conducted in Auckland. NGO groups in Canterbury publicized the online survey. As a result there is a relatively bimodal representation of in ‘public’ respondents, those who live in a comparatively aseismic region of New Zealand, and Cantabrians, most of whom experienced the earthquakes of 2010 and 2011.

-blank-

## Appendix 5.3 Interviews and interviewee selection

Interviews were typically scheduled for and lasted for one hour. In a few exceptions the interviewees indicated they were happy to be interviewed for longer. The questions asked in interview were identical to those asked in survey, but in random order as the interview progressed. The key questions 2 and 3 were always asked early on. In some interviews some of the questions (for example about preferred channels) were not asked for lack of time.

Interviews were mostly conducted face-to-face. A few that were originally scheduled to be face to face, but were cancelled due to a snowstorm in Christchurch that shut the city down were conducted by telephone. One interviewee chose to respond by email, another using the web-based survey but identified himself. The interviews were recorded by dictaphone and converted to digital files. The responses were coded in terms of which key DRR information topics were referred to.

Key considerations in the choice of interview subjects were to gain subjects whose position and experience it was considered would generate richness as well as a variety of perspective across social actor positions. At the same time every effort was made to broaden the demographic variability. That said, interviewees are heavily weighted toward residents of Canterbury involved in some aspect of the recovery. This provides perspective of politicians, experts, advocates and public who have had a significant period in which to reflect upon their information requirements.

There were more male than female interviewees. This gender imbalance occurred despite a deliberate effort at the time of interviewee selection, to approach females rather than males, to balance this. The imbalance was that only 7 of the 24 interviewees are female, and a similar proportion is from outside of Christchurch. The former is a function of who holds certain positions, and deliberate choices were in fact made to raise the female interviewee sample to this level for example to gain interview with a female from within CERA, rather than an alternative male choice.

-blank-

## Appendix 5.4: Observations about differences between survey respondents and interviewees; science background and DRR-role

It was the aim of the anonymous survey to achieve responses from those who have had time to reflect on the Canterbury disaster experience, and those who had not, some scientists, many non-scientists, and with a range of education background. In order to gain the responses of citizens not directly affected by the Canterbury earthquakes face to face surveys were conducted in Otago and Auckland. Using the tetrahedron of characters from Kondo et al 2012 in Figure 2.4. Many experts were also Canterbury residents, otherwise known as 'survivors' or 'victims'. Some citizens were advocates, involved in post-disaster recovery NGOs, other not. Some experts were also public servants.

The demographic characteristics of the selected interviewees are quite significantly different to that of the survey respondents. Interviewees mostly reside either in Wellington being the political seat of New Zealand, or Canterbury. The latter is as a result of a decision to interview mostly those with direct experience of the Canterbury earthquakes. One interviewee had moved out of Canterbury since the quakes, whilst another had moved to live there. Of the two interviewees not residing in Wellington or Canterbury, one was from Auckland and the other from Otago.

Other differences between the survey and interview respondent groups were that the majority of interviewees identified themselves as New Zealand European or European. One interviewee was Samoan, and another indicated they were Ruanui or Tuhoe, Ngati Porou. With few exceptions the interviewees are tertiary–educated, 30% with post-graduate qualifications – and so are not at all representative of what might be termed the 'general public'.

As is also the case with survey respondents many of those interviewed have multiple societal roles in relation to aspects of DRR – directly through their work, in policy advisory roles, involvement in civil defence or communities, and in the home (see Table 3.2). Of those interviewed only two of the non-Cantabrians and the Canterbury family were not involved in response or recovery in any capacity. The often surprisingly lengthy personal narrative-style answers to Question 7 (relating to association with Canterbury earthquakes) would be a rich resource for further research.

Four local policy- and decision-makers were interviewed, Of these two were elected representatives (the CCC deputy mayor and Spreydon Heathcote Community Board chairman). One national government (Opposition MP) was interviewed. The offices of four National (Government) Ministers with portfolios that relate in some way to the Canterbury earthquakes were approached, but all Ministers declined to be interviewed.

Approximately one half (14) of interviewees have a science background and were involved in some capacity in both Response and Recovery to the Canterbury earthquakes. Most are Cantabrians. Some of the survey respondents have a general background in science but could not be described as experts in any form of DRR-related science. The ‘experts’ include individuals with a range of academic, crown research, professional and public service roles. Included are geotechnical and structural engineers, health-scientists (one from public health and the other emergency medicine), geo- and social scientists.

Three of the scientists interviewed specifically mentioned their influence on policy through policy advisory roles (public health, geoscience and geotechnical). In the case of the medical officer of health this policy influence is also at international level through the World Health Organisation (WHO). The Member of Parliament I023 at the time of interview had just been invited to join the UNISDR's Parliamentarian Advisory Group.

Two respondents other respondents’ backgrounds are worth specific mention. One respondent chosen to represent ‘affected citizens’ had coincidentally begun studying geoscience at the University of Canterbury since the earthquakes.

The perspective of an individual who reports a tertiary degree in science, but whose ‘earthquake-predictions’ are not recognized by most geoscientists, that is, who fits the description pseudo-scientist, was also sought. Nowhere in the literature relating to pseudo-scientific earthquake predictions reviewed, does it appear that the views of a pseudo-scientist on the communication of science, risk or DRR have been directly canvassed.

To represent the media perspective a science reporter, and a former radio news presenter who now works at the Science Media Centre were interviewed. One other interviewee has extensive media experience but has chosen to remain anonymous. Disappointingly, early suggestions that a TV presenter would participate failed to come to fruition. All of the DRR-related scientists interviewed have been mass media sources. In addition 5 of the ‘non-scientists’ have also been media sources, and four have written pieces printed in mass media and at least 2 have blogged about the earthquake. One interviewee has past experience as a communications advisor.

Two of interviewees are involved with Canterbury advocacy groups advocates – one from Future Canterbury Network (I009) and the other (I029) as the spokeswoman for Canterbury Communities Earthquake Recovery Network (CANCERN).

Only I005, I016 and I017 indicated that they had neither a science background nor significant involvement past personal experience in the Canterbury earthquake. This reflects the fact that interviewee selection was such that the attitudes of media sources, and those in positions of influence in terms of science communication were explored in detail.

All individuals interviewed have had considerable reason, through both personal and professional experience, for reflection about what is, and has been communicated about earthquakes, disasters, seismic risk and related risk reduction.

-blank-

## Appendix 5.5: Survey question design and limitations

The survey was designed to identify citizens' impressions of media communications before and during the Canterbury earthquakes (Question 1), their views of what should be communicated about earthquake-related DRR (Questions 2 and 3) and to describe the respondents (Questions 4-9).

Questions 4-6 were designed to show association with science, or with DRR (through profession or volunteer work) and lived or professional experience of the Christchurch earthquakes, their response or recovery. The intention was to ensure, and be able to show, that respondents from variety of backgrounds had been included in the survey. Respondents' involvement in DRR generally was canvassed in Question 4. This was in terms of the degree of predisposition to work in a DRR-related discipline, household preparedness or building of community awareness or other capacity i.e. social capital building

Questions 5 and 6 surveyed respondents' response and/or recovery involvement relating to the Canterbury earthquakes, whether as community volunteer, scientist or in another paid position. Their involvement with DRR was identified through Questions 4 & 5. Association with, or lived experience of the Canterbury earthquakes was determined in Question 7. Experience with earthquakes other than any from the Canterbury sequence was not canvassed, although a few respondents voluntarily revealed experience for example the New Zealand 1968 Inangahua, and 1997 Edgecumbe earthquakes, and the Samoa-Tonga earthquake of 2009. That experience of earthquakes was not specifically asked is not considered a particularly significant omission as it was never the intention to conduct detailed cross-correlation of demographics and DRR or earthquake experience with responses.

Question 8 was asked to identify respondents' preferred media channels. Sub-questions in Question 9 were demographic; it was intended that respondents were a cross-section of the community.

It should be noted that some respondents indicated that they did not understand what the 'mass' in 'mass media' in question 1 meant.

A far more significant limitation of the survey however, was the wording of questions 2 and 3. In hindsight these were far too complex despite having been considered many iterations during the survey pilot. The open and long nature of question 2 and question 3 was off-putting to respondents and made for analysis more time-consuming. However the open questioning was favoured over question styles where options would force citizen responses in area they would not naturally mention themselves.

The difficulties faced in wording question 2, its length, and reference to mass media communication about earthquakes and 'minimising disasters' are discussed here because they are considered to be indicative of the issues that are fundamental to the difficulties in communicating DRR, science and risk.

Firstly, it was recognized from early immersion in the media data, and conversations in which the PhD research topic was mentioned, that the typical assumption when earthquake-related disasters and science are mentioned is that the science referred to was earth science. Unless guided, the respondents would likely focus on hazard knowledge, rather than communication of ways of mitigating earthquakes and science. A second challenge was in overcoming the fact that the term disaster risk reduction is not commonly known and therefore could not be used. It was considered that reference to limiting disaster losses would focus responses on the economic and built aspects of disaster consequences. Reference to hazard mitigation would preclude responses that referred to community-building or social aspects of DRR. While the term 'risk management' could have been used instead of reducing disasters, respondents of the pilot survey indicated that this would not be viewed as including individual preparatory actions.

Other alternative wordings were considered and discarded. For example, questioning "What do you want to know?" a contextual model question (Ziman, 1992), would have omitted all things respondents already knew. Instead the rational choice model phrase 'need to know' was chosen. However for some respondents this clearly did not suffice either. Experts wanted a definition of 'people' considering that different people needed to know different things. Some indicated that the question should not be asked of them, but of 'the public'. So the question clearly did not convey, as it should have, the concept of communication to achieve a base-line of knowledge across a broad range of DRR-related topics that all citizens require in terms of seismic risk, disasters, and risk-related reduction.

The decision to use the phrase 'minimising disasters' also proved unpopular with a few respondents. In hindsight the following questions would be asked – question 2 "What do all people need to know before, during and after earthquakes?" – and "Why?" question 3, would be amended to "What could have been better communicated in the news before, during and after the Canterbury earthquakes?" Despite these above-mentioned limitations the responses given in answer to questions 2 and 3 in the main addressed the questions asked and were often rich in detail.

Question 1 referred only to ‘understanding’ in relation to earthquake science (without defining what was meant), and risk and risk reduction. The question did not relate to understanding of all 12 topics, as these had not been refined at that point in the research, and nor did it relate to credibility, awareness, agreement about solutions or motivating effective response.

Survey respondents might also have been asked what sciences they thought were relevant to DRR.

-blank-

# Appendix 6: Summaries of natural hazard- and disaster-media research

This appendix contains one section that describes the results of literature research and analysis of natural hazard media and disaster media, studies including six Tables and two Figures as below:



Tables



Figures

-blank-

## Appendix 6.1: Analysis of natural hazard- and disaster media studies

Natural hazard and disaster media studies may not be robust in terms of DRR

Academic articles relating to the past 35 years of studies of communication of earthquake- and other natural-hazard- risk- and disaster-related topics in the media were analysed in this study. A comprehensive, but perhaps not exhaustive, list of studies analysed (these are detailed in Appendix Tables 6.5 and 6.6). Those tables contain the data presented in Appendix Tables 6.1-6.4 and Appendix Figures 6.1 and 6.2 (and Figure 3.1 and Table 3.6).

Studying natural-hazard- and disaster-media has become popular in recent times. The number of academic papers referring to media content and 'natural' disaster studies was approximately 3-5 per year in the 1980s and 1990s. This has mushroomed in the past 3 years. Fifteen studies identified in literature review for this research were published in 2012. However the value of some of these studies to DRR or science- and risk communication research is questionable.

Only 12.8% of the research undertaken since 1977 has been by disaster researchers (Appendix Table 6.1). Communication researchers (part of the Information, Decision and Management Science discipline group) undertook the largest portion of the research of any discipline. Analysis may be robust by media analysis criteria, but will not likely be theoretically robust in terms of science- or risk communication, and in particular DRR theory. Studies that included both communication and DRR researchers were rare.

**Appendix Table 6.1: Researcher interest in natural hazard- and disaster mediacontent analyses by discipline**

The natural-hazard-related-content analyses (Appendix Table 4.6) were studied by researchers from the disciplinary groups listed below. Discipline groups were explained in section 3.6.4.

| Discipline group | % of natural-hazard-media content researchers |
|---|---|
| Building | 1.2 |
| Cognitive and Behavioural | 13.4 |
| Earth and Planetary | 4.3 |
| Economics | 1.2 |
| Environmental | 3.7 |
| Health | 5.5 |
| Information, Decision and Management | 45.1 |
| Urban Studies/Planning | 5.5 |
| Public Administration/Political | 6.1 |
| Multi-disciplinary and disaster or risk research | 12.8 |
| Other | 1.2 |

Earthquake-related content analyses typically comment on unproven media effects

The proportions of references that examine media effects, role or functions or content are shown in Appendix Table 6.2. Many previous earthquake-disaster-media studies discussed media effects (quantitatively or qualitatively). Twenty per cent related to each of content analyses and citizen surveys.

Literature review has revealed that there is a wide range of media effects (such as specific risk perceptions, judgments or behaviours) that are assumed when discussing the science-risk- and natural-hazard and disaster communication but have not been empirically proven. As noted by Lindell and Whitney (2000) few studies have examined whether and how altering particular message characteristics (i.e. content) affects risk reduction actions.

Few media content analyses refer to DRR media effects research (exceptions are J. Cowan et al., 2002; McClure, Sutton, & Sibley, 2007; McClure, Sutton, & Wilson, 2007). Nor do media content analyses typically combine their comments and recommendations with those from the social psychology of DRR and or communication. Literature review has also shown that some media content analyses are primarily observational, with no, or few suggestions for communication (e.g. Nacher & Ochiai, 2011).

**Appendix Table 6.2: Study types for academic articles about earthquake-related media**

Earthquake-related media studies are as listed in Appendix Table 6.5. Primary study types are as shown in the left hand column. The number of articles is shown in the right hand column.

| Study Type | No. articles |
|---|---|
| Content analysis | 26 |
| Media effects | 39 |
| Citizen survey | 26 |
| Survey of media personnel | 2 |
| Role or function of media | 11 |
| Solely expert opinion | 3 |
| None of the above | 20 |
| Total | 127 |

The intention in this research was to align the methods used and the data gathered with contemporary communicative models that consider a range of social actor views.

Other natural hazard and disaster media research has referred to framing

This research used framing and both qualitative and quantitative methods (as literature review showed many other natural hazard- and disaster media studies did). One of the few studies of natural hazard-related DRR-communication investigated from the perspective of a range of stakeholders that used both qualitative and quantitative techniques was Haynes et al. (2008). That study looked at both contextual and issue-specific factors, as this study did.

Ploughman (1997) is an early researcher in mass media representations of disaster who refers to framing. Researchers who used the term framing in relation to studies of earthquake-related disasters include Balaji (2011), Holm (2012), D. Liu (2010), Mason (2011), Olofsson (2011), A. Yang (2008), and L. Yin and Wang (2010). Others who refer to framing in studies of media and disasters triggered by natural hazard other than earthquakes include Berger (2009), Fu et al. (2012), Hornig (1992), Houston et al. (2012), Paveglio et al. (2011), Sparks (2003), and Spencer and Triche (1994). Some of their results and recommendations are presented and discussed in Chapters 5, 6 and 7.

Similarities and differences between this and previous studies

A study that has some similarities to this one in terms of the stated goal of assessment and type of content analysed is Pasquarè and Pozzetti (2007)'s analysis of mass media representation of geological hazards in the Italian media in 2002-2003. Pasquarè and Pozetti stated that they had assessed 'quality of coverage' in terms of what they referred to as 'key indicators' of 1) information sources 2) attention to hazard prevention and mitigation 3) accuracy and 4) amplification of political conflict. They argued for the dissemination of what they term 'core scientific literature' for a 'lay public' (Pasquarè & Pozzetti, 2007, p. 171).

However there was little linking with communication theory or examples of 'best-practice'. The deficiencies highlighted by their research are attributed to such things as the lack of specialist science staff in the media and 'gaps' between scientists and others researchers. This is not unusual in risk communication related research. Few of the 300 studies analysed clearly disclose communication ideology or goal. This is particularly noticeable when the researchers are from physical science disciplines. While many examine media content in detail, the studies are not linked in any way to science communication theory, content-related or otherwise, or linked to empirical findings of communication or media effects research.

Pasquarè and Pozzetti (2007)'s and Pasquarè and Oppizzi (2012)'s framing analyses of the portrayal of geological hazards in the Italian mass media are two of the few studies that link framing analysis of natural hazard issues with communication theory. However they are examples of analysis rooted in the old communication and DRR models. Pasquarè and co-authors linked discussion to Tichenor's knowledge gap theory (Tichenor, Donohue, & Olien, 1970; Tichenor, Olien, Harrison, & Donohue, 1970) and intimated that it is desirable for academics and researchers to be *'information czars'*. They also showed their roots in the out-dated natural hazards tradition of disaster studies in suggesting that the emphasis in discussions of cause and blame should be on aspects relating to the natural hazard rather than to political or ideological issues, thus missing the framing as

*Disaster = Hazard + Human Community.*

In the broader context of media studies of DRR this research has most similarity with Tierney et al's (2006) sociological study of Hurricanes Katrina and Rita which identified and examined:

a) the themes and timing of disaster-related media stories

b) journalist-constructed science and DRR stories

c) what public required of science and communication of the science - sources (mass media) etc.

d) the relative perspectives of different actors as portrayed in media, and comparing and contrasting these with the reflections of representative actors interviewed.

Studies by McClure et al. (2009); Miles and Morse (2007); Turner (1982); Mileti et al. (2006); Pasquarè and Pozzetti (2007); and Tierney et al (2006) may be said to combine multiple elements of framing research in DRR. These are the broadest approaches to DRR framing and frames identified in literature analysis. However they do not begin to approach the systematic analysis adopted in this research as described in the following section.

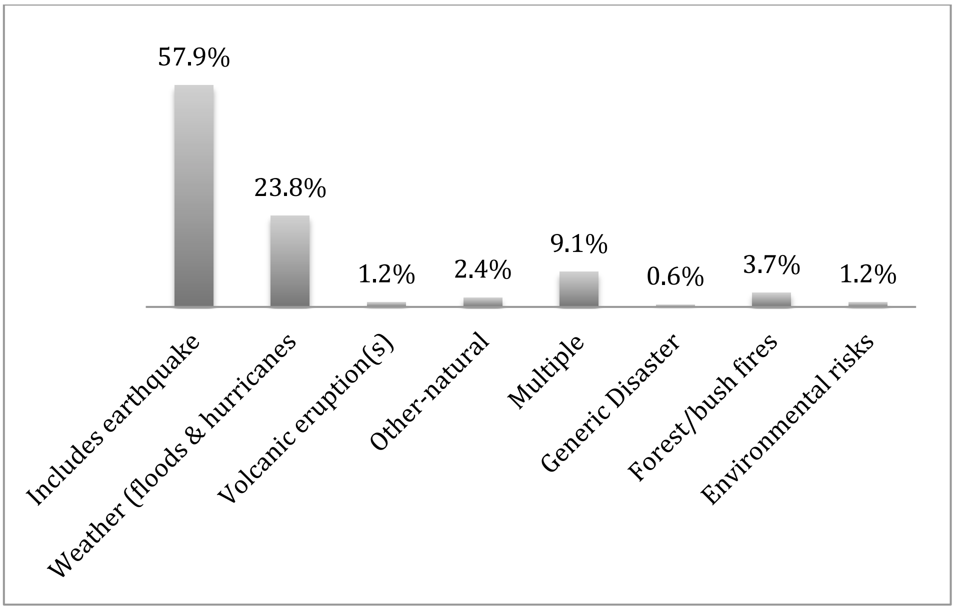
Media content studies that analyse for content related to risk reduction as this study did were rare. Two exceptions were Pasquarè and Pozzetti (2007) and Fu et al. (2012). Fu et al. (2012, p. 75) defined mitigation as activities to '*reduce the long-term risk to human life and property*' but combined the results for response and mitigation. This ambiguity may be the reason that their inter-coder reliability was poor for that code. It also made it very difficult to make comparisons between their studies and the present one.

Review of research articles listed in Appendix Table 6.4 and 6.5 broadly found as did Pasquarè and Oppizzi (2012, p. 152), that:

> *Research on media reporting of natural catastrophic events and geo-hazards targets three major areas: 1) How the media report geo-hazards and disasters; 2) The differences between print and broadcast coverage of the natural extreme events; 3) The ways in which media messages are received and responded to by the audience.*

This research did not look at media effects (3), but instead targetted how the media reports DRR (1), makes limited comment about differences and similarities between print and broadcast media (2) throughout results (Chapters 5, 6 and 7).

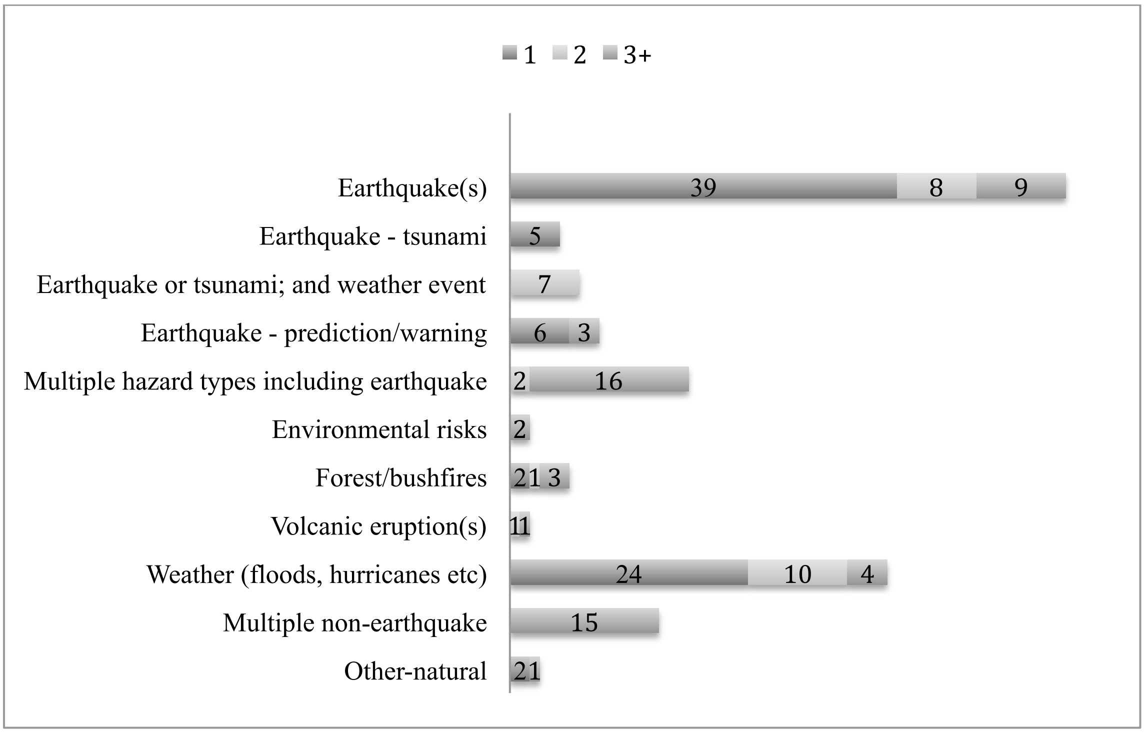
This is one of many studies including content analyses that focused on earthquake (Appendix Figures 3.1 and 3.2).




**Appendix Figure 6.1 Hazard types analysed in natural hazard- and disaster media content analyses**

Hazard types studied in natural-hazard-media content analyses n=164 (see Appendix Table 6.5 for summary of studies analysed). Note that 'includes earthquake' is any of the five first listed event types in Appendix Figure 6.2 below.

The research while pivoting around the Canterbury earthquakes of 2010-2011 has also considered multiple other earthquake events. Most other similar academic studies focused on one event only.




**Appendix Figure 6.2: Event focus of natural hazard- and disaster media studies**

Numbers of natural hazard disaster media studies focused on one, two, or multiple (3+) hazard events; n=312.

Media content analyses of natural hazards published in the English language are dominated by US researchers and by analysis of media located in the United States (Appendix Table 6.3 and Appendix Table 6.4).

Where international media were analysed (that is international compared to the location of the hazard event) the media was typically studied by a US researcher(s) located in the country of the event. This research adds to the less than 10% of media content analyses relating to Australasian or Asian media (see Appendix Table 6.3). It joins only one other study of media content of earthquakes in New Zealand (J. Cowan et al., 2002).

This study has examined both media in the country where the disaster occurred (in respect of New Zealand earthquakes, and also coverage of many other earthquakes as listed in Table 3.7). A key difference between this study and others is that this study has explored a disaster event before, during and after the event. This means that the full DRR cycle has been analysed over a range of DRR topics.

**Appendix Table 6.3: Researcher location for natural-hazards-media-content analysis articles**

This table shows the location researchers were associated with when the 164 natural-hazards-media content analyses were published.

| Researcher Location | Articles |
|---|---|
| Australasia/Asia | 15 |
| Canada | 7 |
| China | 11 |
| Europe | 19 |
| South America | 4 |
| UK | 13 |
| US | 85 |
| International | 7 |
| Other | 3 |

Many of the studies of risk and particularly disaster content are a mix of quantitative and qualitative analyses (e.g. Ashlin and Ladle 2007, Barnes et al 2008, Keshishian 1997, Kodrich and Laituri 2005), with empirical findings reported alongside thematic exemplars. (Examples of such mixed studies include Ashlin & Ladle, 2007; Barnes et al., 2008; Keshishian, 1997; Kodrich & Laituri, 2005; Pasquarè & Pozzetti, 2007; S. Robinson, 2009a, 2009b; Rojecki, 2009; Souza & Martínez, 2011; Voorhees et al., 2007; J. White & King-Wa, 2012; Wilkins, 1985, 1986). This research likewise employs both qualitative and quantitative ways of describing media content.

**Appendix Table 6.4: Country of publication for media articles analysed**

Natural-hazard-media articles were analysed by researchers as shown in Table 3.6 (n=164). For most analyses the country where the event occurred, the analysis took place and the media articles were published was the same. Where the articles were published outside the country where the event occurred, they were coded as 'International'.

| Media Location | Articles |
|---|---|
| Australasia/Asia | 14 |
| Canada | 6 |
| China | 12 |
| Europe | 17 |
| International | 21 |
| Other | 3 |
| South America | 3 |
| UK | 8 |
| US | 71 |
| Unclear | 8 |

## Appendix Table 6.5: Earthquake-related media studies

Study descriptions, events and type of study for 127 academic articles published between 1980 and 2012 that relate to natural hazard and disaster media studies. Eq = earthquake.

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adamo, 2005 | Lisbon earthquake constructed as an event in Italian literature | Eq Lisbon 1755 | 1 | √ | | | | | | | | 2005 |
| Arakiki, 2011 | Indonesian response (aid) to Great East Japan earthquake internet media - qualitative comment | 2011 Tohoku eq 2011 | 1 | √ | | | √ | | | | | 2011 |
| Ashlin & Ladle, 2007 | CDA of UK national newspaper articles relating to environmental aspects of 2004 tsunami | Ind Ocean Tsu 2003 | 1 | √ | | | | | | | | 2007 |
| Atwood & Major, 1998 | Exploring the "cry wolf" hypothesis | Browning Prediction 1989 | 1 | | | √ | | | | | | 1998 |
| Atwood & Major, 2000 | Optimism, pessimism, and communication behaviour in response to an earthquake prediction | Browning Prediction 1989 | 1 | | | √ | | | | | | 2000 |
| Atwood, 1993 | Perception of others' reactions to risk (prediction) | Browning Prediction 1989 | 1 | | √ | √ | | | | | | 1993 |
| Balaji, 2011 | Discourse analysis - racializing of pity | Hurr Katrina 2005 Haiti eq 2010 | 2 | √ | | | | | | | | 2011 |
| Baldwin, 1993 | Perception of others' reactions to risk (prediction) | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Barlow, 1993 | Effect of prediction on preparedness at industrial sites | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Barnes et al, 2008 | Analysis of media agenda setting during and after Hurricane Katrina: implications for emergency preparedness, disaster response, and disaster policy | Hurr Katrina 2005 | 1 | √ | | | | | | | | 2008 |
| Bellegarde-Smith, 2011 | Personal observations of media myth creation and bias | Haiti eq 2010 | 1 | √ | | | | | | | | 2011 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or functions | Survey of Media Personnel | Expert opinion/re commend-ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blanchard-Boehm , 1998 | Public response to - Revised probabilities San Francisco Bay +1 yr anniversary Loma Prieta | eq risk | 1 | | √ | √ | | | | | | 1998 |
| Boccia, 2010 | Brazil's coverage of the warm-up to olympics | Sichuan eq 2008 | 1 | √ | | | | | | | √ | 2010 |
| Borah , 2009 | Visual framing of disaster | Hurr Katrina 2005, Ind Ocean Tsu 2004 | 2 | √ | | | | | | | | 2009 |
| Brown & Minty, 2008 | Empirical study of correlation between media coverage and charitable giving | Hurr Katrina 2005 Ind Ocean Tsu 2004 | 2 | √ | √ | | | | | | | 2008 |
| Buescu, 2006 | Lisbon earthquake constructed as an event in Portugese literature | Eq Lisbon 1755 | 1 | √ | | | | | | | | 2006 |
| Bui et al, 2012 | Online survey - Internet coverage, PTSD Tohuku - online survey France, Canada and US within 2 weeks of Tohuku eq asking for information on disrupted nocturnal behaviour and PTSD | Tohoku eq 2011 | 1 | | √ | | | | | | | 2012 |
| CARMA (Franks), 2006 | Western media coverage of humanitarian disasters (re CARMA report) | Kashmir eq 1995 Dar- fur crisis in Sudan Bam eq 2003 Ind Ocean Tsu 2004 Hurr Katrina 2005 Hurr Stanley 2005 | 3 + | √ | | | | | | √ | | 2006 |
| Chao, 2005 | Media, eq, earth rotation disruption (response to a comment in media) | Sumatra eq 2004 | 1 | | | | | | √ | | √ | 2005 |
| Clark et al, 1993 | Situational and dispositional determinants of affective reactions ot eq prediction | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Cotter, 2011 | Review of internet websites provision of radiation dose information | Tohoku eq 2011 eq effect on Fukushima nuclear plant | 1 | √ | | | | | | | √ | 2011 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/ recommend-ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cowan et al, 2002 | Media & portrayal of earthquakes in New Zealand | LA, Kobe | 1 | √ | | | | | | | | 2002 |
| Dabner, 2012 | Social media response - University of Canterbury -Darfield earthquake | Cant, NZ eqs, 2010 | 3 + | | | | | | √ | | | 2012 |
| Davies, 2009 | Essay on media narratives of China's emergence at time of Olympics and Wenchuan eq's Running Fan - man who ran to save his skin | Eq Sichuan 2008 | 1 | √ | | | | | | | | 2009 |
| de Ville de Goyet, 1999 | Health disaster myths - editorial | *Managua, Nicaragua, eq 1972 Mexico city eq 1995 Hurr Mitch 1998 Turkey eq, 1999* | 3 + | √ | √ | | | | | | | 1999 |
| de Ville de Goyet, 2004 | Epidemics in disaster - disaster myth examples in editorial | various incl eqs & incl Guatemala eq 1976 Mexico City eq 1985 Bam Iran eq 2003 | 3 + | √ | √ | | | | | | | 2004 |
| Deakin, 1997 | Motorist response to 1994 Eq - information provided by mass media one factor | Northridge eq 1994 | 1 | | √ | | √ | | | | | 1997 |
| Dearing & Kazmierczak, 1993 | Content analysis of US newspaper portrayals of 1991 earthquake prediction (Iben Browning) | Browning Prediction 1989 | 1 | √ | | | | | | | | 1993 |
| Dearing, 1995 | Journalists/media and portrayal of 'maverick' science | Browning Prediction 1989 | 1 | √ | | | | | | | | 1995 |
| Dreissens et al, 2012 | Celebrity involvement media relief/charity shows | Haiti eq 2010 | 1 | √ | | | | | | | | 2012 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dereseiwicz, 1982 | Sixteenth century Eurpean earthquakes depicted in German broadsheets (news and illustrations) | Eq Bavaria & Bohemia 1329<br>Eq Fiuli, Venezia, Switzerland & Southern Germany 1511<br>Eq Rosanna & Constantinople 1556<br>Eq Kotor/Kattara 1564<br>Eq Piedmont 1564<br>Eq Ferrara & Florence 1570<br>Eq Italy 1581<br>Eq Vienna 1582<br>Eq Vienna 1590<br>Eq Apulia 1627<br>Eq Calabria 1638 | 3 + | √ | | | | | | | | 1982 |
| Dutt & Garg, 2000 | Overview of science and technology coverage (international academic research and technology development) in Indian English-language dailies | Eq Tehri Dam region, India, 1996 | 1 | √ | | | | | | | √ | 2000 |
| Edwards, 1993 | Survey of Effect of prediction on preparedness - Memphis, Tennessee | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Ergül et al., 2010 | Islamist press portrayal of earthquake (only wrath of Allah & divine judgement?) | Eq Van-Muradiye 19 76<br>Eq Maramaa 1999<br>Hurr Katrina 2005<br>Ankara drought 07 | 3 + | √ | | | | | | | | 2010 |
| Fitzpatrick & Mileti, 1990 | Perception and response to Aftershock warnings during the emergency period | Loma Prieta eq 1989 aftershocks | 3 + | | | √ | √ | | | | | 1990 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farley et al, 1993 | Effect of prediction on preparedness - Survey before and after date of Browning prediction | Browning Prediction 1989 | 1 | | √ | √ | | | | | | 1993 |
| Farley, 1993 | Summary of Special Issue | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Frank, 2003 | Community/personal experience narratives in newspaper coverage of Loma Prieta eq | Eq Loma Prieta 1989 | 1 | √ | | | | | | | | 2003 |
| Fu et al , 2010 | Disabled people's use of mass media in Sichuan China | Sichuan eq 2008 | 1 | | | √ | | | | | | 2010 |
| Fu et al , 2012 | Newspaper coverage of emergency response and government responsibility in domestic natural disasters: China-US and within-China comparisons | Hurr Katrina 2005<br>SIchuan eq 2008 | 2 | √ | | | | | | | | 2012 |
| Gaddy & Tanjong, 1986 | Eq coverage by Western Press of earthquakes outside their countries | Eq - multiple | 3 + | √ | | | | | | | | 1986 |
| Gibson, 2010 | Formation of story based on raw documentary footage | Eq Haiti 2010 | 1 | | | | | | √ | | √ | 2010 |
| Goltz, 1984 | Media responsibility for emergency response myths | Imperial Valley eq 1979<br>Alaska eq 1980<br>Algeria eq 1980<br>Italy eq 1980 | 3 + | √ | | | | | | | | 1984 |
| Gribble et al, 2012 | Media messages and the needs of infants and young children & child aid | Sichuan eq 2008<br>Cyclone Nargis 2008 | 2 | √ | | | | | | | | 2012 |
| Gros, 2011 | Essay that makes reference to media narratives in relation to the cause and/or exacerbation of the Haitian eq disaster | Haiti eq 2010 | 1 | √ | | | | | | | √ | 2012 |
| Haberland et al, 2010 | Media coverage in Germany of Sichuan eq and Olympics media hypes | Sichuan eq 2008 | 1 | √ | | | | | | | | 2010 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hiroi et al, 1985 | Study of Mass media reporting in emergencies | Nihonkai-Chuubu eq 1984 (& tsunami) | 1 | √ | | | | | | | | 1985 |
| Hjorth & Kim, 2011 | Social media Tohuku | Tohoku eq 2011 | 1 | | | √ | | | | | | 2011 |
| Ho & Hallahan , 2004 | Post eq corporate advertising in newspapers | Chi-Chi eq 1999 | 1 | √ | | | | | | | | 2004 |
| Johnson et al, 1993 | Discussion of framing risk probability and Insurance decisions | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Inwood, 2011 | Media coverage of Chinese quake poetry | Sichuan eq 2008 | 1 | √ | | | | | | | √ | 2011 |
| Jalali, 2002 | Civil society, state & media - Turkey eq | Maramara, Turkey 1999 | 1 | √ | | √ | √ | | | | | 2002 |
| Jin & Zhao, 2011 | Classifying Netizen opinion about Yushu eq information | Yushu eq 2011 | 1 | | | √ | | | | | | 2011 |
| Keshishian, 1997 | content analysis two eq in US press | 1988 Armenian and 1980 Iran eq | 2 | √ | | | | | | | | 1997 |
| King, 2011 | Essay on disaster discourse, depravity and myth | Hurr Katria 2005 Haiti eq 2010 | 2 | √ | √ | | | | | | | 2011 |
| Kivikuru, 2006 | Tsunami communication in Finland | Indian Ocean Tsunami '04 | 1 | √ | | | | | | | | 2006 |
| Kodrich & Laituri, 2005 | Topic analysis of online print-media coverage in response period | Gujarat eq 2001 | 1 | √ | | | | | | | | 2005 |
| Kondo et al, 2012 | social reality construction through numbers Kobe and Wenchuan | Kobe eq 1995 Sichuan eq 2008 | 2 | √ | √ | | | | | | | 2012 |
| Krug, 1993 | Interview & media analyses -sense-making of prediction | Browning Prediction 1989 | 1 | √ | √ | | | | | | | 1993 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lamontagne, 2008 | Casualties directly caused by an earthquake in Canada: first contemporaneous written accounts - Use of historic newspaper report to identify that eq caused deaths | Eq Charlevoix, Quebec 1870 | 1 | √ | | | | | | | | 2008 |
| Lamontagne, et al, 1992 | Communications strategy - Canadian seismologists and post-earthquake stress (assumed to arise from insufficient knowledge of earthquakes) | Saguenay, Canada eq 1988 Mont-Laurier, Canada eq 1990 | 2 | √ | | | √ | | | | | 1992 |
| Lan, 2009 | Coverage of the Wenchuan Earthquake; cultural and insitutional legacies & lessons | Sichuan eq 2008 | 1 | √ | | | | | | | | 2009 |
| Leong, 2009 | Mention of international media comment on Chinese media transparency in aftermath of Sichuan, and Chinese media rebroadcast | Eq Sichuan 2008 | 1 | √ | | | | | | | √ | 2009 |
| Lau et al , 2006 | Impacts of media coverage on stress levels in Hong Kong | Ind Ocean Tsu 2004 | 1 | | | | | | | | | 2006 |
| Li, 2011 | Estimating the number of deaths from reporting of Yushu earthquake | 12 eqs since 2001 | 1 | √ | | | | | | | | 2011 |
| Liu, 2010 | Americal and Chinese coverage of Sichuan eq | Sichuan eq 2008 | 1 | | | | | | | | | 2010 |
| Lobb et al, 2012 | Correlation between US donations and stories in traditional and social media | Haiti eq 2010 | 1 | √ | √ | | | | | | | 2012 |
| Major, 1993 | Survey before and after prediction as to perceived salience of disaster and self-efficacy in preparedness. | Browning Prediction 1989 | 1 | | √ | √ | | | | | | 1993 |
| Major, 1998 | Public response to prediction | New Madrid prediction | 1 | | | √ | | | | | | 1998 |
| Marincioni et al, 2012 | L'Aquila Risk Communication | L'Aquila eq, 2009 | 1 | | | √ | | | | | | 2012 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Martyn , 2010 | Kleist very brief mention of Chile earthquake - v tangential | Chile eq 2010 | 1 | | | | | | | | √ | 2010 |
| Mason, 2011 | Mass media discourse - gifting of foreign aid, Haiti | Haiti eq 2010 | 1 | √ | | | | | | | | 2011 |
| Massey, 1985 | Audience uses and gratifications of Loma Prieta media | Loma Prieta eq 1989 | 1 | | | √ | √ | | | | | 1985 |
| Mazzochi & Montini, 2001 | EQ effects on Tourism in Central Italy - (containing repeated anecdotal claims of effect of media coverage) | Umbria eq 1997 | 1 | √ | √ | | | | | | | 2001 |
| McCartney, 2011 | Opinion - media and scientist attention - nuclear or tsunami | Tohoku eq 2011 nuclear | 1 | √ | | | | | | | √ | 2011 |
| McClure et al, 2001 | Countering Fatalism: Causal Information in News Reports Affects Judgments About Earthquake Damage | earthquake as hazard | na | | | √ | | | | | | 2001 |
| Meltsner, 1979 | Science communication and seismology | seismology incl Eq 1868 San Francisco Eq 1906 San Francisco Eq 1924 Santa Barbara | 3 + | | | | | | | | √ | 1979 |
| Mileti & Darlington, 1995 | Response to long term prediction newspaper insert , southern California | Revised eq probabilities, San Francisco Bay announced Sep 9 1990 | 1 | √ | √ | | | | | | | 1995 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mileti & Darlington, 1997 | The role of searching in shaping reactions to earthquake risk information | Revised eq probabilities, San Francisco Bay | 1 | | √ | | | | | | | 1997 |
| Mileti & Fitzpatrick, 1992 | Public Response to the Parkfield prediction | Parkfield prediction | 1 | | √ | | | | | | | 1992 |
| Mileti et al, 1992a | Fostering public preparedness - lessons from Parkfield eq prediction | Parkfield prediction | 1 | | √ | √ | | | | | | 1992 |
| Mileti & O'Brien, 1992 | Public response to aftershock warnings issued for 2 months after Loma Prieta - for two areas- one with highly publicised damage and the other without | Loma Prieta eq 1989 aftershocks | 3 + | | √ | √ | √ | | | | | 1992 |
| Miller, 1997 | Media content blaming seismologists for missed prediction - Kobe earthquake coverage in UK | Kobe eq 1995 | 1 | √ | | | | | | | | 1997 |
| Mucciarelli, 2005 | Earthquake prediction -use of term "surprise earthquake" by seismologists and engineers (not only mass media) | Belice, Italy eq 1968<br>Irprina, Italy eq 1980<br>San Giuliano eq 2002 | 3 + | | | | | | | | √ | 2005 |
| Nacher & Ochiai, 2011 | News media impact on financial markets (uses Tohoku as bad news example) | Tohoku eq 2011 | 1 | √ | | | | | | | √ | 2011 |
| Neisser et al, 1996 | Interview to ascertain description of events post Loma Prieta, immediately after and recall after 1.5 years - those who experience quake, some in Atlanta with no link to quake and others with a link and just news media access. | Loma Prieta eq 1989 | 1 | | | √ | | | | | | 1996 |
| Newhagen & Lewenstein, 1992 | Cultivation of fear and exposure as a result of images of destruction - television | Loma Prieta eq 1989 | 1 | √ | √ | | √ | | | | | 1992 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Noda, 2000 | Survey of Impressions of Mass Media in Information in Response | Hanshin-Awaji (Kobe) eq 1995 | 1 | | | √ | | | | | | 2000 |
| Nong, 2012 | Media response from content analysis - MA thesis | 2008 Sichuan | 1 | √ | | | | | | | | 2012 |
| Ohta & Abe, 1977 | Responses to Earthquake Prediction in Kawasaki City, Japan in 1974 | Kawasaki eq prediction 1974 | 1 | | √ | | | | | | | 1977 |
| Oki & Nakayuchi, 2012 | Media, tsunami - public judgements of danger - survey Survey1036 – 1 month post Chile 1 year pre Tohuku and month post Tohuku | Chile eq 2010 2010Tohoku eq 2011 2011 | 3 + | | | √ | | | | | | 2012 |
| Olofsson, 2011 | IOT in Swedish newspapers | Ind Ocean Tsu 2004 & eq 2004 | 1 | √ | | | | | | | | 2011 |
| Palacios, 1986 | Anecdotal psychological effects of media comm of Mexico eq | Mexico eq 1985 | 1 | | √ | | | | | | | 1986 |
| Paradise , 2005 | Survey of >250 earthquake survivors (42 years later) and residents - risk perception in Muslim country | Agadir Morocco eq, 1960 | 1 | | | √ | | | | | √ | 2005 |
| Quarantelli, 1996a | Basic themes from survey findings on human behaviour, and some comment on content | Eq Mexico City 1985 | 1 | √ | √ | | | | | | | 1996 |
| Rasmussen, 2005 | Tsunami Research and Resources incl opinion/ comments on media coverage – Asian tsunami | Ind Ocean Tsu 2004 | 1 | √ | | | | | | | | 2005 |
| Rodgers et al, 2012 | Disordered eating due to TV and Internet coverage of Japan Eq | Japan eq, 2011 | 1 | | √ | | | | | | | 2012 |
| Rodrigue, 2004 | Media construction and framing of disaster and implications on risk perception - *Match between geographical communities with damage and media coverage of same communities* | Northridge eq 1994 | 1 | √ | | | | | | | | 2004 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rovai & Rodrigue, 1998 | Inequities in media attention - geographical bias | Ferndale eqs 1992 Northridge eq 1994 | 2 | √ | | | | | | | | 1998 |
| Rowe et al, 2010 | Mediated representation of global politics | Sichuan eq 2008 | 1 | √ | | | | | | | √ | 2010 |
| Seid-Aliyeva, 2006 | Analysis of four years of articles on earthquake and survey of information requirements - Role of Mass Media in the Disaster Preparedness and Sustainable Development of Society. | Caspian eq 2000 | 1 | √ | | √ | | | | | | 2006 |
| Seo et al , 2012 | Effects of media (television and internet coverage) on stress, trust and relational resources and willingness to help (brief comment re media coverage) | Sichuan eq 2008 & Tonghai, 1970 | 2 | √ | √ | | | | | | | 2012 |
| Shipman et al, 1993 | Analysis of media coverage of prediction | Browning Prediction 1989 | 1 | √ | | | | | | | | 1993 |
| Showalter, 1993 | Interview with citizens in four small communities | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Smith, 1996 | Reporters & sources and scientific intervention | Browning Prediction 1989 | 1 | √ | | | | √ | | | √ | 1996 |
| Simon, 1997 | TV News and international quake relief | Eqs > 10 deaths 1972-1990 | 3 + | √ | √ | | | | | | | 1997 |
| Stevens, 1993 | Impact of prediction on earthquake research and info centre | Browning Prediction 1989 | 1 | | √ | | | | | | | 1993 |
| Souza & Martínez, 2011 | Theme evolution sources (content), emotions engendered andrecommendations for future television crisis coverage | Chile eq 2010 | 1 | √ | √ | √ | √ | | | | | 2011 |
| Su et al , 2008 | Survey and interview 2 months after Sichuan eq re cognition and responses, channels for information and when most info | Sichuan eq 2008 | 1 | | | √ | | | | | | 2008 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Su, 2012 | Examines media coverage of the 921 Earthquake in Taiwan during two periods in 2009, namely in the wake of another major disaster (i.e. Typhoon Morakot) that occurred just before the tenth anniversary of the earthquake, and then during the regular tenth anniversary commemorations of the earthquake. | 921, Taiwan eq 1999 Typhoon Morakot 2009 | 2 | √ | √ | | | | | | | 2012 |
| Sutton et al, 2009 | Tsunami warning information and social media - Hawaii | Chile eq 2010 Tohoku eq 2011 | 2 | | | | | √ | | | | 2009 |
| Tagle & Nazarit, 2011 | analysis of 'secondary' informational news reports re provision of health services - compared with survey | Chile eq 2010 | 1 | √ | | | | | | | √ | 2011 |
| Tierney, 1993 | Pseudoscientific prediction - Content analysis as background combined with interviews and survey to ascertain reasons for few scientists speaking out on topic & public response | Browning Prediction 1989 | 1 | √ | | | | | | | | 1993 |
| Turner, 1980 | The mass media and preparation for a natural nisaster | 1976 USGS announcement of San Andreas fault uplift Minturn prediction | 3 + | √ | | | | | | | | 1980 |
| Turner, 1982 | Three year content analysis of items dealing with earthquake in 6 major LA newspapers and review of tv and radio treatment of earthquake topics in same period | Eq topics | 3 + | √ | √ | | | | | | | 1982 |
| Turner, 1983 | Scientific & pseudoscientific announcements and reaction | California eq predictions, 1976 | 3 + | | √ | | | | | | | 1983 |

## Appendix Table 6.5 cont/-

| Researchers | Study description | Event or Hazard phenomenon | One, two or multiple events | Content | Media effects | Citizen survey/ interview | Role or funct-ions | Survey of Media Personnel | Expert opinion/re commend -ations | Review | Minor relev-ance | Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turner, 1993 | Summary of history of publicised earthquake prediction and response | Eq prediction events | 3 + | | √ | | √ | | | | | 1993 |
| Vergara, 2010 | Disaster newspaper cover design | Chile eq 2010 | 1 | √ | | | | | | | | 2010 |
| Wang, 2010 | New media and traditional media - Socio-cultural role of the internet - beyond information | Sichuan eq 2008 | 1 | | | | √ | | | | | 2010 |
| White & King-Wa , 2012 | News media communication, coverage content, information delivery, trust and information authentication & DRR -US & China | Hurr Katrina 2005 Sichuan eq 2008 | 2 | √ | | | | | | | | 2012 |
| Whitney et al , 2004 | Eq beliefs and adoption of seismic hazard adjustments based on myth vs fact pamphlet | na | na | | | √ | | | | | | 2004 |
| Xiao & Li, 2012 | Sharon Stone karma comment re Suchuan as media event - media convergence and online discussion | Sichuan eq 2008 | 1 | √ | | | | | | | | 2012 |
| Yang et al, 2011 | Using internet news for early estimation of death toll | Sichuan eq 2008 | 1 | √ | | | | | | | √ | 2011 |
| Ye et al , 2011 | Damage, lessons, using mass media analysis as data source - Wenchuan | Sichuan eq 2008 | 1 | √ | | | | | | | | 2011 |
| Yin & Wang, 2010 | Critical discourse analysis - representation of response actions of Govt, PLA and victims - Wenchuan earthquake in China Daily - myth creation | Sichuan eq 2008 | 1 | √ | | | | | | | | 2010 |
| Yoshii, 1993 | Social impacts of (successful) earthquake prediction | Greek prediction 1988 | 1 | √ | | √ | | | | | | 1993 |
| Zhai et al, 2009 | Damage and Characteristics from media analysis (data mined unattributed to media) | Sichuan eq 2008 | 1 | √ | | | | | | | √ | 2011 |

## Appendix Table 6.6: Summary of natural hazard- and disaster-media content analyses

Study descriptions, events and content analysed for 164 academic articles published between 1980 and 2012 that relate to natural hazard and disaster media content analyses. These articles cover the period from 1980 to 2012. Eq = earthquake. Note that given the concern that is often expressed about the veracity of news reports it is interesting to note that while articles about media content analyses usually contain details about the content analysed, this information was rarely provided for the media-based scientific assessments that data-mine media reports (e.g. Hough et al 2003).

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Barnes et al 2008 | Analysis of media agenda setting implications for emergency preparedness, disaster response, and disaster policy | Hurr Katrina 2005 | print news | -29 - 28 |
| Benoit & Hansen, 2009 | Image repair discourse and crisis communication - Bush's televised speech | Hurr Katrina 2005 | televised speech | 17th day |
| Berger, 2009 | Constructing crime and framing disaster | Hurr Katrina 2005 | TV + print news | 30 |
| Boccia, 2010 | Brazil's coverage of the warm-up to Olympics | Eq Sichuan 2008 | | -36-23 |
| Borah , 2009 | Comparison of visual framing | Tsunami Indian Ocean '04<br>Hurr Katrina 2005 | images in print news | 7 |
| Brown & Minty , 2008 | Empirical study of correlation between media coverage and charitable giving | Tsunami Ind Ocean 2002 | TV + print news | 73 |
| Brunn, 2010 | Cartooning & googling natural disasters and religion | Eq Haiti 2010<br>Volc eruption Iceland 2010 | internet hyperlinks, lead articles & major cartoon databases | unclear |
| Buescu, 2006 | Lisbon earthquake constructed as an event in Portugese literature | Eq Lisbon 1755 | other - literary works | unclear |
| Burgess, 2012 | risk amplification and attenuation indicators and discussion of causal attributions | Volcanic Ash Cloud European 2010 & 2011 | print news | 7 |
| Caldwell, 1979 | Indian press coverage of disaster | Cyclone Pradesh 1977 | print news | 50 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Choi & Linn, 2005 | Hurricane risk communication | Hurr Katrina & Rita 2005<br>Hurr Stanley 2005 | print news (newspaper) | -7 |
| Cowan et al, 2002 | Depiction of earthquakes on event and anniversary | Eq LA ( Loma Prieta) 1989<br>Eq Kobe 1995 | print news | one day and one year after |
| Cox et al, 2008 | Gender bias and absences in recovery voices | Bushfire McLure 2003 | print news (newspaper) | 90 |
| Daly, 2011 | Historical Volcanic Disaster narratives incl. plays & novels | various | plays, novels, paintings | n/a |
| CARMA (Franks), 2006 | Western media coverage of humanitarian disasters<br>(re report by CARMA International (a leading Global Media analyst) | Eq Bam, Iran 2003<br>Dar-fur crisis, Sudan '03 Tsunami Asian 2004<br>Hurr Katrina & Stanley '05 Eq Kashmir 2005 | print news | 70<br>except Dar-fur 150wks |
| Choi & Lin, 2008 | Content analysis of hurricane warnings | Hurr Katrina 2005<br>Hurr Rita 2005<br>Hurr Wilma 2005 | print news | -7 |
| Davies, 2009 | Essay on media narratives of China's emergence at time of Olympics & Wenchuan eqs Running Fan - man who ran to save his skin | Eq Sichuan 2008 | internet blogs & discussion groups, print & TV | 90 |
| de Ville de Goyet, 1999 | Health Disaster Myths - editorial | various including Managua, Nicaragua, eq 1972<br>Mexico city eq 1995<br>Hurr Mitch 1998<br>Turkey eq, 1999 | unclear | unclear |
| de Ville de Goyet, 2004 | Epidemics in disaster - anecdotal disaster myth examples in editorial | Eq Managua, Nicaragua 1972<br>Eq Mexico city 1995<br>Hurr Mitch 1998<br>Eq Turkey 1999 | unclear | unclear |
| Dearing & Kazmierczak, 1993 | Content analysis of US newspaper portrayals of Browning prediction | Eq Browning eq pred 1990 | print news (TV did not give coverage) | 95 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Dearing, 1995 | Journalists/media and portrayal of 'maverick' science | Eq Browning eq prediction 1990 | print news | -90 |
| Dereseiwicz, 1982 | Sixteenth century European earthquakes depicted in German broadsheets (news and illustrations) | Eq Bavaria & Bohemia 1329<br>Eq Fiuli, Venezia, Switzerland & Southern Germany 1511<br>Eq Rosanna & Constantinople 1556<br>Eq Kotor/Kattara 1564<br>Eq Piedmont 1564<br>Eq Ferrara & Florence 1570<br>Eq Italy 1581<br>Eq Vienna 1582<br>Eq Vienna 1590<br>Eq Apulia 1627<br>Eq Calabria 1638 | print news (broad sheets) | unlimited |
| Dreissens et al, 2012 | Celebrity involvement media TV relief/charity 'Help Haiti' shows | Eq Haiti 2010 | 2 TV relief shows | 9 |
| Drury et al, 2005 | The politics of humanitarian aid: US foreign disaster assistance 1964-1995 | various incl.<br>Eq Iran 1972<br>Drought Botswana 1985 Drought Ethiopia 1986 | TV + print news | n/a |
| Durham, 2008 | Media ritual in catastrophic time: The populist turn in television coverage of Hurricane Katrina | Hurr Katrina 2005 | TV | 6 |
| Eisensee & Stromberg, 2007 | US coverage of internal events and effect on relief funds | Various<br>500 natural disasters 1968-2002 (CRED database) | TV - Vanderbilt TV archive | -2 + 40 |

**Appendix Table 6.6: cont/**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Ergül et al., 2010 | Islamist press portrayal of disasters | Eq Van-Muradiye 1976<br>Eq Maramaa 1999<br>Hurr Katrina 2005<br>Ankara drought 07 | print news (newspaper) | up to 365 |
| Fleetwood, 2006 | Information gaps & failing narratives | Hurr Katrina 2005 | TV + print news | unclear |
| Frank, 2003 | Community/ personal experience narratives in newspaper coverage | Eq Loma Prieta 1989 | print news (newspaper) | unclear |
| Freudenberg et al, 1996 | Media coverage of hazard events | Various<br>Eq as part of 128 events | print news | unclear |
| Fu et al , 2012 | Coverage of emergency response and government responsibility | Eq Kobe 1995<br>Eq Sichuan 2008 | internet news (print) | 31 |
| Furedi, 2007 | Narrative vulnerability/resilience - selected media quotes only | Floods UK, 1950<br>Floods UK, 2000 | print news | unclear |
| Gaddy & Tanjong, 1986 | Negative stereotyping versus cultural favouritism - geographical bias - >100 M4 and earthquakes | Eqs ( >100 M4) in countries other than media reporting event | TV + print news | up to 730 |
| Goltz, 1984 | Media responsibility for emergency response myths | Eq Imperial Valley 1979<br>Eq Alaska 1980<br>Eq Algeria 1980<br>Eq Italy 1980 | images in print news | unclear |
| Greenberg et al, 1989a | Coverage of environmental & public health risk US TV 1984-1986 - focus on sources but not in write-up of earthquake | various environmental and pubic health risks<br>Jan 1984 - Feb 1986 incl<br>Eq Mexico City 1985 | TV | up to 780 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Greenberg et al, 1989b | Content analysis television coverage 1984-1986 versus 'scientific risk' and geography | Eq Mexico City 1985<br>& environmental & pubic health risks<br>Jan 1984 - Feb 1986 | TV | up to 780 |
| Gribble et al, 2012 | Media messages and the needs of infants and young children and child aid | Cyclone Nargis 2008<br>Eq Sichuan 2008 | online news | up to 181 |
| Griffin-Padget & Allison, 2010 | Image restoration through rhetoric by leaders | Hurr Katrina 2005 | press conferences + other | unclear |
| Gros, 2011 | mentions media narratives in relation to the cause and/or exacerbation of the disaster | Eq Haiti 2010 | unclear | unclear |
| Guobin, 2008 | Relief efforts and the power of the internet | Eq Sichuan 2008 | unclear | unclear |
| Haberland et al, 2010 | Media coverage in Germany of Sichuan eq and Olympics media hypes | Eq Sichuan 2008 | print, TV broadcast and Internet portals | 8 |
| Hall, 2011 | Mass media blame, accountability, resilience flood UK | Flood North Sea 1953<br>Flood UK 1978<br>Storm The Great UK 1987<br>Flooding widespread UK 2007 | print news (newspaper) | unclear - years |
| Harwell, 2000 | Discourses of technology and the making of Indonesia's natural disaster | Fires, forest Indonesia 1997-1998 | unclear | unclear |
| Hiroi et al, 1985 | Study of mass media reporting in emergencies | Eq Nihonkai-Chuubu 1984 (& tsunami) | radio | 1 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Ho & Hallahan, 2004 | Corporate response thru analysis of post eq corporate advertising in newspapers | Eq ChiChi (921) Taiwan 1999 | print news | 30 |
| Holm, 2012 | framing of vulnerability and resilience - Disaster discourse, fictional, TV vuln/resil_Haiti | Eq Santiago, Chile 1647<br>Eq Lisbon 1755<br>Eq Haiti 2010 | literary works | unclear |
| Hornig et al, 1991 | Analysis of sources in disaster coverage and implications for causal attributions and attributions of responsibility for solutions | Hurr Hugo 1989<br>Eq Loma Prieta 1989 | print news | 30 |
| Hough et al, 2003 | Media-based assessment of damage and ground motions - not a content analysis although uses content | Eq Gujarat/Bhuj India 2001 | print + web | unclear |
| Houston et al, 2012 | Framing and frame changes in coverage | Storm Tropical Allison 2001 Hurr Charley 2004 Hurr Frances 2004 Hurr Ivan 2004 Hurr Katrina 2005 Hurr Rita 2005 Tornado Evansville 2005 Wildfire California 2007 Tornado Super Tuesday '08 Floods Iowa 2008 Floods Arkansas 2010 | TV + print news | pre-event + 1915 |

## Appendix Table 6.6: cont/-

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Hughes et al, 2007 | Bushfires and the media: a cultural perspective - review incl. summarises previous unpublished work - themes of content analysis not details | Fires bush | unclear | unclear |
| Inwood, 2011 | Media coverage of Chinese quake poetry | Eq Sichuan 2008 | poetry | unclear |
| Jacob et al 2008 | Examine perpetuation of 10 social and health myths in Hurricane Katrina Coverage - psychosocial needs and behaviours | Hurr Katrina 2005 | unclear | unclear |
| Jalali, 2002 | Note re media coverage content included | Eq Marmara, Turkey 1999 | unclear | unclear |
| Jenkins, 2007 | Judgement in visual framing of Katrina | Hurr Katrina 2005 | images in print news | unclear |
| Jin et al, 2011 | Classifying Netizen opinion about Yushu eq information | Eq Yushu 2010 | social media | 5 |
| Jönsson, 2011 | Framing of problems, causes and solutions, sources, and certain and uncertain knowledge | environmental risks in Baltic sea 1993 1998 2008 | print news | pre-event |
| Joye, 2009 | International representation on 02 January 2005 of foreign natural disasters in which no Belgians died. | fire forest USA 2005/6 fire forest Australia 2005/6 floods USA 2006 Indonesian flood and landslide 2005/6 Pakistan 2005 | TV | other (1 day coverage) |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Joye, 2010 | Selection and coverage of international disasters by Flemish newspapers | various global 1986-2006 | print news (newspaper) | n/a years |
| Keshishian, 1997 | Content analysis two eq in US press | Eq Iran 1980<br>Eq Armenian 1988 | print news | 365 |
| King, 2011 | Observational essay on disaster discourse, depravity and myth | Hurr Katrina 2005<br>Eq Haiti 2010 | unclear | unclear |
| Kivikuru, 2006 | Tsunami communication in Finland | Tsunami Indian Ocean '04 | newspapers, TV, radio, popular magazines | up to 36 |
| Kodrich & Laituri, 2005 | Media role in disaster through online coverage | Eq Gujarat/Bhuj India 2001 | online news | 64 |
| Kondo et al, 2012 | How numbers construct social reality. Brief summary of earlier studies published in Japanese | Eq Kobe 1995<br>Eq Sichuan 2008 | unclear | unclear |
| Krug, 1993 | Media content & public response to prediction. | Eq Browning eq pred 1990 | TV + print news | -60 |
| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
| Lamontagne et al, 1992 | Seismologists perspective on post-earthquake communication | Eq Saguenay, Canada 1988<br>Eq Mont-Laurier, Canada 1990 | unclear | Unclear |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Lamontagne, 2008 | Casualties directly caused by an earthquake in Canada: first contemporaneous written accounts - use of historic newspaper report to identify that eq caused deaths | Eq Charlevoix, Quebec 1870 | print news (newspaper) | unclear |
| Lan, 2009 | Coverage of the Wenchuan earthquake; cultural and institutional legacies and lessons | Eq Sichuan 2008 | academic periodicals and print news | 110 |
| Leong, 2009 | Mention of international media comment on Chinese media transparency in aftermath of Sichuan, and Chinese media rebroadcast | Eq Sichuan 2008 | unclear | unclear |
| Lewis, 1979 | UK and Indian press coverage - qualitative comparison of Guardian and Hindu coverage of Tamil Nadi and Pradesh cyclones | Cyclone Andrah Pradesh 1977 Cyclone Tamil Nadu 1977 | print news | unclear - weeks |
| Li, 2011b | Estimating the number of deaths from media reporting of Yushu earthquake | Eq Yushu 2010 12 other eqs as in Zhao | online - sina.com.cn | up to 70 |
| Littlefield & Quenette, 2007 | Portrayal of authority/crisis leadership - investigated the terminology used by the media to portray those with legitimate authority | Hurr Katrina 2005 | print news | 6 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Liu, 2009 | Analysis of US government emergency management frames and media disaster frames | various disasters 2005 - 2006 | print news + media releases | up to 730 |
| Lobb et al, 2012 | Correlation between US donations and stories in traditional and social media | Eq Haiti 2010 | internet reports, press releases, TV, twitter posts | 30 |
| Low et al, 2011 | Uses media reports to discuss crisis image repair | Hurr Katrina 2005 Typhoon Morakot 2009 | print news | unclear |
| Mason, 2011 | representation of Canada foreign aid - gift giving, and Haiti as ungrateful receiver | Eq Haiti 2010 | online news | 60 |
| Mazzochi & Montini, 2001 | EQ effects on Tourism in Central Italy - (containing anecdotal claims of effect of media coverage) | Eq Umbria, Italy 1997 | unclear | unclear |
| McCartney, 2011 | Opinion - media and scientist attention - nuclear or tsunami | Eq Tohoku, Japan 2011 | unclear | unclear |
| McKay & Finlayson, 1982 | Mass media reporting and motivation to obtain flood inundation maps | Flooding in Adelaide, SA as phenomenon not event | TV + print news | 2 |
| McKay, 1983 | Prevalence of warning, preparation, loss, response and mitigation information | Bushfires Ash Wednesday 1983 | print news | - 16 + 24 |
| McKay, 1996 | Themes and topics in media | Fires bush NSW summer 1994-1995 | print news | 12 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Mellor, 2010 | Asteroid risk qualitative review of construction of risk over 2 decades | Asteroid impact risk | print news | pre-event (2 decades) |
| Miles & Morse, 2007 | Role of news media - and perception of risk from disaster coverage - % attention to four capitals | Hurr Katrina 2005<br>Hurr Rita 2005 | TV + print news | 60 |
| Mileti & Darlington, 1995 | Response to long term prediction newspaper insert, southern California | Eq probabilities revised San Fran. 1990 (studied Oct '90 - June '91) | print news | pre-event |
| Miller, 1997 | Media content blaming seismologists for missed prediction - Kobe earthquake coverage in UK | Eq Kobe 1995 | print news | 300 – date of quake? |
| Mitchell et al, 2000 | Perpetuation of disaster myths | Fictitious events | movies | n/a movie duration |
| Moeller, 2006 | Uses the media-tracking journal, The Tyndall Report 7 LexisNexis to discuss coverage of international disasters in 2005 and compares with Swiss Re list of 'importance' | Tsunami Indian Ocean 2004 Volc activity Guatemala 2005 Mudslides Central America 2005 Mudslides Pakistan 2005 Eq Kashmir, Pakistan 2005 plus comment re Eq Gujarat India, 2001<br>Eq Bam, 2003<br>Eq Turkey 1999<br>Drought Sudan & Congo | TV + print news | unclear |
| Needham & Nelson, 1977 | choices available in resource and environmental decision making | Flood Lake Eire1952-1953 flooding & erosion 1972-74 | print news | up to 730 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Needham, 1986 | newspaper response (reporting orientations) to natural hazards | Hurr Hazel 1954<br>Eq Alaska 1964<br>Cyclone Bangladesh 1970<br>Eq Peru 1970<br>Flood Rapid City 1972<br>Volc erup Heimaey 1973<br>Flood Grand River 1974<br>Flood Canadian Prairies '74<br>Hurr Agnes 1979 | print news | 60 |
| Newhagen & Lewenstein, 1992 | Cultivation of fear and exposure to images of destruction television | Eq Loma Prieta 1989 | TV | 1.5 |
| Nigg, 1982 | LA public response (from survey n=1700) to eq forewarnings | Eq General reporting 3 yrs incl<br>Eq predictions 1976 | print news | up to 1095 |
| Olofsson, 2011 | IOT in Swedish newspapers - nationalism after catastrophe | Tsunami Ind Ocean 2004 | print news (newspaper) | 8 |
| Olsen et al, 2003 | Effect of media coverage of humanitarian crises on donations & aid | Cyclone India 1999<br>Flooding Mozambique '00 | TV + print news | selected, at 3 month intervals |
| Park, 2003 | Whether there are differences in disaster reporting between Japan and Korea | various disasters 1995 - 1998 | TV | up to 1095 |
| Pasquarè & Oppizzi, 2012 | How media affect perception of geo-hazards and climate change | Geo-hazards (hydrological) + CC 2007-2010 | print news | pre-event |

## Appendix Table 6.6: cont/-

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
| --- | --- | --- | --- | --- |
| Pasquarè & Pozzetti, 2007 | Geological hazards, disasters and the media - Accuracy, selection of information sources, amplification of political conflict attention to geological hazard prevention and mitigation | Seismic, volcanic & hydro geological hazards 2002-2003 incl Italian eqs | print news + online print news | up t0 241 |
| Paulson & Menjívar, 2011 | Case study of flood relief using qualitative content analysis of regional media documents. | Flood Mumbai 2005<br>Hurr Katrina floods 2005 | print news | 60 |
| Paveglio et al, 2011 | Framing and discourse analysis of regional and local newspapers - 2006 Washington and California bushfires | Fire Washington 2006<br>Fire California 2006 | print news (newspaper) | up to 50 days |
| Phillips, 1986 | Media influence on- recruitment, & portrayal of volunteers | Flood midwest US 1982 (studied March, April 1982, event + 8 months, + 12-month anniv March 1983) | TV + radio + print news incl photographs | selected, various |
| Ploughman, 1995 | Media Construction of 5 disasters | Drought Sudan & Ethiopia 1985<br>Cyclone 1985<br>Eq Mexico City 1985<br>Mudslides Puerto Rico 1985 | print news | 1 |
| Potter & Van Belle, 2004 | Coverage 1986-1995 and influence on aid | various 1986 - 1995 | print news | unclear |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Potter & Van Belle, 2009 | News coverage and Japanese foreign disaster aid 1985 - 1998 | Eq Sakhalin, Russia 1995<br>Eq Hanshin Awaji (Kobe) 1995<br>Eq Tukey 1998<br>and multiple 1985 - 1998 | print news (newspaper) | n/a |
| Quarantelli et al, 1993 | Comparative study - Japan and US Mass media reporting of disaster | Flood Tulsa 1984<br>Eq & tsunami Noshiro 1983<br>Nagasaki landslide 1982 | radio TV, print news | variable for each study |
| Quarantelli, 1980, 1985 | Myths and realities of disaster films | Fictitious events | 36 disaster films | n/a |
| Rashid, 2011 | Interpreting flood discourse and risk perceptions from newspapers | Floods Red River 1950 1997 (Rashid) | print news | 150 |
| Rasmussen, 2005 | Tsunami research and resources including opinion/ comments on media coverage – Asian tsunami | Hurr Katrina 2005 | various - mention press, TV bloggers | unclear |
| Robinson, 2009a | Co-production of collective memory through traditional reporters and citizen journalists | Tsunami Ind Ocean 2003 | TV + print news | 18 |
| Robinson, 2009b | differences in commemorative coverage and what reported b4 | Hurr Katrina 2005 | print + TV news + 6 commem-orative books | 18 |
| Rogers and Sood, 1980 | Role of media and how media report disasters | Drought Sahel 1968-1974<br>Cyclone Pradesh 1977 | TV + print news | 730 drought<br>10 cyclone |
| Rojecki, 2009 | Political culture, responsibility and self-efficacy and control of nature in relation to natural disaster | Great Flood 1927<br>Great Flood '05 (Hurr Kat) | print news (newspaper) | up to 365 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Rovai & Rodrigue, 1998/Rodrigue, 2004 | Inequities in media attention - geographical bias | Eq Northridge and Ferndale 1992 | print news | 30 |
| Rowe et al, 2010 | Mediated Representation of Global Politics | Eq Sichuan 2008 | TV + print news | 33 |
| Ryan et al, 2012 | Children's websites and preparedness messages | general | online websites | pre-event |
| Sandman, 1994 | 7 principles of mass media coverage | Environmental Risk Jan '84 - Feb '86 | TV + print news | pre-event |
| Scanlon et al, 1978 | Accuracy in disaster reporting | weather & mudslide & human 1973-1976 | TV + print news | up to 1065 |
| Scanlon, 1980 | provision of advance information, warning, advice, and avoidance of future occurrences | Flood Terrace, Canada 1978 | TV + print news | unclear |
| Seid-Aliyeva, 2006 | Media in Preparedness and Sustainable Development related to eq (conference) | Eq Caspian 2000 | unclear | 1460 |
| Seo et al, 2012 | Brief comment re coverage drop off | Eq Sichuan 2008<br>Eq Tonghai, 1970 | internet + TV | 21 |
| Serra-Lobet et al, 2013 | Media risk management & social learning from review of academic literature and historical and media accounts (latter used as evidence of social learning DRR preparation incl land use planning) | Flood Tous Dam Spain 1982 | media and academic literature | up to 7300 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Seydlitz et al, 1991 | Nature and Effects of media messages on public response | Saltwater intrusion, New Orleans, 1988 | print news | 90 |
| Seydlitz et al, 1994 | Nature and Effects of media messages on public response | saltwater intrusion Missisipi 1988 | print news | 90 |
| Shipman et al, 1993 | Analysis of media coverage of prediction | Eq Browning eq pred 1990 | print news | -180 |
| Simon, 1997 | Earthquake severity, media coverage, and subsequent relief donations for 22 foreign earthquakes. | Eqs general > 10 deaths 1972-1990 | TV | unclear |
| Singer & Endreny, 1987 | Reporting Hazards - benefits and costs. Focuses on risk as threat to mortality. | various 1960 & 1984 | print (paper and magazine) + TV | unclear |
| Singer 1990: Singer & Endreny, 1994 | Nature and accuracy of risk reporting. Accountability | various disasters, diseases & other hazards | print news, magazines, TV, academic | pre-event |
| Singer et al, 1991 | Geographic location and media coverage of disasters | various hazards incl. natural 1960 + 1984 | TV + print news | up to 365 |
| Smallman, 1997 | Trends in the use of keywords, risk, crisis and hazard in media - 1992-1995 | various 1992-1995 | print news | All 4 |
| Smith, 1996 | Reporters and sources and scientific intervention | Eq Browning eq pred 1990 | print news | -180 |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Sommers et al, 2006 | Race and language use and story angle in media coverage | Hurr Katrina 2005 | print news and new media, including weblogs, listservs, on-line bulletin boards, and mass e-mails | unclear |
| Spencer et al, 1994 | Media construction of risk, causal framing of hazard events and sources used | Flood New Orleans 1988 saltwater intrusion drought & pollution 1988 | print news | up to 50 |
| Stock, 2007 | Media and new disaster myth - anarchy | Hurr Katrina 2005 | print news | 180 + anniversary |
| Su, 2012 | Framing of eq just after Typhoon Morakot & closer to anniversary | Eq ChiChi (921) Taiwan 1999 | print news | 80 |
| Tagle & Nazarit, 2011 | Analysis of 'secondary' informational news reports re provision of health services - compared with survey | Eq Chile 2010 | unclear | unclear |
| Tierney et al, 2006 | Disaster myths and media frames | Hurr Katrina 2005 | print news (newspaper) | 30 |
| Tierney, 1993 | Pseudoscientific prediction | Eq Browning eq pred 1990 | TV + print news | unclear |
| Turner, 1980 | Mass media and preparation for natural disaster | Eq USGS uplift announcement re San Andreas fault 1976<br>Eq predictions Minturn & Caltech - Prof Whitcomb predictions '76 | print news, radio, TV movie Earthquake | pre-event over 2 years |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Turner, 1982 | Three year content analysis of items dealing with earthquake in 6 major LA newspapers and review of television and radio treatment of earthquake topics in same period | Eq general reporting | print news, radio + TV | up to 1095 |
| Van Belle & Hook, 2000 | Agenda setting function of US news media through levels of media coverage on amount of foreign aid 1977-1992 | various | TV | unclear |
| Van Belle, 2000 | New York Times portrayal of foreign disasters incl. Kashmir - amount of coverage, number killed, US tourists and distance from US | Eq Kashmir 1995 and other disasters 1964-1996 | TV + print news | unlimited |
| Van Belle, 2003 | Coverage of disasters and foreign aid | Eq Iran 1972 disasters 1978-1999 | TV + print news | unlimited |
| Vergara, 2010 | Disaster newspaper cover design | Eq Chile 2010 | images cover design + ads in print news | up to 7 |
| Voorhees et al, 2007 | Portrayal of minority groups | Hurr Katrina 2005 | TV news broadcasts | 30 |
| Walters & Hornig, 1993 | Faces in news and sourcing patterns | Hurr Hugo 1989 Eq Loma Prieta 1989 | TV | 90 |
| Wenger & Friedman, 1986 | Media treatment of sociological disaster myths | Hurr Alicia 1981 | print news | 15 |

## Appendix Table 6.6: cont/-

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Wenger & Quarantelli, 1989b | Mass media systems and community hazards and disasters. Disaster period, DRR activities, sources and myths | various unspecified community disasters Sep 1985-Aug 1998 mostly US | radio, print + TV | not specified |
| Wenger & Quaratelli, 1989a | Includes analysis of disaster period 18 DRR topics, story type, estimates of impact, sources, disaster myths, tone | various unspecified community disasters Sep 1985-Aug 1998 mostly US | TV print news, radio | up to 1095 |
| White & King-Wa , 2012 | Coverage content (in relation to Communication and Trust) only analysed for Sichuan | Hurr Katrina 2005 Eq Sichuan 2008 | print news (newspaper) | 31 |
| Wilkins, 1985 | Newspaper coverage and portrayal of helplessness | Blizzard Denver 1982 | TV + print news | 31 |
| Wrathall, 1988 | Natural hazard reporting UK press | Various 1 Jul 86 to 31 June 87 | print news | up to 365 |
| Xiao & Li, 2012 | Sharon Stone karma comment - media convergence and online discussion | Eq Sichuan 2008 | online print + TV news and comment | 30 |
| Yang et al, 2011 | Using internet news for early estimation of death toll | Eq Sichuan 2008 | internet news | unclear |
| Yang, 2012 | Using Sichuan and SARS to understand Chinese media changes | SARS 2003 Eq Sichuan 2008 | print news | 90 |
| Ye et al., 2011 | Unattributed use of mass media as data source for damage and loss modeling | Eq Sichuan 2008 | unclear | unclear |

**Appendix Table 6.6: cont/-**

| Researchers | Study description | Event or phenomenon | Content | Period (Event +/- days) |
|---|---|---|---|---|
| Yin & Wang, 2010 | framing of response activities | Eq Sichuan 2008 | print news | 7 |
| Yoshii, 1993 | Social impacts of earthquake prediction | Eq prediction Greek 1978<br>Eq aftershock warning Japanese 1978<br>Eq prediction Italian TV 1985 | unclear | unclear |
| Zhai et al, 2009 | Damage and characteristics from media analysis (data mined unattributed to media) | Eq Sichuan 2008 | unclear | unclear |

# Appendix 7: Generation of the 20-earthquake-research dataset

The 20-earthquake-research dataset was created by searching the Web of Science and Scopus online databases for earthquake-related journal articles and conference presentations between January 2008 and December 2011 relating to the names of the earthquake events listed in Table 3.7. The rationale for choosing the earthquakes was presented in Table 3.8, and further statistics relating to the earthquakes are presented in Appendix Table 7.1. Conference proceedings were included for two reasons, firstly because they are representative of the latest, if not fully developed research ideas that scientist sources may be considering when they speak to the media. Secondly, it had been noted from media immersion that conference events seem to trigger more earthquake-related science media articles than the publication of research does.

There was no restriction on the journal status, if the article or conference proceeding was included in either the Web of Science or Scopus database it was included. This meant that the dataset includes some non-peer-reviewed material such as the personal reflections of, for example earth- and health-scientists involved in disaster research. The dataset also included some industry periodicals (e.g. agricultural, energy, telecommunications etc.).

After screening the 7299 articles originally downloaded for relevance and duplication yielded 1849 articles that were on both Scopus and Web of Science, 2039 were from Scopus only, and 623 from Web of Science only. This shows the value in examining both sources to obtain a representative dataset.

The number of articles downloaded relating to each earthquake is shown in Appendix Table 7.2. A total of 4376 unique articles were identified. Most articles (4276) related to one event only, and a further 100 articles related to multiple events (see Appendix Table 7.3). Of these 3538 were journal articles and 838 conference-related titles and abstracts.

Tables

**Appendix Table 7.1: Key statistics about the global earthquake disasters included in the 20-earthquake-DRR-research dataset**

| Eq # | Event | Magnitude (USGS) | Fatalities (USGS) | Fatalities (EM-DAT) | Affected (EM-DAT) | USM$ (EM-DAT) | %GDP (SwissRe Sigma Database) |
|---|---|---|---|---|---|---|---|
| | | earthquake.usgs.gov | | (EMDAT, 2014) | | | 2014 |
| 1 | Kashmir, Pakistan | 7.6 | > 86000 | 73,338 | 156,622 | 1,000 | |
| 2 | Yogyakarta, Indonesia | 6.3 | 5,749 | 5,778 | 3,177,923 | 3,100 | |
| 3 | Java, Indonesia | 7.7 | 730 | 802 | 35,543 | 55 | |
| 4 | Pisco, Peru | 8.0 | 514 | 593 | 658,331 | 600 | |
| 5 | Bengkulu, Sumatra | 8.5 & 7.9 & 7.6 | 25 | 25 | 459,567 | 500 | |
| 6 | Gisborne, NZ | 6.6 | 1 | - | - | - | |
| 7 | Sichuan, China | 7.9 | 87, 587 | 87,476 | 45,976,596 | 85,000 | |
| 8 | Balochistan, Pakistan | 6.4 | 166 | 166 | 75,320 | 5,200 | |
| 9 | Lac Kivu, Dem Rep of Congo | 5.9 | 44 | 47 | 17978 | 7 | |
| 10 | L'Aquila, Italy | 6.3 | 295 | 295 | 56,000 | 2,500 | 0.2% |
| 11 | Fiordland, NZ | 7.8 | 0 | - | - | - | |
| 12 | Java, Indonesia | 7.0 | 79 | 128 | 339,792 | 160 | |
| 13 | Samoa/Tonga | 4.2 | 192 | 182 | 8592 | 159.5 | |
| 14 | Padang, Indonesia | 7.6 | 1117 | 1195 | 2,501,798 | 2,200 | |
| 15 | Port au Prince, Haiti | 7.0 | 316 000 | 222,570 | 3,700,000 | 8,000 | 121.0% |
| 16 | Concepcion, Chile | 8.8 | 547 | 562 | 2,671,556 | 30,000 | 18.6% |
| 17 | Yushu, China | 6.9 | 2968 | 2968 | 1,112,000 | 500 | |
| 18 | Mentawai, Indonesia | 7.7 | 435 | 530 | 11864 | - | |
| 19 | Canterbury, NZ | 7.0/6.1 (7.1/6.3) | 0/185/0/1 | 181 | 301,500 | 24,500 | 5.3% /10% |
| 20 | Sendai, Japan | 9.0 | 15,836 | 19,846 | 368,820 | 210,000 | 5.4% |

**Appendix Table 7.2: Numbers of articles identified for each of the global earthquake disasters included in the 20-earthquake-DRR-research dataset**

| Eq # | Eq ID | Event | No. articles 2005 | No. articles 2006 | No. articles 2007 | No. articles 2008 | No. articles 2009 | No. articles 2010 | No. articles 2011 | Total articles 2008-2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | KA | Kashmir, Pakistan | 6 | 27 | 38 | 30 | 34 | 41 | 30 | **135** |
| 2 | YG | Yogyakarta, Indonesia | 0 | 1 | 7 | 3 | 6 | 11 | 5 | **25** |
| 3 | JV | Java, Indonesia | 0 | 2 | 8 | 4 | 7 | 9 | 2 | **22** |
| 4 | PE | Pisco, Peru | 0 | 0 | 0 | 8 | 11 | 17 | 10 | **46** |
| 5 | BK | Bengkulu, Sumatra | 0 | 0 | 0 | 11 | 2 | 12 | 11 | **36** |
| 6 | GI | Gisborne, NZ | 0 | 0 | 0 | 1 | 0 | 1 | 1 | **3** |
| 7 | WS | Sichuan, China | 0 | 0 | 0 | 347 | 827 | 732 | 647 | **2553** |
| 8 | BA | Balochistan, Pakistan | 0 | 0 | 0 | 1 | 1 | 3 | 2 | **7** |
| 9 | DC | Lac Kivu, Dem Rep of Congo | 0 | 0 | 0 | 1 | 0 | 1 | 1 | **3** |
| 10 | LQ | L'Aquila, Italy | 0 | 0 | 0 | 0 | 27 | 84 | 128 | **239** |
| 11 | FI | Fiordland, NZ | 0 | 0 | 0 | 0 | 0 | 3 | 6 | **9** |
| 12 | J9 | Java, Indonesia | 0 | 0 | 0 | 0 | 0 | 2 | 0 | **2** |
| 13 | ST | Samoa or Tonga | 0 | 0 | 0 | 0 | 0 | 16 | 24 | **40** |
| 14 | PD | Padang, Indonesia | 0 | 0 | 0 | 0 | 0 | 11 | 7 | **18** |
| 15 | HT | Port au Prince, Haiti | 0 | 0 | 0 | 0 | 0 | 215 | 248 | **463** |
| 16 | CM | Concepcion, Chile | 0 | 0 | 0 | 0 | 0 | 86 | 125 | **211** |
| 17 | YU | Yushu, China | 0 | 0 | 0 | 0 | 0 | 39 | 66 | **105** |
| 18 | MN | Mentawai, Indonesia | 0 | 0 | 0 | 0 | 0 | 3 | 9 | **12** |
| 19 | CT | Canterbury, NZ | 0 | 0 | 0 | 0 | 0 | 21 | 66 | **87** |
| 20 | TS | Sendai, Japan | 0 | 0 | 0 | 0 | 0 | 0 | 495 | **495** |
| | | | | | | | | | **TOTAL** | **4511** |

**Appendix Table 7.3: Numbers of articles related to one or multiple events for each of the global earthquake disasters in the 20-earthquake-research dataset**

| Eq ID | Event | Journal Year | Unique Articles (covering 1 event) | Articles related to multiple events | Total articles 2008-2011 |
|---|---|---|---|---|---|
| 1 | Kashmir, Pakistan | 2008-2011 | **124** | 11 | **135** |
| 2 | Yogyakarta, Indonesia | 2008-2011 | **19** | 6 | **25** |
| 3 | Java, Indonesia | 2008-2011 | **13** | 9 | **22** |
| 4 | Pisco, Peru | 2008-2011 | **43** | 3 | **46** |
| 5 | Bengkulu, Sumatra | 2008-2012 | **29** | 7 | **36** |
| 6 | Gisborne, NZ | 2008-2011 | **3** | 0 | **3** |
| 7 | Sichuan, China | 2008-2011 | **2509** | 44 | **2553** |
| 8 | Balochistan, Pakistan | 2008-2011 | **5** | 2 | **7** |
| 9 | Lac Kivu, Dem Rep of Congo | 2008-2011 | **3** | 0 | **3** |
| 10 | L'Aquila, Italy | 2009-2011 | **233** | 6 | **239** |
| 11 | Fiordland, NZ | 2009-2011 | **7** | 2 | **9** |
| 12 | Java, Indonesia | 2009-2011 | **0** | 2 | **2** |
| 13 | Samoa/Tonga | 2009-2011 | **28** | 12 | **40** |
| 14 | Padang, Indonesia | 2009-2011 | **14** | 4 | **18** |
| 15 | Port au Prince, Haiti | 2010-2011 | **433** | 30 | **463** |
| 16 | Concepcion, Chile | 2010-2011 | **171** | 40 | **211** |
| 17 | Yushu, China | 2010-2011 | **84** | 21 | **105** |
| 18 | Mentawai, Indonesia | 2010-2011 | **8** | 4 | **12** |
| 19 | Canterbury, NZ | 2010-2011 | **78** | 9 | **87** |
| 20 | Sendai, Japan | 2011 | **472** | 23 | **495** |
| | **SUBTOTALS** | | **4276** | **235** | **4511** |
| **Unique articles relating to multiple earthquakes** | | | | **100** | **Total 4376** |

# Appendix 8: Sciences of DRR – research emphasis 2007-2012

<u>Sub-tables for Appendix 8.1 giving research emphasis of the twelve disciplinary groups</u>



**Appendix Table 8.1: Research emphasis on twelve disciplinary groups**

This series of sub-tables summarise the research emphasis identified from analysis from the articles in the 20-earthquake-academic-research–dataset (Table 3.5) for each of the twelve disciplinary groups shown in Table 3.14.

**Building Sciences**

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| Architecture | Architectural (not engineering) design for mitigation and sustainability in recovery |
| Sustainability Science (Construction) Materials Science | Materials innovation for mitigation, performance of existing materials, and recycled disaster waste products. |
| Structural-buildings Structural-infrastructure | Design construction, vulnerability, damage to and reconstruction of buildings and infrastructure and their components. Infrastructure includes tunnels, dams and communications. (Not building loss calculated in economic terms). |
| Technology | Performance and design of non-structural elements (contents). Structural health monitoring systems, rescue robots, water purification. (Not RS/GIS technology and Geo-early warning systems (on-land and tsunami) - Geotechnical). |
| Non-structural infrastructure | Non-structural aspects of energy supply, transport, and water (e.g. travel patterns, water supply, hazardous substances or nuclear energy). |
| Environmental Engineering | Waste. May involve Other public health, economic and/or engineering non-structural infrastructural implications including nuclear. |
| Other Engineering | Database of vulnerable buildings, loss assessment, effects on industry, recovery cost-planning, project management, education or training, policy, zoning, or codes etc. discussed by engineers. |

**Appendix 8 Table 8.1 cont/-**

**Cognitive and Behavioural Sciences**

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| Social Psychology in DRR | Perception of risk, coping, disaster and DRR. (For coping style see health-psychosocial. For perceptions and behavioural responses data-mined from communications see information, decision and management science). |
| Human Geography in DRR<br>Sociology<br>Social Anthropology | Social aspects of disaster and DRR – e.g. behaviour in response (mutual aid or maladaptive behaviour, e.g. racial issues in response). NB some volunteerism in Emergency Management studied as Public Administration/Political Science, financial aid as Economics). |
| Crime Science | |

**Earth and Planetary Sciences**

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| **Atmospheric** Science/Meteorology | Atmospheric observations pre- and post earthquake. Also weather conditions that exacerbate disaster effects in response and recovery. |
| **Geology**/Physical Geography/ Geomorphology<br>Oceanography<br>Seismology (Geophysics)<br>(Remote Sensing/GIS/Seismic network) | Surface effects, modelling and related hazard assessments<br>(rupture/displacement).<br>Tsunami/coastal effects, modelling and hazard assessments.<br>Subsurface effects and modelling earthquake processes and general seismic risk assessments, including aftershocks (not slope hazards see Geotechnical).<br>(Observations coded in categories as per above. Where motion, liquefaction, slope process, or RS/GIS process is the subject, coded as Geotechnical) |
| (Also studied as Political/Public Administration, Emergency Management or general Disaster Research, also Engineering- loss and cost planning and energy industry effects) | Business & Industry - Effects on business, industry, business continuity planning, risk management, corporate philanthropy, and recovery strategies including mobile commerce. (Tourism largely studied as Management Science some Public Admin. Some recovery strategies – Management Science)<br>Other Financial-aid effects and efforts government assistance (cash grants) and personal donations, philanthropy. For corporate social responsibility see Business & Industry, Financial/Markets financial effect (individual, local, regional, national and global, employment and markets. Also economic modelling/loss assessment. Insurance - catastrophe securitization and bonds. Also effects on Insurance companies as Business & Industry sector (in stories Business & Industry). |

**Appendix 8 Table 8.1 cont/-**

## Environmental Sciences

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| Botany, Ecology, Hydrogeology, Zoology, Biological and Coastal Science, Ecology, Environmental Science, Sustainability Science, | Disaster effects on natural environment, in particular air, water and land and their continuing ability to sustain life (air, land/earth/sediment, river/stream/ freshwater aquatic/groundwater, marine/coastal or flora/vegetation/forest or zoology-faunal). Whole-system land cover and land use, ecological /ecosystem/habitat assessments or management. |
| Environmental Engineering | Sustainability Science approaches also in architecture, planning or engineering. Waste. May involve 'other public health', economic and/or engineering non-structural infrastructural implications including nuclear. |

## Economics

| | **Scientific research-derived topic area description** |
|---|---|
| *(Also studied as Political/Public Administration, Emergency Management or general Disaster Research, also Engineering- loss and cost planning and energy industry effects)* | <u>Business & Industry</u> - Effects on business, industry, business continuity planning, risk management, corporate philanthropy, and recovery strategies including mobile commerce. (Tourism largely studied as Management Science some Public Admin. Some recovery strategies – Management Science) Other <u>Financial-aid</u> effects and efforts (individual, local, regional, national and global, government assistance (cash grants) and personal donations, philanthropy, corporate social responsibility, <u>Financial-markets</u> employment and markets. Also economic modeling/loss assessment. <u>Insurance</u> - catastrophe securitization and bonds. Also effects on Insurance companies as Business & Industry sector . |

## Geotechnical

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| Geotechnical Engineering and Motion/damage, site effects/remediation | 1) Secondary and tertiary hazard effects in general 2) Ground motion (incl. peak ground acceleration, and flooding due to consolidation or horizontal movement) +/- damage, site effects/selection 3) slope failures and/or associated flooding (debris flows, rock falls, land-slides, 'quake lakes' and their assessment, and related warning and mitigation. Typically one aspect, sometimes overall for remediation. |
| Geo-spatial Information Earth Observation & DRR | Informatics applied to earth science or built environment (otherwise see information science). |
| Remote Sensing/GIS/Seismic network and technology | Geo-observation and emergency management, monitoring, EEW, monitoring, risk reduction and recovery. About observatories, monitoring, remote sensing processes and geospatial info/ data processing and application to hazard and loss assessment in 4Rs. |

**Appendix 8 Table 8.1 cont/-**

## Health Sciences

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| **Emergency Medicine** (Medicine, Pharmacology) | Descriptions of injuries and treatment. |
| **Forensic Science** *(Dentistry, Epidemiology, Forensic Anthropology, Pathology*) | Cause of death/injury. |
| **Psychosocial** (*Psychology/Psychiatry*) | Psychosocial effects and treatment. |
| **Technology/IT-Health** | Examples - portable sonography, mobile phones in health treatment/management. |
| **Other Public Health** (*Environmental Health, Nuclear Medicine, Public Health* | Identification and treatment of pre-existing illness and disease. Aspects of health and the environment – nuclear, air, land, water contamination/supply, waste, hazardous substances spills etc. Health-related aspects of Emergency Management, humanitarian response and reconstruction of health services. Injury rehabilitation. Health & Safety and health development policies. |

## Information, Decision and Management Sciences

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| Information and Computation Science | Media discourse studies of communicated content re aspects of disaster, risk, risk reduction and scientific involvement for general use– relating to various topics. Information in DRR - Analysis of social and traditional media, (disaster discourse) to understand citizen behaviour, perception and opinions., and Studies examining crisis communication performance. |
| Management Science (includes emergency management, tourism) | Best practice and review of DRR management (particularly crisis and recovery) e.g. NGO practices in EM, success of delivery of cash grant schemes, financial strategies in general, post-eq business management – e.g. tourism regeneration strategies etc. Also recovery and readiness planning. May also be studied as Inter-/multi-disciplinary disaster research or public administration/political science. |
| Other Communication Sciences (see also discussion related to communication in 'Other' sciences) | Communication for education/awareness/social learning. For communications technology see Engineering-infrastructure). Communication for recovery decisions. Risk communication – warnings |

**Appendix 8 Table 8.1 cont/-**

**Public Administration/ Political Science**

| Sub-discipline/topic area | Scientific research-derived topic area description |
| --- | --- |
| Political Science and Public Administration (policy, governance, leadership, legislation and compliance) | Economic Policy – aid-related governance and policy – e.g. tourism, economic development, employment promotion, recovery resourcing.<br>Leadership/Management - Failures of governance as cause of disaster. Political interventions/approaches to DRR and effect on Response and Recovery. Provision of information may also studied by Communications discipline(s).<br>Other Communication in Crisis and Public Policy and Relations - Surveys of citizens re risk, Response needs (including information), or for Recovery, support for risk reduction actions. (Also studied by Sociologists, Social Psychologists, Health Scientists, EM professionals and disaster researchers).<br>Other Legal/Social – e.g. legal/compliance, or social policy – e.g. housing rights, asylum, transnationalism, social protection, immigration. |

**Urban Studies and Planning Sciences**

| Sub-discipline/topic area | Scientific research-derived topic area description |
| --- | --- |
| Planning/Landscape Architecture<br>Human Geography/ Urban Studies/Demographics | Planning and Environment - reduction in recovery. Planning for sustainability and DRR. Considerations in pre-event zoning or decisions re siting for reconstruction or codes. (See also geotechnical re site selection) |

**Multi-/Inter-Disciplinary – Disaster and Risk Research**

| **Sub-discipline/topic area** | **Scientific research-derived topic area description** |
| --- | --- |
| Disaster Research/Risk Research/ Human Geography | Inter/multi-disciplinary teams' observations relating to disaster effects or assessments of disaster risks. Combined physical and social research into factors that lead to disaster or general need for/implementation of risk reduction practice. (Disaster Research-Response-PolSci+Management+Social+/-Eng, DRR-lessons/reflections or Disaster Research-Recovery-Planning/PolSci/Geotech and/or Eng+/-Ec. (For best practices or roles in Emergency Management or Recovery see also Management Sciences or Political – leadership. Where there are earth science and engineering teams only, no social science see Geotechnical). |

**Appendix 8 Table 8.1 cont/-**

**Other Sciences**

| Sub-discipline/topic area | Scientific research-derived topic area description |
|---|---|
| Archaeology/Historical Restoration | Damage to and reconstruction of heritage structures (may also be Engineering). |
| Resource Sciences -Energy, Horticultural (incl. forestry), Agricultural & Veterinary Sciences | Livelihoods + Lifestyles – Economic, social and industry effects and approaches to DRR. e.g. effects on/needs of agricultural animals. Also Veterinary alone – relating to needs of pets. |
| Mathematics/Statistics | Applied to any of the above topics. General aspects of science, research and science and technology studies. |
| Pedagogy | Education and training (typically tertiary) in relation to any disaster discipline |
| Sport Science | Sport topics reveal social and governance aspects of DRR. |
| STS/Sociology of Science | |
| Sustainability Science | Cross-disciplinary application e.g. environmental or engineering or disaster |

# Appendix 9: Frame and code description detail

Most code descriptions are located in the body of the thesis as identified in Table 3.12. This Appendix presents detail about frames, codes and coding not presented in the body text of the thesis. Details are presented in three sections and five tables as detailed below. A brief description of 4R codes can be found in Appendix Table 9.1. Coding of DRR topics and examples of DRR topic coding of headlines from media articles are presented in Appendix Tables 9.2a) and b). A description of DRR communication topics from analysis of global earthquake research database is presented in Appendix Table 9.3. Earthquake-related media headline story type descriptions are presented in Appendix Table 9.4a) to d). For keywords and keyword groups used in identifying science articles see Appendix Table 9.5.

Sections



Tables

-blank-

## Appendix 9.1: Coding of 4Rs

Content (e.g. media or research articles) were coded according to the phase of the DRR cycle the headline related to, as per the discussion in section 2.5.3-2.5.6 and brief descriptions in Appendix Table 9.1.

**Appendix Table 9.1: Brief description of 4R codes**

| DRR Topic Code | Media headline and article reference |
|---|---|
| Readiness | About disaster history (cause), audit of solutions, planning or advice for the response or recovery phases of the DRR cycle. Includes identification of preparedness actions, survival kit, emergency supplies, and planning for any phases of the DRR cycle. Includes legislation and insurance. Also any references to cause or blame relating to losses, audits or reviews of actions in any phases of the DRR cycle. See topics 4-6 for further details. |
| Response | Media articles written during the response phase of events or otherwise about the response phase of events, or research articles about observations, assessments or actions or behaviours in the response phase. See DRR topics 7-9 for further details. |
| Recovery | Identification or observations of long-term effects of an event, about recovery assessments or recovery actions, such as insurance bail-outs, community assistance, rebuild, reconstruction, rehabilitation. See DRR topics 10-12 for further details |
| Reduction | About risk or risk solutions, vulnerability assessment and physical DRR actions outside an event’s response or recovery. Primary research about hazard, forecasting or other studies relating to the probability of disaster events, assessment of vulnerability. Focus on the physical mitigation of the built, economic, social or natural environments such as reducing rock-fall risk, engineering design and construction or materials innovation. See DRR topics 1-3 for further details. |

A second or blended code with a 50:50 weighting applied where for example the topic was planning (readiness code) for recovery (secondary code). Another example would be the audit of the response phase which would be readiness (primary code) , response (secondary code). Concerns about the recovery phase if raised during the response period coded as recovery primary code. Demolition in Response is an example of a reduction (primary code) in response (secondary code). Avoidance through zonation is an example of reduction in recovery and the primary and secondary code will depend on the emphasis in the headline.

-blank-

## Appendix 9.2: Coding of DRR topics and subtopics

When coding DRR-communication topic frames in material that referred to two or more DRR-communication topics, a judgment call was made as to which was dominant. This is an area where inter-coder disagreement may have occurred. The first concept mentioned has typically been considered dominant.

Up to three ‘DRR-topic’ frames were assigned to each article headline (for mass media articles) or article titles (for the DRR research dataset) reflecting the degree of attention placed on one or more of the twelve topics. Where it was considered that there were two frames the dominant frame was assigned a score of 2 and the other 1. Where there were three or more frames each was assigned a value of ‘1’. An example of an exception, where dominant coding (weighted 2) coding has been chosen for the second concept, is the article “Wood ideal material for rebuild” (Anderton, 2011). That article was coded as *Recovery Assessment*-rebuild (i.e. DRR communication topic 11) rather than a *Built-mitigation-Construction materials* code (i.e. DRR communication topic 3). Where all frames were present, ‘all’ was entered as the first frame code and each was assigned a value of ‘1’. The weighted values were summed. The results are presented in Tables 7.5 and 7.6.

Subtopic coding within a topic area is also possible. Where there has been subtopic coding in this research this is described in the relevant results chapter. For example for causation this has been in relation to the characters attributed with responsibility for cause discussed the code list for which is in section 7.4 (Table 7.8).

Where there was a need to separate between consequences or actions in terms of response and recovery it was considered logical that the date used was that of the expiry of local or national state of emergency.

**Appendix Table 9.2a: Description of DRR-communication topic and environment codes –media articles**

N = natural, S= social, E= economic and B = built environment, or a blend of these possible.

| DRR Topic Code | Description of headline topics |
|---|---|
| 1N | Background science relating to what to expect; primary and secondary effects – land, air, water, flora, fauna and how assessments about these topics are achieved. |
| 1B | Background science about the built environment and for example understanding likely consequences from known events tertiary effects - infrastructure, commercial, cultural and recreational buildings and dwellings |
| 1S | Background science about the social environment. |
| 1E | Background science about the economic environment. |
| 2 | Vulnerability assessments and associated warnings about any of the environments, outside of or unrelated to response or recovery phases of a disaster (e.g. infrastructure (B) economic systems and practices (E), or nature of communities (S)). |
| 3 | Design and construction of buildings and infrastructure (B), warning technologies and devices. Medical equipment and techniques including rescue equipment (S), land remediation techniques (NB) and technology and also other research equipment. |
| 4 | Discussions about earthquake history if focus on cause. For example increasing development means greater losses if don't mitigate, or greater ability to invest in mitigation (E). |
| 5 | Audit, inquiry, commission, review of DRR practices, lessons identified or learned in any phase of DRR. |
| 6 | Preparations for survival in response, stocking, training (emergency response including first aid training and drills,) resource inventories, logistics and recovery planning. Insurance (risk transfer). Taxation to pay costs of mitigation, Legislation (e.g. building codes, or re insurance. Communication (e.g. about warning technologies and devices). |
| 7 | Initial observations of losses (e.g. environmental, water and air – N, if linked to health NS), damage assessments if not related to needs (B)). |
| 8 | Needs assessments (e.g. of critical infrastructure – B). |
| 9B | Cleanup of rubble, cleanup of silt (BN), avoiding further damage or injury - cordons or evacuations (BS). |
| 9S | Search and rescue, provision of shelter, household survival without services, policing, announcements and other actions to avoid disease, procurement, logistics, warehousing, transport, distributions, helping others and other physical and emotional solidarity. |
| 9E | Grants, donations, fundraising. |
| 10 | Long term effects (e.g. mental wellbeing (S)). |
| 11 | Long term economic needs (E). |
| 12 | Building back (better) – e.g. retrofitting while restoring URM buildings damaged in earthquake (B) Post-event land resonation, land remediation (N, or NB), long term social factors (S), post-event functionality and amenity (SB) Return to normal (S or E), future insurance, economic costs of mitigation in recovery (E), environmental rehabilitation (N). |

### Appendix Table 9.2b: Examples of DRR topic coding of media headlines

Note that the DRR-science issue code (cf. Figure 4) may be quite different (another example of a topic code 2 "Fault lines no reason for panic (Littlewood, 2011)" is a "Reaction to risk" DRR-science issue story (as per media headline) whereas the example in the table below is DRR-science issue story "Warning/Risk".

Note also that the examples below relate to different environments.

Some of the stories appeared under two headlines and the different framing affects the DRR topic coding. An example is M. Wright (2011c)for which "Christchurch Earthquake / CTV Building Vulnerable" was an alternative headline to "Questions over CTV Building Construction".

| DRR Topic Code | Media headline and article reference |
|---|---|
| 1 | Ask an Expert/Where does liquefaction come from (Fairfax NZ News, 2011j) |
| 2 | Where is the safest place to live in NZ? (Fairfax NZ News, 2011c) |
| 3 | $6m event centre to pioneer quake rods (Newton, 2011c) |
| 4 | NZ "blessed" no one died: Civil Defence minister (NZPA, 2010f) |
| 5 | Royal commission hearings start in October (Carville, 2011a) |
| 6 | Quake safe bill may fall to public (Nichols, 2011) |
| 7 | Earthquake alters water levels (Wardle, 2010b) |
| 8 | Quake may give brutal shock to NZ economy (Rutherford, 2011) |
| 9 | Christchurch water may be chlorinated after quake (Todd & Chug, 2011) |
| 10 | Quakes affect two thirds of NZ businesses (Steeman, 2011) |
| 11 | Redcliffs may be green (M. Wright, 2011d) |
| 12 | Businesses unite to keep Christchurch alive (Tamlyn, 2011) |

### Appendix Table 9.2c: Examples of DRR topic coding of media headlines – multiple codes

Some examples of media headline coding of up to three DRR topic codes as described in section 3.6.6.

| DRR Topic Codes | Media headline and article reference |
|---|---|
| 4, 1 | Ask an Expert/ Did dairy farming trigger quakes (Associated Press, 2010c) |
| 4, 7, 5 | 'Exceptional' shaking caused PGC collapse (Fairfax NZ News, 2011e) |
| 5, 6 | Many not prepared for big earthquake (Amanda Fisher, 2011) |
| 5, 9 | Health boss recognised for quake effort (Stylianou, 2011a) |
| 5, 12 | Little interest in quake inquiry (Heather, 2011f) |
| 5, 12 | What Napier can teach Christchurch about earthquake recovery (Sharpe, 2011) |
| 7, 2 | Pacific quake sparks brief tsunami scare (Associated Press with The Press, 2010) |
| 12, 10 | Deal with earthquake jitters front on (Fairfax NZ News, 2011e) |
| 7, 8, 9 | Christchurch earthquake: Latest news –Wednesday (Fairfax NZ News, 2011a) |
| 8, 9, 5 | Confusion over damage assessment (Heather, 2010b) |

**Appendix Table 9.3a: Description of DRR-communication topics – research articles**

This table was generated from immersion in all literature reviewed and academic dataset analysed in the course of this research. Common or key words from academic literature (headlines) that denote the topic are italicised. The relationship to DRR topics is shown in Figure 3.4.

| DRR code number | DRR-communication topic and subtopic description |
|---|---|
| 1 | Background scientific observations, testing etc. – all environments. (*characteristics, mode, mechanism, influences, classification, distribution* for earth science, geotechnology and health. *Features, knowledge, understanding* for emergency medicine) Includes studies of earthquake precursors (can only be used for warning if mention predictions and forecasting), *behaviour (*engineering), *experimental analysis* on engineered structures, *factors (associated) with, or indicators* for medical and psychosocial conditions. |
| 2 | Risk Assessments (all environments). Results of risk assessments. Risk perception; suggestion that there is potential for negative effects or a *safety* issue, and/or cause for warning or reassurance. *Warnings/Forecasts/susceptibility/evaluations/vulnerability/estimation/simulation* including *Post-earthquake reliability/safety assessments (see below)* structures, land for evacuation and refuge, investigation – water quality/mosquito larvae testing (*investigation*), *susceptibility/monitoring/surveillance* landslide and other secondary hazards/disasters such as quake-lake breach/tsunami/aftershocks post earthquake even though these may occur in response and may be followed by Actions in Response (9) they are a hazard assessment earthquake *precursors, prediction/forecasting (premonition, paleo-seismicity/tectonic history, geode(ctic/sy), cycle(s))*<br>*risk* (measured) for medical and psychosocial conditions |
| 3 | *Solutions; avoidance of risk and mitigation possibilities. Design, construction, seismic strengthening, securing contents, bracing, retrofit, dampers, pads* and other energy dissapation technology<br>Structural health monitoring systems, early warning systems (on-land and tsunami, even for logistics risks), shut-off devices, *tools,* disaster applications of medical *technolog*ies, earth and atmospheric observation technologies. Closures and demolitions that do not occur in response or recovery (e.g. decision in Wellington or Otago to demolish building even if in Canterbury's recovery period – (arguably may have 10 as second consequence code). |
| 4 | *Cause* of disaster/where blame attributed, *responsibility* for disaster – whether attributed to natural environment, social, economic systems or nature of built environment *man-made* |
| 5 | Assessment process for attribution of responsibility for DRR– *reviews, audits, evaluations, revisions, damage investigations* of building (often culturally significant or schools, lifelines etc.), media, emergency medical, authorities EM, leadership *performance* assessment post-event, *lessons learnt, outcome, comparison, improving, report, rethinking, testing models, R&D, utility, wake-up call, compliance, effectiveness, thoughts, reflections, restructur(e/ing), validation, failure* |
| 6 | Emergency management *Planning strategy,* business continuity planning, risk management, and recovery strategies *Codes/standards*/zoning<br>*Training*, *research*, *data collaboration* (e.g. for/between engineers or medical practitioners)<br>*Communication/display*/provision of warnings and reaction to warnings (including fear), funding of research is also preparation<br>*Insurance. Policies and plans that require building closures.* |
| 7 | Any short-term consequences – all environments (*co-seismic*, *triggered by, reconnaissance, effects)*<br>Secondary effects (see (Appendix Table 3.2) and built environment effects and mitigation. Where headline relates to immediate aftershock effect coded as 7 otherwise 10 (e.g. another, or many).<br>Financial effects– inter/national, regional, local, business, industry, household, employment, individual<br>Including volunteerism in emergency management, resilience in Response (or maladaptive behaviour)<br>Injuries, trauma |

## Appendix Table 9.3a cont/:

This table was generated from immersion in all literature reviewed and datasets analysed in the course of this research. Common or key words from literature that denote the topic are italicised. The relationship to DRR topics is shown in Figure 3.6.

| DRR code number | DRR-communication topic and subtopic description |
|---|---|
| 8 | Assessment of loss/damage/needs in order to make decisions about ways to alleviate (emergency management) - loss assessment/evaluation/modelling (primarily economic and built (engineering) also environment), *scenarios*, logistics<br>trauma *evaluation, screening* (emergency medicine), *anxiety assessment, monitoring, disease surveillance system, 'social reconnaissance'* |
| 9 | Authorities' activities (Civil Defence/emergency management and government) – financial assistance, crisis information (including public health advice), various assessments and closures and urban shoring, cordons, infrastructure meantime alternatives (e.g. portaloos, delivery etc.)<br>Business efforts – e.g. mobile commerce,<br>Emergency medical *treatment, therapy, care, nursing*<br>Mutual aid - donations, aid, charitable activities<br>Technology used in response - rescue robots and aircraft, health response equipment, communications, social media, disaster management systems<br>Act of inspecting and monitoring post-earthquake – as opposed to results of those safety inspections (2) or loss/damage (8)<br>Remedial/safety actions cordon, quake lake draining etc.<br>Crisis communication including social media use and tweeting, knowledge/data sharing occurrence and tools (wikis etc.) |
| 10 | Any long-term consequences – all environments – (*aftermath)* - examples *disability, PTSD, aftershocks* includes mountain hazards triggered by earthquake although if no time given in research papers will be coded as topic 7. |
| 11 | Recovery assessments – assessing cost benefit in relation to recovery decisions relocation, reconstruction, rehabilitation. (Changes to legislation or planning albeit triggered by event and recovery were coded as topic 6. |
| 12 | Recovery actions include resumption of social institutions, relocation, re-building, reconstruction, restoration, and closure and demolition decisions, and long-term infrastructure repair, recovery reinforcement/retrofit. Also health rehabilitation (*functional recovery*,) including psychosocial interventions, recovery-related disaster research |

-blank-

## Appendix 9.3: Coding media headline story types

A significant challenge was deciding how to categorise media stories relating to scientific research and research knowledge. Research and associated knowledge is an activity that occurs and is reported on in all four phases of the DRR cycle, yet reported in similar story types regardless of the phase. Essentially *Background* stories are stories that give information on scientific detail behind and research findings on effects, recovery and response needs and actions and possible solutions from previous studies. Scientists discuss what occurred in a variety of *What Happened/What's Being Done* or *Road to Recovery* story types from *Understanding Natural Hazards*, *Emergency Medical Treatment* or *'Business, Financial or Employment Initiatives* to *Environmental Rehabilitation*. Vulnerability and warning-related science stories are part of the relevant disaster risk story types, while funding and planning of research is part of *Scientific Monitoring & Warning Systems*. The latter includes funding and planning for research in all capitals.

When choosing categories of stories for coding it was considered that doing so in terms of a science- or DRR-focus would be artificial as this would not have been the media's intention. For example, like sport, or military or police involvement in response, education is an issue topic that academics have particular interest in. As the media also have journalists focusing on these 'beats' it was tempting to use these code groups. However the media used a variety of different story types to report on education topics; from *Damage/Devastation* (damage to school buildings), though schools' involvement in fundraising (*Fundraising/Donations by New Zealanders*) or *Community spirit* regarding pupils' solidarity with or courteousness to victims. Emergency response closures have been coded as separate *Schools Closed/Reopening*, and pupils moving to other schools as *Pastoral Care* within *Aid, Volunteers or Solidarity*. (There were also other education-related brief mentions in what were coded as *Other Education* articles).

Police issue topics include antisocial behaviour, assisting with relief efforts, and enforcement in response. The story types for these are: *Antisocial Behaviour and Law Enforcement*, *General Emergency Management*, and *Military or Police Relief/ Aid.*

The body text of the stories may traverse a range of media headline story types. For example a discussion of the tertiary effects of the Tohoku earthquake may range from *Background/Expectations* to *Research Findings* to *Other Health Warnings* and may include a paragraph that is in itself a *Survivor/Victim Story*. The headline will however be framed as only one of these.

An example of how media story types were coded is a story with the headline "Google creates a person finder for quake affected" (TV1, 2011-02-23b). This television story has been coded as a *Businesses Helping Out* story because Google, the business, is the subject of the headline and mentioned first, although the story headline could arguably also have been a *Technology*! story. Such coding difficulties account for the less than 100% inter-coder reliability. Examples include discussion of EQC levy increases; these might, depending on the headline framing either have the story type code *Insurance, Reinsurance* or *Business or Industry effects* stories. It was decided that since the increases were only proposed ones to keep all together in the former story type.

## Appendix 9.4: Story type descriptions

A set of tables describing each of the 155 story types follows as below:

-blank-

**Appendix Table 9.4a: Disaster Readiness category story type descriptions - Research & Findings group**

Description of the 20 ‘Disaster Readiness’ (warning) stories of the 155-related media headline story types identified in the New Zealand mass media. These are separated into two groups a) ‘Research and Findings’ and b) ‘Warnings/Risk’. The latter group is split into subgroups according to the four environments while the ‘Research and Findings’ group includes stories explaining or summarising events issues or research findings.

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | **Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable** |
|---|---|---|---|
| | **About any of 4Rs** | | These are articles couched as findings of research that are headlined without a risk interpretation (for the latter see "Warnings/Risk" group of articles. Research findings articles may be either about studies of an event in the country of the event, or elsewhere. In the latter case the findings of research are not associated with earthquake event. Study findings related to an event satisfy researchers' event curiosity and overall sensemaking, in the long term. and are coded as Understanding Earthquakes & Aftershocks. In this case typically about earthquake-related hazards. |
| 1 | | Background/Expectations | Background knowledge and understanding in relation to research in all scientific disciplines and about all scientist roles in relation to DRR. Immediately after an event these are 'sense-making' articles, explaining what is understood of the processes that resulted in the observed/experienced events. Alternatively the article headings suggest someone with expertise is making a prognosis on the likely searthquakeuence of events now that the hazard event has occurred. (These are comments on what could occur. They are not 'Forecasting or Prediction' media stories, which are focussed on the probable timing of the hazard event itself). |
| 2 | | Research Plans | Articles or items about planned research, either in relation to an event, or elsewhere. Typically journalist interviews research leader(s). |
| 3 | | Researchers/Researching | Articles or items about research or a conference presentation that is occurring at the time, either in relation to an event, or elsewhere. Typically journalist visits research location and interviews participants. May include citizen participation in research. |
| 4 | | Research Findings (Research of Event/Research Future Event) | These are articles couched as findings of research that are headlined without a risk interpretation (for the latter see "Warnings/Risk" group of articles. Research findings articles may be either about studies of an event in the country of the event, or elsewhere. In the latter case the findings of research are typically general in nature and not associated with a specific earthquake event. Study findings related to an event satisfy researchers' event curiosity and overall sensemaking, in the long term. Includes findings of 'unusual' earthquake effects. (Articles coded as 'Understanding Earthquakes & Aftershocks" are summaries of research findings or initial observations of scientists.) |
| 5 | | Historic (Earthquake) Events | Articles produced on event summarising previous event details. May be articles on 6-month or one year anniversary .Not lists or fact boxes (see Historic Event Lists) |
| 6 | | Historic Event Lists | Lists or factboxes about largest, deadliest etc. events, typically created immediately after event. Provides a very brief history of the hazard. |
| | **Anniversary** | | |
| 7 | | This Day in History | Articles about historic media reports of hazard events |
| 8 | | Historic Commemoration | Articles about anniversary commemoration of event in distant history where recovery has occurred (e.g. for the 1931 Napier earthquake in New Zealand). These articles may summarise aspects of the event itself, as well as comment on recovery progress but are focussed on the commemoration event otherwise coded as "Historic Event" or "Recovery Progress". |
| 9 | | End of Year | Disasters of the year' or 'earthquakes of the year' articles. Also summary of some part of recovery in an end of year article. |

**Appendix Table 9.4b: Disaster Readiness category story type descriptions - Warnings/Risk group**

| | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story Type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| 10 | Warning-natural environment | Forecasting or Prediction | Understanding future seismological risk as understood by main-stream earth scientists (risk of earthquake), including of aftershocks (aftershock forecasts). In contrast Predictions (pseudoscientific) (e.g. Moon Man/Ken Ring or Berkland) or by religious or other leaders - e.g. kaumatua on Waitangi day or Doomsday). (Aftershock forecasts are also discussed in some articles about other aspects of earthquakes in explanations given by scientists in Response (Understanding Natural Hazards). Some body text comments relating to forecasting and prediction of aftershocks may be found in 'Understanding Natural Hazards'. Reaction to forecast/prediction, or Alpine Fault 'overdue'. Articles about scientifically unproven precursors here also. |
| 11 | | (Animals) Sensing Earthquakes | Stories asking and attempting to answer the question as to whether earthquakes are able to be 'sensed', and if so act as an earthquake early warning system (EEW). This is typically about animals sensing earthquakes, but may also include human psychological changes or curiosity about pre-earthquake atmospheric effects including weather. |
| 12 | | More to Come? Link? | These are articles answering the question of whether there might be more or larger earthquakes to come after an event has occurred. This includes whether an occurrence is a foreshock, a quake in one area is likely to trigger another, or whether there is a link between multiple earthquake events. May also include stories of the type "No link - not worse to come " or some type of "Don't Worry" on event that not sign of worse to come. Note that although they will have been coded as New Zealand Felt, or International Occurrences story, headlines emphasising that an event is a second or third in a short time frame extend this theme. |
| 13 | | Volcanic Eruption | Articles about felt earthquake occurrences in an article about a volcanic eruption. These are mentions earthquakes in conjunction with volcanic alerts, or volcanic eruptions, or that |
| 14 | | Tsunami Warning | International or New Zealand tsunami warnings in relation to an international or local earthquake event. Also cancellation of warnings. Not "Reaction to Warning". Not stories with headlines that question authorities' performance in communicating warnings (see "Reviewing Awareness"). Not about tsunami processes (see "Background/Explanations"), or what the effects were when a tsunami or earthquake-induced tidal surge occurred (see "Associated Secondary Effects". Nor are these stories about the installation of monitoring or warning technology (see "Monitoring or Warning"). |
| 15 | | Weather Worries | Warnings of bad weather, e.g. wind or flooding, cold temperatures that are likely to exacerbate conditions for victims and/or relief workers. |
| 16 | | Secondary Land Threats | Warnings or references to risk or reassurances about other possible secondary natural hazards associated with earthquakes. These are long-term risk advice and short-term warnings re liquefaction, lateral spreading quake lake breach, landslides or rock-fall, fault rupture and vertical displacement resulting in flooding. |
| 17 | Warning-built environment | At Risk: Buildings (or Infrastructure) | Vulnerability of, or reassurance about built environment. Susceptibility to failure, safety of buildings, whether earthquake prone, or located where at risk of secondary hazard effects, such as fire, nuclear reactor breaches etc. 'Earthquake-prone' building stories or those about buildings deemed to be safe. |
| 18 | Warning-economic environment | Economic Vulnerability | Suggestions of economic vulnerability pre-quake. In wake of an earthquake fears of, for example, market collapse, small business vulnerability in recovery, or prediction of boom. |
| 19 | Warning – social environment | Other Health Warnings | Social vulnerability and health warnings. Potential death toll, health effects etc. Warnings about disease in natural disaster or other public health risks, albeit not about efforts to prevent these in Response (for latter see "Environment & Public Health" or "Infrastructure & Public Health"). Shouldn't include tertiary health effects e.g. nuclear threat from Japan. Not finding that '(un)prepared'. |
| 20 | General Warnings | At Risk: Cities, Regions/Scenarios | General warnings for cities or regions or articles painting the scene of likely scenarios. These are typically articles about risk in other regions that are triggered by an event elsewhere - e.g. "If it Happened in Wellington" articles. |

**Appendix Table 9.4c: Earthquake!/Disaster! category story type descriptions – Event & Effects group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| | **Event & General Effects** | | In this study relates to Canterbury Earthquake (unless indicated by suffix 'International') Event and General Damage and Disaster |
| 21 | | Felt Occurrence | Nil or slight damage events. These may be a) International Occurrences, b) New Zealand Felt Occurrences occurring in New Zealand before or during the Canterbury earthquake sequence that are unrelated to Canterbury event. Included are any article that reports a Canterbury aftershock without reference in the headline to second or third quake or 'aftershock' or 'another quake'(for those see "Felt Occurrence-multiple" or "Aftershock(s)"). Articles that emphasise that the number of earthquakes are increasing or linked to a past or future event are coded "Worse to Come? Link?". Artices that mention an earthquake occurrence in an article that headlines volcanic activity are coded as "Volcanic Eruption" |
| 22 | | Felt Occurrence-multiple | Articles that emphasise that a second or greater number or cluster of earthquakes have occurred. Also references to 'new' or 'fresh' earthquake. |
| 23 | | Aftershock(s) | Any article includes reference in headline to 'aftershock' or 'another quake' after a major event. These are typically written in the style of felt occurrences. Not articles summarising how many earthquakes there have been after a long time (see "Research Findings"). Not articles that emphasise damage (Damage/Devastation), stress (Scared Stressed Struggling), or how rescue is affected (Search & Rescue), or give a tally of total number of aftershocks (the latter are "Research Findings"). |
| 24 | | Disaster Occurrence | Canterbury, New Zealand or International first report of major earthquake, aftershock or tsunami (unless emphasises stress or damage in which case coded as such). Raw Footage of severe Quake or aftershock. For other disaster type (not earthquake) with comment linked in some way (e.g. QLD flooding insurance, or Pike River tragedy) etc. see "Non-earthquake Disaster". |
| 25 | **Effect on Built environment** | Damage/Devastation | Articles whose headlines relate to built environment where there is no indication of DRR activities. Includes raw footage of quake or aftershock. Often shows damage to contents. |
| 26 | **Foreigners Affected** | Foreign Survivor/Victim Story | See below - story types are similar to New Zealand Survivor Victim Stories (see below). However this set are either written by overseas journalists about survivors in the country of the event, or by New Zealand journalists about nationals visiting New Zealand at the time of an international disaster |
| | **New Zealanders Affected** | | Harms/Benefits-International occurrence- (implications on New Zealand/ers. New Zealanders involvement - experience, relatives/friends in New Zealand, and MFAT notifications as to missing or deceased persons, bodies being return to New Zealand. Also on persons well-known to New Zealanders - Expats or tourists- survivor stories. New Zealander fundraising for International event. New Zealand SAR Team, other New Zealander going to aid. When no New Zealander then becomes Australian missing or involved. May include mention of what in New Zealand stories were Other Social effects, for example effects on tourists from other countries. Leader Condolences, or Solidarity. |
| 27 | | Survivor/Victim Story | Stories of New Zealanders effected by an event. Affected residents' stories in country of event, are of damage and general survival, media and sporting personality reports of damage in a neighbourhood, and stories about victims and their funerals although these latter two types contain fewer details about earthquake. On occasion these are stories obtained from interviewing those who arrive in town/city of media having evacuated the disaster zone. For International Events the stories are told from the perspective of expats or tourists, or those at home recounting stories of loved ones who were victims. There are stories about victims that include details of where they were and what they were doing at the time of the disaster. Other story sub-types are "Shaky Delivery', regarding births during or soon after the event, and "Brides to Be" about survivors wedding despite the disruptions caused by the event. A further story subtype relates to stories about people who have also survived previous earthquakes. 'Injury Rehabilitation' stories are a type of Survivor/Victim Story told in recovery. "Researcher/Researching" and some "Search & Rescue" stories are also Survivor/Victim Story subtypes. As brief mentions in articles Survivor/Victim mentions are typically references to someone having died in an event, or the storyteller or a relative having been in a particular location when any of the major events occurred. Not "Citizens in Recovery" (see Recovery Assessments & Initiatives group) or "Change in Luck" or "Double Disaster" stories (see Recovery Milestones group for descriptions) |
| 28 | | MFAT info/Missing New Zealander(s) | Missing persons, or Ministry of Foreign Affairs info on expats and tourists in countr(ies) of disaster. Also Missing persons now found to be safe. Includes dead New Zealanders |
| 29 | | New Zealanders flown home | New Zealanders flown home stories are a type of survivor/victim story headlined by a reference to their return to New Zealand or a reunion in a country away from the disaster location for New Zealanders. |
| 30 | | Other Effect on New Zealand(er) | Effects of an International event on New Zealand or New Zealanders, for example on New Zealand businesses. Not "Survivor/Victim story" or New Zealander missing or flown home, involvement in fundraising or relief, or solidarity. |

**Appendix Table 9.4c cont\: Earthquake!/Disaster! category story type descriptions – Event & Effects group**

| | | | |
|---|---|---|---|
| 31 | | Stressed, Scared, Struggling | Stress, mental well-being, grief, loss, tiredness, being traumatised by, or fear of aftershocks. Not how to deal with these emotions - see "Ways to feel Better". |
| 32 | | Other Social Effects | Effects and reactions to earthquake in Response not categorised elsewhere in 'How Lives Change' or 'Social/Response Initiatives) and not 'Mentions Only'. Other Disruption - Transport Time , Other cultural, Other including positive - silver lining, opportunity (items relating to solidarity & volunteerism not included here).nor does it include fleeing or evacuation on event (see "Fear, Flee or Panic". Not about missing pets and effects (see "About or Assisting About Animals"). RWC decision. Not created art . Not what do on shaking for survival, or fear or fleeing on shaking (see DRR Options).. Also brief mentions - effect of quakes on sport fundraisers, to odd distal effects such as quality of fish and chips in Dunedin purportedly because of potato quality being affected by water level changes in Canterbury. |
| 33 | **Effect on Nature** | Understanding Natural Hazards/Aftershocks | These are articles providing sense of the event that has just occurred or advertising or summing up public lectures about event-related earth science. These articles provide earth science understanding or Expert Perspective on event; the magnitude or intensity of the event, about the faults that caused it. These are immediate observations rather than the planning or results of any research reported in the media (see Research of Event) up to three months after the event. For articles about research findings after that time, or articles solely about why the event occurred - e.g. plate tectonic, fault or tsunami processes see 'Research Findings/of Event'. This code does not include articles relating to funding of future research, or research elsewhere. Nor does it include question about future risk of aftershocks or earthquakes (see 'Forecasting & Prediction' or clustering, links to other earthquake or volcanic events (for latter see 'More to Come/Link?' (Volcanic Association). Not articles that are explanations about, or studies of secondary hazards such as liquefaction, slope failure or displacement (see 'Associated Natural Phenomena', Research Elsewhere or Research of Event). Some articles may include body text comments about seismic forecasting and prediction. Does not include finding of 'unusual' earthquake effects - See "research Findings" |
| 34 | | Associated Natural Phenomena (Liquefaction, Silt, Flooding, Rock-fall, Quake Lakes, Landslides, Tsunamis, Rupture etc.) | Secondary Natural hazards and their effects or consequences - such as surface rupture, shaking, liquefaction, rock fall, slope stability, horizontal- and vertical-displacement (subsidence) & their effect on human communities. Where these have occurred, when, how widespread. While these typically include reference to effect on roading and other transport this is not the main focus. Not articles only about the clearing of silt (Cleaning Up, Survivor/Victim Stories or Aid, Volunteerism & Solidarity,) or threat of rockfall, or removing boulders (Making the Natural Environment Safer). Not volcanic association (see Felt Occurrences-volcanic association) Subset - unusual earthquake |
| 35 | | Strange Phenomena | Articles about phenomena associated with earthquakes that are not fully accepted |
| 36 | | Other Environmental Effects | Descriptions about effects to the natural environment (ecological effects) without any related public health implications or warnings (see Environment & Public Health). |
| | **Economic Effects** | | What financial harm or benefit is occurring or might occur. Articles after state of emergency expires are coded a 10 (long term effect) but the story-type remains |
| 37 | | (Un)Employment | Impact of the hazard event on individual (un)employment. Mentions of 'employment', work(er), "jobs", 'job + losses/cuts/to go,' redundancies', 'staff cuts' account for all ODT codes. Also stories relating to salary and wages. |
| 38 | | Insurance Claim Numbers or Costs | Insurance Claim numbers or cost of insurance losses/payouts |
| 39 | | Business or Industry Effects | Impact on Business & Industry; on financial reporting and business confidence - includes effects on industry sectors such as real-estate (property), tourism, exporters. Not insurance even if cost of (coded as Insurance or Reinsurance). Does not include cordon impact on business-access to retrieve business items. Not Business Initiatives in response or Recovery or articles about shops reopening (see "Return to normal/resilience".) Includes 'silver linings that have occurred though 'possible positive effects' are "Background/Expectations". |
| 40 | | Impact on Economy | Impact on the Economy - from global to New Zealand and regional economy to stock markets, interest rates and consumer confidence. |

**Appendix Table 9.4d: Earthquake!/Disaster! category story type descriptions – What's Happened/Being Done? group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| 41 | **General Effects & EM** | Death Toll or Injured | Group of stories that refer to death toll or injured in headline. Although at first glance these stories are arguably more 'Earthquake! or Disaster!' in terms of their headlines, these stories typically go on to describe various aspects of damage and some emergency management procedures. Just the fact that the numbers are estimated is part of the early EM effort in assessing the impacts of the event. Not treatment of injured, missing persons or search and rescue, or victim ID (coded separately as below). Not stories about missing persons or victims. |
| 42 | | Latest Update - Live Update, News | Latest developments on range of subtopics from descriptions of consequence through response, rescue, individual, organisational and government initiatives to relieve immediate and on-going effects, authorities advice etc. |
| 43 | | Authorities Update | Authorities' (Council staff, Mayoral, Emergency Services, CDEM) media briefings or press conferences and advice. These stories contain a mix of consequences and emergency management information. |
| 44 | | State of Emergency | Article headlines that refer to declaration of State of Emergency. The expiry of State of Emergency is coded as "Return to normal/resilience". |
| 45 | | General Emergency Management | About supplies, crisis communication or general authorities advice. Messages from authorities regarding supplies, infrastructure, use of telecommunications networks, use of hospitals, vehicle recovery etc. Does not include "Antisocial Behaviour & Law Enforcement"- (Not police assistance - see "Aid Volunteers & Solidarity - "Military or Police Relief/Aid"). About issues relating to food and water distribution, but not general relief - see Aid, Volunteers or Solidarity. Does not include "Cleaning up" or "Government Assistance" - relief portaloo distribution or help for disabled. Announcing transition from rescue to relief. Police updates (that also discuss damage) but not police and military patrols, curfew, and security or security breaches ( see "Antisocial Behaviour and Law Enforcement". )Not State of Emergency. Nor is it about performance aspects of response - see "Doing More/Better in Response". Also not police assistance ("Military or Police Relief/Aid"). |
| 46 | | Political in Crisis (includes TV1's "Q+A") | General political EM-EMS-Leadership, Interviews, Announcements addresses, and press conferences-or Other) up to two weeks after major event. Leader visit (official or dignitary). Not condolences (see Solidarity) politician comment about any other Story category. For example, not financial assistance - see Business, Financial & Employment-initiatives. Not "State of Emergency", "Leader Visits" or praise or criticism of response "Doing Better/More in Response" or PMs involvement in "Awards, Commendations or Thanks". |
| 47 | **Social Response** | Victim ID or Name Release | These articles are headlined as numbers of victims identified, or that particular victims identified, name release or about the disaster victim identification (DVI) process, or praise of the process. The stories are typically a combination of authorities' information about release of names, or funeral arrangements for the deceased, citizen relief at being able to say goodbye, Coroner or forensic scientist explanations of the time required for the DVI process if not the process itself, and of victims not ben able to be identified. These are not stories about funerals and victims (see "Survivor/Victim Stories"). For praise or thanks to DVI team see "Awards, Commendations or Thanks". |
| 48 | | Antisocial Behaviour & Law Enforcement | Stories about observations of, and law enforcement relating to maladaptive behaviour. Crime rates, theft, burglary, looting and domestic violence and sentencing. Also cordon breaches, relief fraud, price hikes by business or industry landlords, and impersonating officials. Emphasis on the behaviour as well as the policing, and legal consequences. Stories about police and military patrols, curfew, and security. However this code does not gather all articles on topic of policing or military involvement in DRR (see also "Military or Police Relief/Aid"). This code does not include aid-related antisocial behaviour such as relief scams, selling aid on the black market, and 'kidnapping of orphans' which have been coded as "Aid Issues". For possible insurance claim fraud see "Insurance Problems". Would have added an equivalent code for recovery had stories been found that discussed long-term antisocial behaviour without "Ways of Feeling better" or if not a "Citizens in Recovery" type story. |
| 49 | | Sport | Articles prefixed with the Sport's name; sports stories that in print version would be in sports rather than general news section. There are two predominant types of story - fundraising (including sports celebrity support), or event disruption +/- venue damage. "Other Sports" brief mentions are also coded into the two above types. This story type includes full articles on a sports team in town training and affected by quake check not Other Social consequences). (The major event disruption issue in relation to the Canterbury earthquakes was related to the Rugby World Cup (RWC). Not re the decision not to host the RWC (coded in Other Social consequences). Not stories that emphasise fundraising or solidarity in general or related to RWC (for which see "Aid, Volunteerism or Solidarity - "Celebrity Involvement" or "New Zealander Relief Volunteers""). Not sporting bodies compassion in allowing recruitment of other players from outside area etc. ("Solidarity, Compassion & Community Spirit") |
| 50 | **Social Health Response** | Environment & Public Health | Effects on Air, Land/Earth/Sediment, River/stream/freshwater aquatic/groundwater, Marine/coastal, Flora/vegetation/forest or Zoological/Faunal). Whole-system land cover and land use - ecological/ecosystem/habitat rivers and beaches when associated with Studies, Science, Scientists-Research-Environmental or Public Health Advice. Not Environmental effects only. |
| 51 | | Infrastructure and Public Health | Infrastructure effects, or assessments, repairs, restoration of-power, heating, communications overload, hospital. Also the need for water conservation. EM/EMS and infrastructural consequences. Includes functionality of hospital and communications infrastructure although these rarely include advice or implications for future. Also for disease outbreak, disease risk and public health advice. Body text may include disease and electrocution risk, and messages to GPs re checking vaccines. Includes expert perspective on event. May also relate to distal infrastructure. Not effects on rivers and beaches (see "Environment & Public Health" for waste water and public health)Not damage and restoration of lifelines - service to power (lighting, heating) water and waste water (including sewerage), unless public health emphasis in headline (would be "Not Infrastructure Damage & Restoration"...Not reduction in recovery aspects - e.g. hi-tech earthquake equipment in sewer rebuild (see "Construction methods or materials"). Not transport infrastructure – coded either in "Secondary Natural Hazards" (and their associated tertiary effects on infrastructure) or "Disruption". |

**Appendix Table 9.4d cont/: Earthquake!/Disaster! category story type descriptions – What's Happened/Being Done? group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| 52 | | Search & Rescue | Story subtypes include a progression from Miracle Rescues, International team arrival or New Zealand USAR team departure, Search and Rescue (SAR), Updates on search progress with descriptions of the process, a subset of Survivor/Victim stories that focus on hope and gratitude for rescuers' efforts, Rescuer interviews/stories, with rescuers portrayed as heroes, stories about search & rescue dogs, hopes fading of finding live survivors, USAR team departure from disaster zone, transition to, and then end of (body) recovery. (Many articles cover damage & damage assessment in body text). "New Zealanders Missing" stories may also include information about international search and rescue efforts or Trapped. International events will emphasise any New Zealanders, Australians or perhaps British found alive. For technologies used in SAR see "Technologies in EM". For any stories that emphasise medical treatment during rescue as well as afterward see "Emergency Medical Treatment". Stories that focus on thanks for search and rescue effort are in "Awards, Commendations & Thanks". |
| 53 | | Emergency Medical Treatment | Articles about injuries, or demand for, and actions of first responders general practitioners (GP) or emergency ward health professionals. Also articles about continuation of other health services. |
| 54 | | Burying Dead | This is a story set for International Disasters, part of the reported response process where the focus turns from search and resuce to body recovery and funerals. |
| 55 | **Environment in Response** | About or Assisting Animals | There are two types of stories about animals and those who care for them 1) Survival or Death - About animals who have (miraculously) survived the earthquake. This includes headlines naming new-borns after the earthquake (e.g. Richter the kiwi). 2) Stories about individuals caring for animals after the event; most often vets, and/or animal welfare NGO representatives. This code is not for animal behaviour prior to shaking (see "Forecasting & Prediction"). There are also some animal-related "Search & Rescue" stories. |
| 56 | | Other Environmental Response | Stories about damage to the environment and immediate actions taken to protect the environment. |
| 57 | **Economic Response Initiatives** | Business Response Initiatives | Business, Financial & Employment-initiative in response. Includes emphasising that businesses still trading and promoting New Zealand as 'safe'. Not business corporate social responsibility or mutual aid, i.e. goods, fundraising or donations (see Aid, Volunteers or Solidarity). Key infrastructure restoration and return to normal are in "Infrastructure Damage/Restoration" and "Return to normal/resilience". |
| 58 | | Government Assistance | Government grants such as wage subsidies and other financial assistance. Includes government assistance packages for rural and small business, accommodation package, and funding for psychosocial recovery. If long-term should be coded as "Government Recovery Initiatives". |
| 59 | **Response-Built+** | Schools Closed, to reopen | Education Minister or schools or tertiary institutions advising of school closure or likely time to reopen reopening. Coded as "Return to normal/resilience" if normalcy and reopening is stressed. |
| 60 | | Disruption | Event cancellation, venue change or transport issues. (Venue changes either due to building damage, restricted access or to a decision to let Cantabrians concentrate on response and recovery). Built and social effects of earthquake, including cancellation or postponement of events, time and other transport issues (roading damage, flights & traffic). For sporting event disruption or venue damage that is mentioned in sports stories see "Sport"). Does not include supplies and food distribution, which has been included in "General Emergency Management". Readers also learn about what has been disrupted from "Return to Normal/resilience" stories. |
| 61 | | Infrastructure Damage/Restoration | This story type is about information about service infrastructure damage, disruption, demand or likely duration to infrastructure restoration where there is no public health or safety issue emphasised. For these see "Environment & Public Health" or "Infrastructure & Public Health". |
| 62 | | Cleaning Up | Stories about the official efforts to clean-up or clearing of debris (rubble from built environment and/or natural from rock-fall, liquefaction or spread by tsunami). Not stories relating to volumes of waste or recycling (see "Recycling or Not"). Removing silt from liquefaction from gardens and roads may be framed as "New Zealand Relief Volunteers" or "Survivor/Victim Stories" |
| 63 | | Building Assessment & Decisions | Building assessment & stickering, stabilisation or demolition general. Stories include those about building Assessment inspection process and performance and difficulties posed by aftershocks. Stories about which buildings, the number of buildings to be demolished (includes churches & cathedral damage) and reasons for demolition and about assessment and stabilisation process. Not debate re heritage buildings, where there is deliberation regarding the pros and cons of demolition and preservation of historic buildings (see "Heritage Building Matters", nor post-event "Strengthening" see Safety, Strengthening & Construction). This includes reports in ODT of DCC checking dams in Dunedin for earthquake damage. |
| 64 | | Insurance Claims Process or Repairs | Insurance claim issues for individual home-owners, business and councils. Discovering that cover did not extend to meet needs (e.g. depopulation cover). Includes "this is a new insurance event' stories. Not "Insurance Claim numbers or costs". Not "Insurance Problems" (see Disaster Cause/DRR Review Category. For implications on "Future Insurance or Reinsurance" see below in DRR Options Category. |
| 65 | | Housing, Homelessness or Shelter | Social consequences of building damage - shelter in Hagley Park or welfare/relief centre, homelessness or being displaced, housing/rental crisis in Canterbury or elsewhere in New Zealand, issues re tenancy agreements and possibility of rent relief. Harms/Benefits-Homelessness/displaced, Housing/rental crisis, Tenancy agreement/rent relief. Includes night in Hagley Park. Only one for TV - Auckland housing shortage! Temporary relief shelters may have been shown in latest updates. Long term housing issues in "Recovery Progress" or "Rebuild Logistics/Rebuild Progressing" depending on whether a concern, or not (respectively). |

**Appendix Table 9.4d cont/: Earthquake!/Disaster! category story type descriptions – What's Happened/Being Done? group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| | **Aid, Volunteers or Solidarity** | | Compassion and goodwill, donation of goods and financial aid and time for relief work. Not "Search & Rescue". Fundraising, donations, clean-up volunteers, volunteers-general, solidarity (includes two minutes silence and media event such as Breakfast for Canterbury) and world leader condolences, international assistance. Also individual response coping - resilience. For International media this also becomes Orphans. B There are also a few Aid, Volunteers & Solidarity-related stories in Sport. For the International Aid & Solidarity - includes military & medical volunteers, SAR team departure and return. Includes volunteer engineers (unless emphasises "Building Assessment & Decisions"). Not government financial assistance (for which see "Government Assistance" or "Government Recovery Initiatives") neighbours/community- solidarity and morale in community/Cantabrian spirit.). Not sporting personalities assistance & fundraising (see Sport). Remembrance but not "Commemoration & Memorial"). Not "Awards, Commendations or Thanks" (for relief). Calls for aid coded as "Doing Better/More in Response". |
| 66 | | Fundraising/Donations by New Zealanders | Includes good donations, and funds distribution by individuals in the country of the analysed media, or expats from that country. Includes donations 'in kind' e.g. dentist giving free treatment, or well owner giving out water. Not issues relating to funds distribution or relief fraud (for which see "Aid Issues"). |
| 67 | | Outstanding International Individuals | Outstanding fundraising efforts by individuals from overseas. |
| 68 | | International Aid | Fundraising/Donations by individuals from countries other than the country where the event occurred. In the case of an International event stories of fundraising by those of nationality where quake occurred - e.g. Chinese for Sichuan are coded as International Aid. Accidents to aid transportation and orphans in Haiti are (International) "Aid Issues". |
| 69 | | New Zealand Authorities' Aid | Calls for and pledging aid at government level, Aid departing for, or reaching disaster area, particularly if international. Only funds for international disasters. Not rates relief, or other financial assistance for New Zealand disaster (see "Government Assistance", not medical teams (see "Search & Rescue"). If emphasises military coded as Military Aid. About International relations when going overseas or about regional relations - e.g. Council, Police or Fire Service from other regions going to the assistance of Cantabrians, or assistance centres for quake evacuees. (Note Councils in New Zealand play a lead emergency management function.) |
| 70 | | New Zealander Relief Volunteers | Clean-up volunteers. Includes medical volunteers arriving, not Emergency medical treatment. May also include stories about staff from Councils who volunteered to go to Canterbury to assist in infrastructure repairs albeit in paid capacity. Includes aid workers returning to New Zealand, including medical aid stories, unless medical treatment is emphasised |
| 71 | | Leaders & Aid | Leaders promoting aid for other countries or their own in disaster. Not foreign dignitary visits (see "Leader Visit" in Recovery Milestones group). |
| 72 | | Celebrity Involvement | Celebrities' (typically sporting and entertainment industry) involvement in fundraising and other aid projects (e.g. clean-up) where the focus is on their involvement rather than the fact they are a relief volunteer or fundraising. |
| 73 | | Businesses Helping Out | Corporate Social Responsibility (CSR) - businesses fundraising to assist those affected, or other types of assistance from free fuel, grace period to pay bills, to free mentoring of small businesses. Not praise for companies assisting with response or recovery (see "Awards, Commendations or Thanks"). |
| 74 | | Schools Pastoral Care | Education beyond emergency response closures (see General Emergency Management) and reopening advice (see Return to Normal). For example pupils moving to other schools, Pastoral Care is in Aid, Volunteers or Solidarity. (Note that there are also other education-related mentions also brief mentions in Other Education articles.). Other Education topics not coded here are stories within "Fundraising/Donations by New Zealanders" or "Solidarity, Compassion & Community Spirit" stories that come from reporters on the Education beat (re pupils' solidarity). |
| 75 | | Accommodation/Break Away | These articles are about offers by individuals form other regions of accommodation, they show solidarity by those offering the aid, and also the psychological need for a break away. |
| 76 | | Military or Police Relief/Aid | Police/military assistance where it is not crime-fighting (for which see "Antisocial Behaviour & Law Enforcement"). Emphasis on military or police assistance in Relief as opposed their playing an enforcement function - includes aid drops. Have included articles on messages of solidarity from Kiwi military serving abroad. Military withdrawal from aid zone is however coded in "Return to Normal". |
| 77 | | NGOs and Aid | Stories surrounding international events that NGOs face such as compassion fatigue. How much use there is of welfare offered. Management issues such as resources being stretched or other charities needing to adapt to the fact that fundraising is going to disaster cause - and in CHCH case ODT - trademark breach for using 'Kia Kaha'. |
| 78 | | Leader Condolences | Headlines of messages of condolence by international leaders |
| 79 | | International Solidarity | Headlines conveying solidarity through gatherings overseas - for domestic gatherings see "Remembrance" |
| 80 | | Solidarity, Compassion & Community Spirit | Support and solidarity for others - nationally or internationally. Includes granting of extensions of time for completion of projects and stories of solidarity between schools and positive effect on students elsewhere. Also sporting bodies compassion in allowing recruitment of other players from outside area etc. |
| 81 | | Remembering | Domestic gatherings or tributes - vigil, prayers, minutes silence, tribute - if in recovery "Commemoration or Memorial" |
| 82 | | Thanks for Relief | Headlines conveying gratitude for solidarity, compassion, search and rescue or other actions in response. |

**Appendix Table 9.4e: Road to Recovery category story type descriptions – Recovery Assessment & Initiatives group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| 83 | Environment in Recovery | Environmental Rehabilitation | Decision to remain in affected location (e.g. Canterbury) or relocate. A mixture of human interest stories and data/science suggests/shows. Includes those wanting to relocate for safety reasons, to escape aftershocks, or for ability to 'move on' quickly, through to those who are reluctant, or refuse to relocate. Displacement, depopulation, migration, exodus . Also reverse migration - other regions moving to Christchurch. This set of stories occurred in the response period of the February 22 event but much later after the Darfield earthquake. Includes stories about sports people, students or artists who have moved to Dunedin in ODT. If specifically about students code as "Students Staying/Going". |
| 84 | Social Issues & Adaptation | Staying/Going | Staying/Going stories with an education sector emphasis. In communities outside that affected (ODT has many of these stories) these are stories about particular schools and students or overall numbers of students moving to or staying in region for schooling. |
| 85 | | Students Staying/Going | Injury rehabilitation. Determination to succeed in recovering from physical injury, life as amputee. Includes return home for badly injured. |
| 86 | | Injury Rehabilitation | Advice as to how to cope with earthquake-related stress. This may be from clinical psychologists, counsellors, or non-expert suggestions on easing stress through sport, or retail therapy (the latter a popular culture suggestion that occasionally comes up). Includes suggestions re dispute resolution. Not included are long-term resilience suggestions (see "Community/Health Preparations"). |
| 87 | | Ways to Feel Better | Voluntary assistance with rebuild or physical rehabilitation, including long term philanthropic trusts, UN endorsement of projects, locals involved in projects New Zealand Authorities involvement announced in response phases ODT) |
| 88 | | Aid Projects in Recovery | These stories are about recovery realities and adaptation in recovery. They are human interest stories that while they will tell of recovery performance and living conditions are not "Recovery Progress" reviews. These are in effect the bulk of personal interest or 'Survivor/Vicitim Stories" but in recovery rather than response. The stories are about citizens and how they are faring in disaster recovery, what they are doing to cope with recovery, including art created. Also stories of marriage after quake. Not "Celebrity Visits" to see damaged areas in recovery or "Change in Luck" or "Double Disaster" stories (see Recovery Milestones for latter two). |
| 89 | | Citizens in Recovery | Decision to remain in affected location (e.g. Canterbury) or relocate. A mixture of human interest stories and data/science suggests/shows. Includes those wanting to relocate for safety reasons, to escape aftershocks, or for ability to 'move on' quickly, through to those who are reluctant, or refuse to relocate. Displacement, depopulation, migration, exodus . Also reverse migration - other regions moving to Christchurch. This set of stories occured in the response period of the February 22 event but much later after the Darfield earthquake. Includes stories about sports people, students or artists who have moved to Dunedin in ODT. If specifically about students code as "Students Staying/Going". |
| 90 | Issues & Adaptations Built+ | Rebuild: Plans & Vision | Rebuild (housing & infrastructure) or CBD (incl visioning. Also recovery legislation to speed up process... includes building back better |
| 91 | | Land Decisions | Land Zonation, Land Use & Land Remediation and associated geotechnical reports & decisions. (For emphasis on delays and progress coded as "Recovery Progress" For concerns at transparency and freedom of information see "Reviewing Communication"-Info Release. Debate, and assessments relating to division of the city into coloured zones according to the scale and category of damage suffered and assessments as to future building viability. Planning in terms of land zonation, future land use, remediation possibilities for liquefaction or rock fall - authorities intitiatives that policy or decision-makers commented on (e.g. mayor or minister), key announcements - includes research. Where the emphasis is on the governments' payout plan more than the geotechnical land use decision see "Rebuild Logistics/Rebuild Progressing". For articles where the decision on build on lands severely damaged by the "Reviewing Awareness" for lack of information and confusing reports about the decisions. See "Recovery Progress" for articles about land decisions that emphasise the wait for decisions. |
| 92 | | Recycling Earthquake Waste (or not) | Recycling building waste, reusing red-zoned homes or making new products from waste (e.g. silt) & other sustainable practices, or stories about the dumping of waste. |
| 93 | | Rebuild Logistics/Rebuild Progressing | Stories about deals signed or actions put on hold, stages of the rebuild, details of deals and descriptions of the transformation due to the rebuild. Includes stories that in response would have been "Housing, Homelessness & Shelter". Not shortage or otherwise of trades (see "Skills Shortage") or review of the progress of recovery (see "Recovery Progress"). Includes what in response were "Infrastructure & Public Health", "Environment & Public Health", and "Building Assessment & Decisions" story types but have not 'gone wrong' (in the latter case see "Recovery Progress" in Disaster Cause/DRR Review group) |
| 94 | | Skills Shortage | Articles that identify issues related to appropriately skilled labour-force for rebuild or possible solutions. |
| 95 | Economic Recovery & Adaptation | Business Recovery | Long term negative effects on regions, and sectors (e.g. rural or tourism) or specific businesses or industries as well as suggestions of boom and return If return to normal is emphasised see "Return to normal/resilience". |
| 96 | | Economy in Recovery | Also rent/tenancy issues. (Advice re dispute resolution in "Ways to Feel Better"). In brief mentions cost of recovery/rebuild used by government Ministers to explain other funding decisions. |
| 97 | | Business Recovery Initiatives | These stories tell of new way of doing business, technology used or collaboration to prompt or speed up business recovery . Such things as working out of mobile premises or promoting or bolstering tourism . See also recycling or not- reusing homes or making products from waste. Shops reopening and Businesses returning to normal, see Return to Normal. |
| 98 | | Government Recovery Initiatives | Any government assistance more than three months past the date of the quake, or long term financial interventions - e.g. cut of official cash rate (OCR). |

**Appendix Table 9.4f: Road to Recovery category story type descriptions – Recovery Milestones group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| 99 | Events in Recovery | Leader Visit | Headlines announcing or describing the official visit of a leader to a disaster zone, or focus on the leader in describing attendance at a "Commemoration or Memorial" or "Remembering" event. |
| 100 | | Celebrity Visit | Celebrity visitors are typically internationally known individuals visiting foreign disaster zones. The emphasis here is on the tour of the most damaged zones. There may be no obvious link to fundraising or rebuild project. |
| 101 | | Return to normal/resilience | Rather than comment on Recovery Progress as above this is announcement of a specific event in Recovery that showcases the city's resilient spirit or a return to normal. 'Use of term 'normal'. State of emergency lifted, welfare centres close, business as usual, business, mall, recreational facilities or shops reopening, schools reopening, return home for evacuated residents (e.g. Port Hills), event attendance as normal (e.g. A & P show).Articles about infrastructure being restored where the emphasis is on return to normal not repair progress. Not easing of cordon unless stresses return to normal. Not rescue team departure where these are more (TV) angled at giving up hope and transition to recovery than a return to normalcy. For international stories this impression of return to normal is marked in the New Zealand media as the military withdrawal. |
| 102 | | Commemoration or Memorial | This story set includes the description of any event in commemoration of disaster while on the recovery period of that disaster) otherwise see "Historic Commemoration". For example in the Canterbury example there are articles re the memorial service timing debate controversy, who involved (including celebrities), the memorial itself in Christchurch (and before and after perspectives of Brownlee, Beck, Parker & citizens) and other national or international marking of the event. Royal visit (Prince William) for memorial service. Also Red Zone Tours. Other - e.g. physical memorials including mass grave for unidentified victims, switching on of White Lights of Hope, and prayer for and honouring of victims, and mementos - e.g. jewelry. Books commemorating the event are "Media/Communication or Awareness". Another type of event commemoration exists in "End of Year" stories. Two Minutes Silence shortly after the event is coded as "Remembering". |
| 103 | | Change in Luck | Change of fortune since involvement in an earthquake event. These recovery stories emphasise, later good news, a 'silver lining' turn of events', for example wining lottery or there being less damage than initially expected. |
| 104 | | Double Disaster | Stories about a new event that affects a survivor of/recovering from a previous event. |
| 105 | | Political in Recovery | General political interviews, announcements from two weeks after major event. Bipartisan approach; political parties working together in Recovery, and general comments on each others' general approach to Recovery. Announcements regarding and comments on recovery leadership. Effect on local body and national elections e.g. Mayor Parker's leadership secures mayoralty win. Not about grants - see "Government assistance", Government financial assistance, "Leader visits" or opposition party's quake levy plan (see "Future Insurance or Reinsurance"). For articles about, enactment, and review of recovery laws see "Recovery legislation". Not "Reviewing Authorities' Preparation", "Doing Better/More in Response" or "Reviewing Construction & Codes". |

**Appendix Table 9.4g: Disaster Cause/DRR Review category story type descriptions**

Keywords for DRR Review media articles include: accountab(le/ity), agenc(y), avoid, bad, cost, benefit, dangerous, fail(ed), ineffective, inquiry/Commission, issues, less(on)/learn(t), needs an overhaul, not up to standard, review, so long/delay/, (aren't/weren't) safe, (why) building(s), collapsed/building failure, why didn't, went right/worked well/went well, (what went) wrong

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| 106 | Contributing factors | Reflecting on History, Cause | Considering the cause of disasters - either the event itself or factors contributing to exacerbation of effects. For example may be cause of recovery problems, such as "History shows obstacles can block Haiti's recovery" ODT. Includes ODTs 'Faith & Reason articles - |
| 107 | | Fatalistic Beliefs | Any fatalistic beliefs about earthquakes and disasters (references to miracles, luck, god, implications that there is nothing that can be done to reduce damage and destruction from earthquakes and other natural hazards). Also headline references to unproven theories about earthquake cause such as including solar flares as link to earthquakes. Includes fatalism to prepare. |
| 108 | | Liability, Litigation or Inquiry | General blame or calls for inquiries and suggestions of suing. Also general procedural matters re inquiries (not findings) (may include response or recovery, though not generalised comments about performance in event. Not code compliance - see "Codes, Standards, Polices". |
| 109 | | Inquest/Cause of injury | Cause of death or injury, typically through inquest findings |
| 110 | Reviewing DRR Measures | Reviewing Communication | There are three story subtypes in the Reviewing Communication set. These are 1) Warnings: warning procedures, communication of warnings and science behind warnings, 2) Info Release - freedom of information and government transparency 3) Media coverage of events |
| 111 | | Lessons or Reflections | Includes recovery lessons from previous events – e.g. delegation to San Francisco and recovery lessons learnt from other earthquake disasters (e.g. Napier and San Francisco). Editorials, opinion pieces by experts, columnists/media bloggers. Could be New Zealand research team involved in international event (though there were no stories framed this way in the period analysed). Reflections re decentralisation see "Development, Levies & Financial Incentives" |
| 112 | Reviewing DRR Measures - preparation | (Un)prepared Citizens | Findings of polls and surveys that citizens/society are (un)prepared for disasters. |
| 113 | | Reviewing Authorities' Preparation | Assessing authorities planning and preparation, safeguards etc. |
| 114 | | Citizen Awareness & Cultural Memory | Reviewing response and rescue. Articles that relate to issues citizens have with response or rescue practices or businesses or recovery service providers that are not insurance related (see" Insurance Problems"). |
| 115 | Reviewing DRR Measures - response | Doing Better/More in Response | Criticism relating to funds distribution (explanation of how funds are distributed is "Background/Expectations". Antisocial behaviours in response to aid including scams, aid on the black market, or whether orphans being kidnapped. Also included are incidents involving aid storage and transportation. |
| 116 | | Aid Issues | Awards and Commendations relating to Research, Response or Recovery. Includes general praise or thanks for aid, volunteer relief efforts, stories of praise for rescuers, of general resilience, the efforts of companies in response and professional emergency management efforts. |
| 117 | Reviewing DRR Measures – reduction | Awards, Commendations or Thanks | These stories emphasise citizen awareness through cultural memory and either rate it as having saved lives, or evidence of need to communicate risks better. |
| 118 | | Reviewing Construction & Codes | Expert reviews or perspectives in inquiries or research reviews or as part of official review of construction and building code. General (especially pre-inquest) comment on reasons for building collapse are in this category. If the finding is and emphasis on unsafe, or safe this should be coded as a Warnings-built environment "At Risk: Buildings (or infrastructure)" |
| 119 | | Heritage Building Matters | About demolition or preservation specifically of heritage buildings. Consequences and initiatives-social and built-heritage not closures or evacuations. Includes strengthening when it is described as a disruption. |
| 120 | | Reviewing Land Use | These are stories that question previous decision-making about land-use, and whether concerns about hazards and vulnerabilities have been adequately considered. |
| 121 | Reviewing DRR Measures-recovery | Insurance Problems | Not "Future Insurance or Reinsurance". Problems that citizens have with insurance companies. Also in reverse, problems that insurers have with claimants - e.g. allegedly false and therefore rejected claims, or proven fraudulent claims. |
| 122 | | Recovery Progress | Issues with recovery living conditions or performance, issues with rebuild timeline. Includes general living conditions in recovery, general demolition and rebuild progress. Also engineering-cost planning/budget blowout. Includes what in response were "Infrastructure & Public Health", "Environment & Public Health", and "Building Assessment & Decisions" story types but have 'gone wrong'. Includes articles marking three-, six-month or one year anniversary that headline recovery problems. |
| 123 | | Recovery Legislation | Implementation of, and reviewing recovery legislation |

**Appendix Table 9.4h: DRR Options category story type descriptions - Approach to DRR group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| 124 | **General** DRR | Supporting Research or not | Research awards, financial backing for any DRR research, or funding bid failures. Calls for research. |
| 125 | | Sustainability | Articles headlining sustainable DRR options |
| 126 | | DRR is costly/Good Investment | Investment in DRR - whether costly or considered to be good value. Also defiance over policies regarding strengthening of properties nowhere near the standard of current building code. |

**Appendix Table 9.4i: DRR Options category story type descriptions - Reactions to Warning/Risk group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| | **Evacuation** | | Evacuation in the broadest sense of the term; on authorities' advice, self-evacuations, search for information about warning/risk. Includes evacuations on identification of rockfall risk or tsunami warning and from buildings (as "Restricted Access"). Not discounting or ignoring risk |
| 127 | | Restricted Access | Authorities advice and info re cordon or evacuation, and comments on restricted access. Articles about cordons and business access, public safety implications, general, cordon reduction, safe zones or routes through red zone, Cordon in place. Not breaches of, or policing of the cordon. Includes stickering and citizen right to stay in home. Not red stickering of individual buildings - see "Building Assessment & Decisions". |
| 128 | | Fear, Flee or Panic | Stories mentioning fear, alarm, or panic or actions such as fleeing on short-term warning or initial shaking; some element of implication that reaction is irrational. Includes last minute warning and immediate reaction to quake - fear, fleeing, evacuation on event. Not reports of calm or considered evacuation or other safety reaction (which would be "Rational Reaction"). Also not, not heeding tsunami warning (which would be "(In)action"). |
| 129 | | Rational Reaction | Evacuations on identification of risk (e.g. rock fall or tsunami) warning that does not occur in response phase (in which case "Restricted Access"). Also self-evacuations on warnings. Information seeking is a rational action. |
| 130 | | Code compliance | Headlining council enforcement of policy regarding vulnerable buildings. |
| 131 | **Discounting Risk** | (In)action | These stories relate to media reporting of citizens or authorities discounting of risk in direct reaction to a recent warning. For other discussion of risk discounting see also "(Un)prepared" which are reviews of general preparedness. |
| 132 | | Don't Worry (Authorities/ Experts Denial of Risk) | These are predominantly reports of authorities reaction to pseudoscientific forecasts; predictions that are not recognised by the scientific consensus or institutions advising authorities, but may include reassurance when experts downplay risk identified by a scientific study. |

**Appendix Table 9.4j: DRR Options category story type descriptions - New Policies or Procedures group**

| No. | Story SUBGROUP | MEDIA HEADLINE STORY TYPE | Category, Group, Subgroup and Story type Descriptions plus subtype introduction where applicable |
|---|---|---|---|
| | **Built Mitigation +** | | About achieving safety, strengthening, and construction of the built environment - about construction methods and materials. Mitigation or avoidance - closures for, or successful closures (Not council rules for closure see "Codes, Standards, Policies"). Strengthening of at-risk buildings including seismic strengthening by individuals, MCDEM/CDEM initiatives excluding response phase. Includes preparedness of infrastructure. Scientific testing of foundations, and technology. Register earthquake prone buildings. New Buildings with earthquake resistance |
| 133 | | Construction methods or materials | Construction methods and materials (not infrastructure) - from cladding solutions to retrofitting. Newly completed buildings with innovative/cutting edge DRR technology. Not "Strengthening" in headline. |
| 134 | | Safety Assessments/Soil reports | About safety assessment - assessments that do not occur in area of quake occurrence in response - not emphasis on what will do afterward, or an emphasis on whether risky or safe (for latter see warning or "Don't Worry") |
| 135 | | Strengthening | Articles that focus on possibilities in retrofitting or strengthening, or related projects that are planned or underway. Not general debate on "Heritage Building Matters". |
| 136 | | Codes, Standards, Policies | Initiatives and actions to reduce seismic risk, including compliance. Generally about government legislation - e.g. building code, soil report before building, whether compulsory or not. Includes deadlines for strengthening. Includes notes on council Land Information Memoranda (LIMs), and council policies on strengthening, evacuation, building closure, other district council initiatives, earthquake prone building register. Not resource consent hearing (see "Development Hearings"), or building closures (see "Closures"). |
| 137 | | Closure | Closures without emphasis in heading of 'strengthening' in which case "Strengthening". The implication is permanent closure or closure for demolition decided outside of event response or recovery (in which case coded as "Building Assessment & Decisions"). Includes chimney removal. |
| 138 | | Development Hearings | Resource consent (RMA) hearings for building or infrastructure development. |
| 139 | | Infrastructure Upgrade | Headline upgrading of infrastructure. Could include gas-shut-off valves and ensuing enough water supply. Not tsunami barriers (which is "Making the Natural Environment Safer"). |
| 140 | | Securing Contents | Articles focused on appropriate or successful ways of securing contents. |
| 141 | **DRR in the Environment** | Making the Natural Environment Safer | Removing natural hazard risks. This often occurs in response or even recovery period, for example removing boulders. Would include erection of tsunami barriers were this done in New Zealand. |
| 142 | | Land Use & Zoning | Stories focused on the opportunities to avoid risk through land use and zoning unless these are in Canterbury recovery (see "Land Decisions"). Not stories where this is reviewed "Reviewing Land Use". |
| 143 | | Monitoring or Warning Systems | Earthquake early warning (EEW) or tsunami warning systems. Also communication systems for emergency management. If the emphasis is on associated "Research Planning" see that story type. For associated funding will be "Supporting Research or not". |
| 144 | **Social Preparations** | Fostering Awareness | Stories about the promotion of disaster or natural hazard risk awareness through messages, books, media reports or campaigns, movies, documentaries or social media. |
| 145 | | Communication in Response | About communication systems or meetings in response. Includes response information co-ordination and the role of social media sites, including the latter being used by scientists as a data source, or crowd-sourcing of information. |
| 146 | | Recording for Posterity | Art, books, documentaries created about disaster events |
| 147 | | Household Preparations | Supplies, kits and other individual and household preparations and planning. Stocking supplies, preparing evacuation kits. Planning where to meet. Not consideration or planning relating to "Future, Insurance or Reinsurance". |
| 148 | | Authorities Response Planning | Civil Defence training and refreshers, stockpiling by authorities, and any planning by emergency services. |
| 149 | | Drills | Drills and other training. References to actions on event (e.g. Drop, Cover & Hold). Not performance in warnings and drills (see "Reviewing DRR Measures") |
| 150 | | Community/Health Preparations | Articles about possible social preparations. Possibilities from government social legislation to community resilience-building, or call for Red Cross volunteers. |
| 151 | | Technology! | This story type is about technology in DRR (except monitoring and warning systems). Mostly is technology used in disaster response such as earth observation technologies to assist authorities' decision making, or information technologies available to the public to assist in finding loved ones and services in disaster. |
| 152 | **Economic Preparations** | Future Insurance or Reinsurance | Reinsurance for insurance companies or rising costs of insurance and difficulties in gaining post-quake insurance - includes Council reinsurance. Also earthquake performance. Also considering cover for depopulation. Not possibility that quake prone buildings may not be insurable (see Development, Levies and Financial Incentives). |
| 153 | | Development, Levies & Financial Incentives | Any headline mention of development, levies or financial incentives to undertake DRR. Includes decentralization. |
| 154 | | GDP/Development Saves Lives | Headlines suggesting GDP or development saves lives or reduces injury. |
| 155 | | Financial Planning & Preparation | Business or government financial planning and preparations including for recovery. |

**Appendix Table 9.5: Keywords and keyword groups used in identifying and coding science articles**

| **Science headline keyword group letter, and name** | | **Science headline keywords** | **Media headline keywords** |
|---|---|---|---|
| | | | **Generic - Any Science in Society Issue** |
| a | science | discipline | particular **discipline** name - e.g. ogy or health, economic etc |
| | | expert | **expert**, international |
| | | scien/tist) | scientist, ist ... Dr, Prof |
| | | pioneer/history | **pioneer, history** and synonyms - e.g. breaking ground |
| | | technology | **technolog**y, e.g. design, satellite, warning system |
| b | results | quantify | quantify, numbers (digits given), count |
| | | | **data/fact** |
| | | | **report, result(s),** answers |
| | | identified | **identified -** find(ings), reveal, uncover, infer |
| | | qualify | duration - long/short, size, big, small, large, level- high, low, reduce |
| | | | superlative - best, worst, unusual, rare, extreme, exceptional |
| | | | comparative - bigger, smaller, better, worse, less, more, just as, increase, decrease, rise, fall, up down, drop, raise |
| | | record/report/ rate | record, report, rate, map, show(s/n), list, timeline |
| | | quality | quality, improve, effective |
| | | relationship | related, link, association |
| | | teach/lecture | explain, teach, lecture, talk |
| c | research & questions | research | research, study, poll, info(rmation), project, exercise, university, |
| | | questions | question(s) - what, where, when, why, how, who, |
| | | identify | search, hunt, probe, assess, look, test, check, identify, probe (inquiry is |
| | | | **mystery**, puzzle, challenge, secret, hidden |

## Appendix Table 9.5 cont/-

| Science headline keyword group letter, and name | | Science headline keywords | Media headline keywords |
|---|---|---|---|
| d | issues | issue_risk | **risk**, threat, danger, opportunity, scare, fear, panic, alarm, terrify, struggle, face |
| | | issue_ Health & Safety | **health/safety** (save lives), death, injury, harm, medic(al/ine), hospital, casualt(y/ies), illness, disease, trauma, emergency department |
| | | issue_awaiting decision | **delay,** on hold, wait, in limbo, uncertainty, disagreement |
| | | issue_controversy | **dispute**, debate, controversy |
| | | issue_problem (other) | **problem**, unfair, vulnerable, synonyms |
| | | | environmental/social - taint, choke |
| | | | social/built - collapse, ruin |
| | | | hit/strike - see also other earthquake issues |
| e | responsibility | event | **review**, inquiry, inquest, hearing, commission, trial, judge, performance, audit, charge |
| | | results of review | expected, fail, known, expected, unsurprising, robust |
| | | blame | **blame**, cause, reason, link, change, concern, issue, claim, sue, fail |
| | | cost:benefit | cost, benefit, loss, gain |
| | | | lessons, learnt |
| f | decisions/ opinions | decision | **decision**, option, fate, right, feasible |
| | | forecasting | predict, **forecast**, chance, possib(le/ity), probable, sign, sceptic |
| | | possible | likely, expect, could, would, will, may, might, requires, needs, never, no not |
| g | information | information | info(rm) - most |
| h | advice | advice | advice/se), urge, told/tell, need to (and other imperative statements) |
| | | warning | **warn**, assure |
| | | restrictions | **restrict**/ban, off limits, notice, requirement, must, don't, stop, heed/ignore |
| i | legislation /political | legislation | legislation, law, policy, code, standards |
| | | planning | plan(ning) |
| | | political | Government, Ministry, Council, Crown, politic(al/ian), Prime minister (PM), election, leadership, official, authorities |
| | | | *NZ politician examples - Brownlee, Key, Sutton, Smith, Parker* |

| Science headline keyword group letter, and name | | Science headline keywords | Media headline keywords |
|---|---|---|---|
| i cont/- | | | *NZ authorities/institutional examples - GNS, EQC, (Earthquake) Commission, NIWA, CERA, Civil Defence* |
| | | citizens | residents, citizens, public |
| | | | Earthquake-disaster-related observations - eq and disaster or liquefaction, tsunami or fault + |
| j | Earthquake and disaster | Earthquake itself | quake, tremor, jolt, aftershock, fault, tectonic, plate, epicentre, shock, seismic, rupture |
| | | Disaster | disaster, emergency, calamity |
| | | quake location identifiers | Canterbury, Christchurch, Avon(side), Lyttleton, Darfield, Sumner, Port Hills, Brighton, Kairaki, Kaiapoi, Selwyn, Waimakariri |
| k | Effects | Of natural consequences | liquefaction, rock fall, air, water, dust, silt, boulder, rock, sieche, flood, tsunami, river, beach estuary, coast, environment, sea, bird, pollution, spill |
| | | Of consequences to built environment | damage, demolition, destruction (Canterbury buildings PGC, CTV, Forsyth Barr, Manchester Courts) |
| | | Of economic consequences | econ(omy/omic), insurance, claims, business, retail, GDP, interest rates, consumer confidence, tourism, jobs, lay-off, recession, growth, fund |
| | | Of social consequences | health (as above), heart, amputation, crush syndrome, surgeon, doctor, patient, survivor, stress, PTSD, shock, crime, survive, flee |
| | | | Earthquake-related issues - eq and disaster or liquefaction or tsunami or fault+ |
| l | Risk | risk | prone/resistant, safe, vulnerable/resilient, building susceptibility, fear |
| | | | Moon Man (prediction), Canterbury location + rockfall, risk elsewhere (e.g. Wellington), other forecasts |
| m | Response | response natural | waste, sewage, smog |
| | | response built | demolition, heritage/historic, rubble |
| | | | hous(ing), shelter |
| | | | sticker, check, assess, cordon, |
| | | response social | victim id/unid(entified), rescue, search |
| | | | stay/go (exodus, leave), return, open/close, delay |
| | | | aid, give, help, donate, relief, support, volunteer, advice |
| | | | crisis communication, media |

## Appendix Table 9.5 cont/-

| Science headline keyword group letter, and name | | Science headline keywords | Media headline keywords |
|---|---|---|---|
| n | Recovery | recovery | recovery, reconstruction, rebuild (fix), resolution (decision-making) resilience |
| | | recovery, reconstruction, rebuild (fix), resolution (decision-making) resilience | anniversary |
| | | | DRR ACTION |
| o | Risk Reduction | risk reduction (before disaster or in recovery | land zon(e/ing), land use, strengthen, retrofit, construct, foundations, remediation, clos(e/ure), design, resilience, prepare/ation) |
| p | | risk reduction | any from i) |

# Appendix 10: Summaries of interviewee responses

The following pages contain summaries of interviewee responses to Questions 2 and 3 of the survey: what people need to know and could be better communicated in New Zealand about earthquakes and reducing seismic risk.

-blank-

## Appendix 10.1: Interview summary narratives

Note that these are not quotes, but are key points made in interview, paraphrased by researcher to match terms used throughout the thesis, and have been accepted by interviewees as an accurate reflection of the interview.

I001- Simon Markham – Waimakariri Recovery Manager

The solutions, what we can do to manage risks, should be better explained. This includes not only preparedness, but adaptation and resilience - economic resilience and social cohesion. There needs to be communication of things that are 'action oriented' rather than only 'situation descriptive'. The value of holistic approaches to DRR needs to be communicated. The decision-making should have been better explained, particularly around land stability and performance. It would have been useful to have had clarified in the mass media the fact that while there are treatments to mitigate against certain types of land damage in areas susceptible to liquefaction, and buildings can be made more resilient through design and construction of their foundations, liquefaction itself cannot be prevented. The costs of seismic strengthening and land use treatments could have been better explained. Another area that could have been communicated better is building science and building performance, the determinants of structural stability, and whether the differences in damage sustained were due to differences in the application of seismic engineering or simply due to the economic choices made. We should be careful about how risk profiles are communicated - and that's not necessarily only about the worst-case scenario of one event, but the cumulative effect of a number of events. People need to be reminded that it is unhelpful to label documentaries such as the 1996 about liquefaction and the potential impact of earthquake on Christchurch 'alarmist'. People need to understand that DRR is about more than response. They need to be made aware of the importance of reflective thinking in recovery, and the dangers of not bringing into our decision-making an awareness of the implications of the decisions that we are making. Cantabrians needed more knowledge about expected psychological responses to the earthquakes, preventative self-treatment, and where and how they could get other treatment. Other communities' experience of earthquakes and other disasters, and the lessons learnt they have learnt need to be explained, with a discussion of how they are being codified and turned into a new set of DRR actions.

I002 - Richard Ball - Canterbury City Council Strategy Support

Understanding the geoscience prior to the earthquake would have been useful to help awareness, but unlikely to change behaviour. What might have changed behaviour is knowledge about what to expect - the hazard effects (like liquefaction, flooding, rock-fall). The geoscience after the event is quite different in that people are hungry to understand and come to terms with what has happened. It's hard for people to understand and comprehend probabilistic statements in a rational way - there needs to be more explanation of specific risk exposure and risk scenarios. In terms of liquefaction it would have been useful to know not only that it can happen but about the sand, the dust. The duration of likely aftershocks should have been better explained, as could the possibility of there being another major event after September 4. More information about the types of psychological effects that other communities have faced would be useful rather than only immediate public health messages. Understanding the cost:benefit arguments around heritage buildings would be useful. Whether people would support retrospective strengthening of other buildings or to achieve new building code compliance if the costs were made clear in the media is an interesting question.

## Appendix 10: Interview summary narratives – cont/-

I003 – Chris Mene - Community Board Chairperson from Canterbury

After an earthquake people want to know the reality, what, how big, where the epicentre was, the impacts - this information gives them security after an event. Information in crisis is very important - particularly about practical matters, and how to cope - the psychology, which should be backed up by lessons learnt in other communities. There could have been better explanation of the necessity for cordons and evacuation in case of building collapse. In crisis there are a wide variety of information needs. While mainstream media cannot be expected to give detailed information at the local level they could provide links to that information. It was good to have aftershock forecasts once these were more openly reported - it meant we could choose to go out and to do something physical to prepare if we wanted to and that made us feel better. It would have been useful to give tips as to how to prepare along with the forecasts. There was generally an absence of key messaging in the preventative space. Small events that occur now could be used as triggers for prevention messaging. Before the quakes it would have been useful to have more information from structural engineers about likely building and infrastructure performance and the value in land-use planning measures - for example the reasons for setbacks along waterways. In recovery it would be extremely useful to have simple, evidence-informed explanations of the decision-making about the built environment and infrastructure - 'We have new building standards because... You will start to see these [mitigation] features because...". There is a need for evidence-based and evidence-informed information, presented very simply –clever graphics, videos, and Youtube. This could be descriptive (e.g. timelapse of Canterbury over 12 months of what happened), or simple messaging about geotechnical reasoning behind decisions relating to built environment and infrastructure such as "the land is likely to continue to move, and therefore individual pump sewerage units are needed".

I004 Peter Townsend Canterbury Business Leader - CEO of the Canterbury Employers' Chamber of Commerce

Planning at a household and business level is very important. First off there need to be plans for contacting each other in crisis. Realising the value of connectivity in response and recovery is critical. Understanding insurance is very important. People need to know what works in recovery the lessons learnt from other communities who have recovered from disasters. People need to know that recovery will take a long time, but it is an opportunity to look to the future not the past, to embrace new ways of doing things that disaster taught us we could do, and to be part of creating a new city, and that is exciting. Every communication that mentions preparation should link to, or reference to, 'Yellow Pages'-type information. Communications should create an environment of certainty, and allow decision-making – for example "When am I going to rebuild my fence? We're unlikely to get another 6, we might get a 5 but I'm building it to withstand a 5... "People want certainty, and certainty doesn't have to be good news, certainty can be bad news… and then underpinning certainty is science accurate information and good information, good exemplars of how to construct, and knowing what to do with your foundations, knowing the options you've got with your rebuild. People need to understand that the best performance measurement of recovery is what their grand-children say in future about living, working and playing in Christchurch.

## Appendix 10: Interview summary narratives – cont/-

I005 – Rose George - Female public from Otago (not directly affected)
The more information the better. Survival actions are the most important thing for people to know. Next most important is that they need to be as prepared as possible in terms of keeping warm, fed and clothed. What could have been better explained was that people would need to be self-reliant for such a long time. People need to know that aftershocks can have as many consequences as the major one and that damage can be exacerbated by aftershocks. They also need to know how long aftershocks can potentially go on for - that typically isn't ever covered in the news of international events. The term aftershock is confusing, and how insurance defines what's an aftershock and what isn't. There are always going to be earthquakes so more information about buildings, and building codes and constructions of roads and bridges needs to be communicated. Liquefaction should have been better explained. People need to understand and plan for supply issues in the response phase.

I006- Dr Hugh Cowan - EQC Research Manager – Wellington
In an average New Zealander's lifetime there is likely to be a strongly felt or destructive in an urban setting in New Zealand. What is needed is awareness of the potential consequences of an earthquake and information that provides a basis for informed choice for survival and avoidance actions. We could do with public discussion about the way we frame our building controls and how we articulate them. Citizens would profit from knowledge that informs their choice of where to live and work, from understanding their risk exposure, and what they can do to control it. Information as to how they can mitigate the financial consequences would be useful - for example the cost of mitigation or risk transfer (insurance). Information that allows citizens to make risk cost:benefit trade-offs is necessary - Am I better off spending money on insurance premiums rather than the capital cost of securing foundations? Am I willing to accept or live with the prospect of some damage and temporary loss of amenity? How much risk am I willing to accept or retain? We are nowhere near having an honest conversation about how to optimise the options in managing risk, how much to transfer, how much to control, how much to avoid. Part of the problem is that the way in which we've set out our building controls as a proxy for consumer protection is largely geared around the channelling of liability. A focus on compliance will drive performance to minimums. A focus on value creation will take you in another direction in risk management and its' communication.

I007 – Prof Michael Ardagh - Expert in emergency medicine involved in February 22 response.
Before an earthquake people need to know the types of geographical hazard they may face, and the likelihood of it happening so that they can prioritise preparation, and so that it is not a surprise when it happens. After an earthquake it is important psychologically for people to understand what they are seeing in the context of what has happened in Christchurch. People need to know appropriate survival actions - during an earthquake and beyond (against disease outbreak). Perhaps there could be more discussion in the media about appropriate types of first aid. Having legislation explained (not only when enacted) would be useful. There's been a lot of discussion about engineering, but less general education (than geoscience) e.g. about inspection and stickering processes and performance expectations. There should be more discussion about acceptable risk, risk tolerance and liability in risk management.

## Appendix 10: Interview summary narratives – cont/-

I008 – Dr Alistair Humphrey - Canterbury Medical Officer of Health

Preparation needs to be about taking an all- hazards approach, knowing your neighbours, supporting the vulnerable, and in a little more detail, about putting by supplies. It's not so important to convey the evidence for public health and other preparedness messaging. What we need to do is convey a consistent message telling people what to do. If you look at risk scientifically it becomes very difficult to prepare a community. The risk of dying in an earthquake is very low, and there is no way of predicting what will happen next. People should not be complacent about certain pats of the country – nowhere is safe in New Zealand. To motivate preparedness instead of saying 'if' you have an earthquake the message should be 'when' you have an earthquake. Another is about the possible consequences 'this is what your city will look like'. There should be more discussion and thought about tsunami risk. There is little value, even psychologically, in knowing that it was the Greendale Fault or how deep the earthquake was etc. Knowing about site geology, understanding geotechnical and engineering aspects of mitigation are very important so that at a policy level decisions can be made as to where to put collective resources for mitigation, what is most cost-effective for the country as a whole. However all individuals need know is that the legislation, the rules [building code and land use] have been followed. The public should understand that securing contents is affordable and that should be promoted more. Making CDEM surveys available so people know how different regions are preparing might be useful.

I009 – Francis Wevers - Wellington-based advocate for the Canterbury recovery

Most people see the mass media as noise, young people don't listen to or read news, and even if told things are unlikely to prepare. Nevertheless MCDEM should be using events (local and international) to remind people about risk in New Zealand, and possibilities in risk reduction. Scientists and Crown Research Institutes have a responsibility to articulate that New Zealand is at high risk of earthquakes everywhere. Other than information about response people need to know the likely duration of a seismic event and the likely duration of recovery. It would be nice to have more reflective pieces about recovery. People need to know that they need to take personal responsibility for preparation, including having emergency supplies (for more than a week). MCDEM should be using events to remind people about risk in New Zealand and possibilities in risk reduction Beyond that perhaps there is value in understanding that the reality is that we prepare for lower levels of risk than 100%. There should be better articulation of the reasons (including science) for why we get to decisions … for example building standards and land use decisions. More fundamentally though people need to understand that science is uncertain, and that earthquake in New Zealand is something we have to accept, and not expect to be 100% safe. Perhaps a weekly earthquake forecast would be useful - so that people start to see it in the same context at the weather - everyone would come to understand that small earthquakes are constantly happening all over the country, and they know the forecast will be wrong sometimes but they would be living with risk, and it would keep raised awareness.

## Appendix 10: Interview summary narratives – cont/-

I010 – Paul Gorman - Science Reporter - The Press

After a quake there is a place for information about the cause, for the science - it helps in coming to terms with what has happened. Those involved in the disaster will have different information needs though. Maybe there could have been more information about how to prepare before the quakes. Knowing about the level of hazard or risk, particularly if it is perhaps higher than previously thought, will help preparedness. The Press was constantly getting feedback on the way all aspects of the earthquakes were being reported. We agonise about running stories, releasing information - and we get mixed reactions to what we do run – the predictable mix of 'they're sweeping things under the carpet, why don't they just tell us?' and 'the media's just scaremongering'. Two examples are the Ken Ring prediction and aftershock forecasts. People were talking about the March 20 prediction anyway before we finally ran the story. Was it responsible to release the aftershock forecast or was it going to freak people out – in the end we decided we had to in case something happened. We in the media think that people should be allowed to make their own decisions, and they shouldn't be falsely assured. It's patronising or condescending for experts to be saying 'we know best what to tell you'. It's important for people to know the likely (decreasing) trends, and the lengthy duration of aftershocks. I haven't tended to do much on the engineering, psychology, environmental science and social science relating to earthquakes - it's seen to fit into other rounds. Engineering issues were reported and the T&T [Tonkin and Taylor] reports were covered, but engineering is technically dense. Also I think a lot of that stuff [the scientific basis for the land use decision-making, the geotechnical aspects and the engineering possibilities, what foundations, what materials etc] hasn't been reported because the government won't release how they've actually done the work … but I can't say whether other reporters have really pursued this.

I011 – Dr Stefano Pampanin - Canterbury Academic - Civil Engineering, sometime media source

The media did a great job of communicating the important general topics, and everyone was talking about liquefaction, magnitude of earthquakes, and the effect of shallowness and shaking intensity on the built environment. Instead of being told how many faults are unknown, the focus should have been on telling people that earthquakes are expectable, but not predictable. The event was very much seen from a seismologist's point of view, there was not so much engineer-oriented communication, which would be we are living on earth, earthquakes are part of the deal, it's not about when the next one is going to be, or can I get out of the house, or trying to see the future, it's all about solutions more than problems. What was probably missing was to move immediately, not down the track, into discussing the level of safety of buildings and infrastructure, to reminding people that all technology has the possibility of collapse. The CTV collapse should have been more reasonably reported - should people be surprised if someone died in an old car that hit the wall at twice the speed of the crash test? The building code should be better explained - what does 67% of code mean? People should have had explained to them that an engineering assessment is like going to the doctor - you get the level of assessment you ask and pay for, whether it is a visual check or one that goes into the 'anatomical detail' of the building's drawings. Then you have to have a discussion and make a decision about the medicine - how you treat the problem. People should have been given more about the truth that it doesn't cost that much more to engineer increased levels of seismic safety. People should be told about the retrofit solutions for New Zealand buildings. There should be more in the media comparing not only the direct, but indirect costs of earthquakes with what it would have cost to avoid the problems in the first place. Most importantly the media should be getting us to question our value priority - do we want safer buildings in our country, for ourselves, for our families, for people in other cities in New Zealand? They should be reminding us that if so, we should be demanding that our Governments think about DRR long-term, well past electoral cycles, and we should be prepared to pay for them.

## Appendix 10: Interview summary narratives – cont/-

I012 – Anonymous - Geotechnical expert who has been a mass media source

Hazards are everywhere and you pick your hazard wherever you live. The mechanics of fault rupture - that's detail that doesn't need to be communicated - the message should be 'these are the likely consequence of an earthquake'. A key message about risk would be Don't panic, make sure you think about things in a balanced way, but at the same time don't fool yourself with the idea that it's not going to happen to you'. Probabilistic concepts of risk should be presented alongside an indication of comparative risk (e.g. crossing road, flying on a plane etc.). When you build something you've got two options, you build it so it can withstand anything nature can throw at it, or you balance the risks and the costs and come up with some pragmatic middle ground where you accept that there is an exposure to some risk but you're not over-engineering to the point you can't afford something. Throughout the life of that construction, and when there is a disaster people need to remember what the trade-off was that was made, and not feel hard done by when what residual risk was accepted, happens. The risk balancing that has been happening behind the scenes could probably do with being communicated - for example so that people fully understand what additional risk comes with cheaper options. Design codes should be explained better so that people understand what they mean. People need to have explained that recovery is a long process, that it is a necessarily well-considered balanced process and decisions aren't necessarily going to be popular but are part of that balance. The public health messages in response could have started earlier and have been followed up for longer. It might be useful to explore the concept of habitability in seismic design rather than only life safety in the media.

I013 – Dr Stephen Goldson - Scientist- from office of PM's Chief Science Advisor

People shouldn't be allowed to forget about the possibility of earthquakes. However they need to know that just because there is a fault nearby it does not mean there will be a quake on it. They should also be told about their exposure to particular consequences - for example liquefaction, infrastructure damage, or flow-on effects of loss of culture and amenity. Understanding that earthquakes can happen away from the immediate plate boundary in areas that might be not as well researched and understood might also be useful. Once they have awareness they need to know the appropriate planning and emergency survival actions  - specifically what to do in the case of an earthquake event, but also stocking for self-sufficiency. People need to know that no-one can predict what the train of events is going to be, and that in the event of an earthquake sequence beginning they're not going to get precise information about what's going to happen next. What they should be told is that it's known that a declining trend in aftershock magnitude and frequency is consistent with what is known. Immediately after the event they need information about what has happened, and the likely emotional responses. Later, being given an understanding of the background to land use and other geotechnical decision-making is essential. It would be useful to benchmark where a community is in recovery compared with other places that have been through disaster events – temporally and on a spectrum of successful recovery. In relation to recovery people should also be told that there is a wealth of experience and knowledge informed by science, and scientific data collection and modelling techniques and technology behind recovery, particularly the redesign of infrastructures. It would also be useful for people to understand that the additional costs to achieve mitigation are not always high.

## Appendix 10: Interview summary narratives – cont/-

<u>I014 – McCaw Family member - Canterbury affected public (has experience of media and communications and tertiary science training including some earth science)</u>

There's not so much that one needs to know from science and scientists - mostly what you need to 'get thru' is the practical things. Things like, it will be a long time until anyone will help you, and that having travel insurance is really useful if you want to get back home after there's been a disaster, kitty litter mops up spills, always have fuel in your car, supermarkets should have wire on shelves to stop bottles from falling, first aid and hygiene. People need to know and plan for response actions, escape routes, what to do in case of tsunami, to have survival kits. People should know that the earth is dynamic and to expect earthquakes. They should know to look for warning signs of tsunami like long periods of shaking and the sea going out. They also need to know about hazard effects like liquefaction and what they do to a city - the impact on a city and it's infrastructure. After an earthquake good general communication in crisis is really important. Building inspections, and building codes, building performance and the reasons for building closure need to be explained better. Nobody was really expecting how hard recovery would be so more public awareness on mental health issues might have been useful, and it would have been useful to be told earlier than the information that was given, first came out.

<u>I015 – McCaw Family member - Canterbury affected public - university student who took up geology after the quakes</u>

People need to know that humans make a disaster, not the hazard. They need to know that earthquakes happen and that you can't control them. You need some science in order to realise the need to be prepared. At the same time you need to be aware that life is risky and there are many potentially catastrophic risks that we live with and don't consider (like an Australian nuclear accident). It could have been explained that faults are a 3D thing, and they don't have to be on the surface; there don’t have to be obvious signs of faults like on the movies. It would have been useful to understand more about aftershocks, particularly the likely length of duration, but mostly that they are to be expected. Understanding the psychological effects of earthquakes and long periods of aftershocks would be a good thing to know.

<u>I016 – McCaw Family member - Canterbury affected public - Secondary school student from Canterbury</u>

You need to know the earthquake risk in your area. People need to be reminded that you could be anywhere when an earthquake happens, so you should be thinking about and planning for different scenarios including how you are going to get home. People need to know the different things that can happen after earthquakes (secondary effects), including things like the possibility of bridges not being safe to use. We should have been told about liquefaction, and things about earthquake waves, and definitely about the duration of aftershocks and that there's lots of them and that you could have 5 or 6 of them that were just as bad, before the earthquakes happened. Probably no-one cares but it’s interesting to know that it depends which way the earthquake goes, what falls off your shelves. People did know about liquefaction but they just decided to put houses there anyway, even though they knew the risks - we need to understand why. It's important that people know where they can go to get help if they are not coping emotionally after an earthquake.

## Appendix 10: Interview summary narratives – cont/-

I017 – McCaw Family member - Canterbury - affected public

Earthquakes can happen anywhere in New Zealand, and you could be anywhere when one does, not just in your home region. People need to think about the risk of tsunami if they're near the coast, and think about ways to higher ground. People need to know all the things about being prepared, securing things to walls, hot water cylinders, having survival kits and particularly about the need for self-sufficiency. You need to know to be self-sufficient because there'll be infrastructure damage and supply issues - supermarkets might not have things. After an earthquake has happened people need to know what's happened. People also need to know how many aftershocks to expect and how long they might keep happening for.

I018 – Anonymous - Policy advisor with a strong background in mass media

People want to know the likely length of the event and the probability of a damaging event in a given timeframe. There should have been a public conversation before the earthquakes about aftershocks. People are entitled to the best scientific information, they should not be patronised by making the message more palatable. Acknowledgement of the psychological effects in the mass media is important, and it would have been useful to have a better understanding of the experience elsewhere in disaster situations. We had all these tools [policy, planning, zoning, RMA] and all this knowledge [about the hazard and local geology] but because people regarded this as such a remote risk it didn't translate into action. A better understanding of acceptable risk, tolerable impact, risk analysis and transparency around decisions being made is needed – the media should be asking questions on behalf of the public. Alerting people to other sources of information would be useful. The Commission of Inquiry could have been less spasmodically and better reported, as could other reporting of land use and building standards - so that citizens can make good decisions about what they are prepared to take on.

I019 – Dacia Herbulock - Science Communicator - Science Media Centre, Wellington

People need to know what is known, and a summary of the history of enquiry into earthquakes. There needs to be a sense that the risk of earthquake is ever-present and therefore there is an urgent need for risk reduction. Having risk maps with red and green was not good for giving people a clear understanding that earthquakes can happen anywhere in New Zealand. People need to have explained to them how important planning is, and how it can assist in an event. There should be more drills, and media should be involved in this - to create 'body memory'. Good information in the response phase - crisis communication - is critical. There is a need for informed commentary and analysis of what is going on and in that situation people gravitate towards experts. If there are scientists or experts who are being consulted then they need to be considering a disaster event a rare opportunity to communicate about DRR. Scientists should not shy away from telling people the truth about the length of duration of aftershocks even if it might not have been what they wanted to hear. People need to know that there could be years and years of renewed crises. Get Ready Get Thru suggests getting through something and then someone else will be taking care of it - that's not been the Cantabrians' experience. It might be useful to have had more probing around engineering of buildings, not only focussing on the threats, such as unsafe buildings, but on recovery, for example having it explained just how much more it would cost to have buildings exceed compliance.

## Appendix 10: Interview summary narratives – cont/-

I020 – Ngaire Button – then Deputy Mayor of CCC

People are hungry for good (healthy, balanced) information, they want to know the real issues in recovery, positive stories about recovery and lessons learnt elsewhere about it. There is also a need for more information about earthquake risk - likelihood and nature of future event, roles in decision-making, decision timelines, costs, who will pay, likelihood of future. The message needs to go out that mitigating a disaster is having a well-prepared, well-networked and engaged community who have planned for an event and its recovery, as well as emergency management teams who can swing into action when they have to. The options in earthquake strengthening should be better explained and then buildings should be placarded so that people have a personal choice as to whether they enter a building. More explanation from engineers is needed and more unity between different organisations in providing collective answers and comment on issues (e.g. implications of TC3 zoning and mitigation options).

I021 – Anonymous - from Ministry of Civil Defence and Emergency Management

Geophysical mechanisms need to be explained so that people understand that earthquakes are part of life, that we know quite a bit about their mechanics and likely impacts, and therefore the need for personal preparation. The effects of earthquakes, the potential and actual damage to buildings and infrastructure and the consequences for human communities need to be explained, but this should not be by depicting a ‘scorched earth'. It is hard to explain to the public the probability of earthquakes. In the immediate aftermath of an event things are too raw for DRR messaging. Later, and in preparation for another event, people mostly need to understand simple messages like drop cover and hold, and where to get information about being prepared. Other aspects of risk management are the authorities’ responsibility. Policy -makers and planners need to understand risk, consequence and probabilities in ways the public don’t. Risk and particularly the likelihood of events are very complex to explain and so have been misrepresented – the media should not be used to explain hazard and probability. The cost benefits involved in earthquake strengthening could be better explained as could the risk presented by earthquake-prone buildings or the potential in insurance incentives to reduce the risk to the community . The potential for tsunami in New Zealand could be better explained . The value of generating community resilience, and undertaking DRR initiatives in all four phases of the DRM cycle – reduction, readiness, response, , and recovery needs to be communicated better.

## Appendix 10: Interview summary narratives – cont/-

<u>I022 - Anonymous</u>

People need to understand that low risk in New Zealand does not equal no risk. The way that relative risk has been portrayed on hazard maps using red, yellow and green colours has been unhelpful, and has led people to discount risk. People need to know what the problem is, why they need to do something about it, and what they can do about it. We know that people are more likely to engage in DRR, to act, if they perceive the risk to themselves, they perceive that they can do something about it, and they believe that they have skills that they can do something about it. Overall though, I think we've been focussing too much on the problems and not the solutions - it is essential to understand the problem to find the solutions but it is only part of the process. Innovative engineering design could be better highlighted in the media. There needs to be clearer messaging in the media around everyone's roles and responsibility expectations for DRR – individual and institutional. That way we would now have fewer contradictory situations, such as with insurance where those who prepared and had insurance are still waiting for assistance, and those who didn't have been helped. Better explanations of the reasons for decisions would be helpful, so that slow beaurocracy, conspiracy, political drivers, and social class ideologies are not attributed as the reasons and so that there is more emphasis on sharing the risk, and owning the solutions. It may be a motivator to frame preparedness as 'a way of helping others should an event occur, because if your community doesn't need a supply that frees it up to go somewhere else'. Overall, it would be useful to frame DRR as being part of, and in a mainstreamed innovative sustainable resilient community context.

<u>I023 – (Hon) Lianne Dalziel - Opposition MP from Canterbury - appointed to UNISDR disaster recovery advisory group in 2012, and frequent media source</u>

There is a need to understand what has happened and to contextualise this in the wider international experience - people are empowered through explanation. Beforehand we needed to have known more about the possible effects of earthquakes. After Sep 4 everyone, citizens, organisations and institutions, needed to have been better alerted to the possibility of another significant event. Yes, there should be a degree of reassurance, but don't hold back on the truth - people can take it, they'd rather know than not know. We need to improve what is communicated in crisis and recovery, and it needs to be a dialogue - community leaders know what people's questions are. Communicators should make sure they are answering those questions. There need to be public conversations about acceptable risk and the alternatives in mitigation, and not only in terms of their costs. Insurance and incentives for mitigation need to be discussed, as do possible treatments for damaged land. Understanding that DRR is not only about personal preparation and survival actions, but that it's about not entrenching pre-existing vulnerabilities would be useful public knowledge.

## Appendix 10: Interview summary narratives – cont/-

I024 – Dr Kelvin Berryman - Expert seismologist, Manager GNS Natural Hazards Research Platform, frequent media source, science-policy interface - government advisor

While the earthquakes were happening there was a thirst for the fundamental earth science knowledge - What are fault lines, what are earthquakes, what's going to happen next, why are there caverns under the road when there's liquefaction, are there going to be tsunamis? Scientists, including engineers have been talking about too much technical stuff, not really the impact - the consequences, people need a whole lot more simple explanations about how an earthquake might affect them, and people need to understand the economic impacts better. There's certainly been a big misunderstanding around the building code - its not a farce, just miscommunicated. People need to understand risk from a more clinical, analytical, rather than emotional space. People should be told "An earthquake could happen tomorrow, but X or Y (other risks) are more likely to happen. They should do some of the basic things [survival actions and a household plan] then they should get on with their lives". We need to have some discussions around acceptable risk and tolerable impact at a societal level. These are complex issues yet they are typically being treated in the media as simple cause and effect. The big learnings out of Christchurch need to be communicated. Everybody should be talking to everybody, more talking, more finding out what other people don't know and what they want to know.

I025 – Ken Ring - Non-institutional commentator in New Zealand mass media on earthquake prediction and risk

Warnings reduce people's anxiety and fear if they know something might possibly happen. (Geo)scientists' job is to warn. The government has been placing economic considerations couched in a desire not to 'alarm' above life safety, and not warning, or evacuating. The reason for having Geonet and monitoring programme should be made clear to people; one would have to assume it is to warn citizens – so people should have been told whether there were any precursors to the September 4 event. International science about earthquake precursors needs to be better explained. The opportunities for citizen science to assist in research around some of these phenomena needs to be embraced, and the media could assist in this (for example geodectic changes observed away from existing monitoring sites, reporting of cracks, or even arthritic feelings). The attention of science and media on single, disastrous events, on the unusual, and the random (as a means of gaining more funding, or selling news) rather than on cycles and patterns is not good science, or good for understanding earthquakes and people should be told this. (Despite attempts to draw other responses out, this interviewee made no comment on the communication of other aspects DRR-related science communication.

## Appendix 10: Interview summary narratives – cont/-

I026 – Anonymous - Interdisciplinary DRR researcher - Canterbury, sometime media source
It is important for people to know their current risk to earthquake so that they can understand the significance of earthquake risk compared with other hazards they are exposed to in their daily lives. In order to have a sense of criticality and how bad it would be if an earthquake occurred they need to know what impacts an earthquake may have on their community. They also need to know ways to mitigate the impacts so that they have a sense of empowerment - that they can do something to manage the risk. The ongoing risks from an Alpine Fault event could have been, and should be discussed more. Reporting on the Royal Commission could have, but did not assist with explanation of vulnerability of the built environment, about post-earthquake buildings assessments and tagging. Nor was it highlighted that buildings are designed to withstand a particular level of earthquake and any building exposed to an earthquake that exceeds that level will exceed capacity and experience damage. There needs to be more awareness in the general community about the hazard from earthquake prone buildings, about building assessments and stickering. Use of the term 'earthquake proof' buildings should be eliminated as there is no such thing.

I027 - John Mitchell - Emergency Manager involved in DRR programmes who was resident in ChCh at the time of the earthquakes and heavily involved in response, sometime media source
If people don't have an idea of how natural processes work and concepts of risk rather than probability, then they are not well prepared to deal with those things. Making people's exposure to seismic risk more visible would be a good idea - things like painting a blue line on a road as an indication of a maximum inundation line for a tsunami. Regional risks are well documented, but they need to be communicated more effectively. People need to be reminded that a risk management based approach does save lives and they need to know pragmatic measures and steps that can be taken to reduce risk. It would be useful to introduce discussion about some things that prevent people from preparing - e.g. most leases prohibit the securing of things to walls. The heightened risk of building failure and rock fall after an event should be better communicated. Responsibility in response needs to be more honestly communicated - most rescues are effected by neighbours and passers-by, and people need to be able to survive on their own. People need to understand the broad range of possibilities in DRR, what is being done on a big scale, and what can be done at a household level. Communication and media have played a big part in the myth of civil defence - a top-down hierarchical response - that significantly undermines the community's ability to understand risk and what they need to do in response to it, and when events occur, actually respond. The value of flexibility and adaptability in response, innovation and 'connected self-reliance' should be communicated.

I028 – Dr Mark Quigley - Academic Geoscientist and frequent media source.
People need to know that there is a tremendous amount of high-end seismological research. They need to know how seismic hazard models are constructed and how this interfaces with the building code. They also need to understand that scientists can forecast earthquake probabilities, understand many fault systems rather well, can put probabilistic estimates on the likely magnitudes, locations, mechanisms, etc of future earthquakes, but that there is of yet no reliable short-term earthquake prediction scheme. The possibility of triggered seismicity on adjacent faults to the east of the Greendale fault could have been discussed more. References to the possibility of triggered earthquake sequences elsewhere could have been introduced earlier although bringing such scenarios up immediately after Sept 2010 might have done more mental harm than good.

## Appendix 10: Interview summary narratives – cont/-

<u>I029 – Leanne Curtis - Canterbury-based Recovery Advocate (CanCERN) and post-quake media source.</u>

Knowledge is power. People need to understand that how connected a community is really dictates how well you will get through the emergency phase and recovery. Everyone needs to know that disaster recovery is about people. The physical damage, the physical trauma is just one part of a disaster, so any kind of messaging about preparedness before earthquakes has to be more than a physical preparedness it has to be more about the social connectiveness, more about the people. People do not recover at the same speed as the buildings. People need to understand how to mentally get through recovery. Citizens need to be told that they need to be prepared to survive independently for weeks, not three days. People in institutions and organisations need to be given the message to 'get your systems in place so that you can hear really well, directly, from the grass roots'. The communications need to be honest whether the news is unpalatable or not, and they need to contain timelines, and be transparent about risk trade-offs being made. Scientists haven't been telling us what to expect, what's normal and so we've become experts ourselves. Everybody felt the need to become very technically knowledgeable, in the absence of strong leadership - because they didn't trust what was being communicated. Citizens need to be told the pros and cons and the costs of the decisions and need to feel party to and therefore part of the decision-making. Instead of being told that for example insurance and EQC are working together we needed to know what it is they are working together on, what are the road blocks, what are the implications, what are the options, what are they grappling with? Understanding why decisions have been made makes you feel less powerless; then you can say 'I don't like the decision, but I do understand it'.

-blank-

# Appendix 11: Scientists/experts mentioned in earthquake-related media

This Appendix contains one table (Appendix Table 11.1) showing the scientists and expert sources, scientific disciplines and individuals representing scientific institutions and organisations mentioned in the New Zealand earthquake-related media in 2010-2012.

-blank-

## Appendix Table 11.1 List of scientists and experts on online broadcast (TV1) and online print media (Stuff) articles

The following pages tabulate the scientists and experts sources, named, and unnamed (listed as 'unknown') who were mentioned in articles on the online print media website stuff.co.nz (1000-Stuff dataset) and television (TV1 dataset) after the Darfield earthquake of 2010. In most cases these were the sources who communicated about science. For acronyms relating to institution and organisation acronyms see p. xvi-xviii.

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Abbas, Maysoon, Mahdi | STUFF | family doctor | Other - medical degree from Baghdad University, Iraq, and her master's degree from Sheffield University in England | |
| Aberkane, Teresa | STUFF | senior air quality analyst | ECAN | |
| Abrahamson, Norman | STUFF | adjunct professor of civil engineering | University of California at Berkeley | Prof |
| Abreu, Rafael | STUFF | geophysicist | USGS | |
| Adams, Ian | STUFF | animal collection manager | Orana Park | |
| Ahlers, Doug(las) | STUFF | senior lecturer in disaster recovery; who has advised San Francisco and Los Angeles on recovery and resiliency planning | Harvard university | not given |
| Aldrige, Brett | STUFF | environmental protection manager | ECAN | |
| Alexander, Tony | STUFF | chief economist BNZ bank | BNZ bank | |
| Alkaisi, Maan | TV & STUFF | Dr - whose wife died in the CTV building (known to be structural engineer) | | Dr |
| Alkaisi, Maan | TV & STUFF | Associate professor at Canterbury University's School of Engineering. | University of Canterbury | |
| Altenberg, Cerina | TV | doctor | Pegasus Health | |
| Anderson, Helen | STUFF | seismologist and former chief executive of the Research Science and Technology Ministry | Not given | |
| Anputra | STUFF | nurse | Not given | |
| Archibald, Gareth | TV & STUFF | engineering geological surveyor | GNS | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Archuleta, Ralph | STUFF | Professor, of the | University of California at Santa Barbara | Prof |
| Ardagh, Mchael/Mike | TV & STUFF | emergency medicine professor/ specialist emergency physician/ national clinical director of emergency department services with the Ministry of Health/ emergency department specialist / Emergency Dept. Clinical Director | University of Otago, Christchurch School of Medicine/ Ministry of Health. Christchurch Hospital | Prof |
| Arsenau, Therese | TV | | UC | Dr |
| Ashenden, Caroline | STUFF | duty seismologist | GNS | |
| Ashton, Caroline | TV | seismologist | GNS Science | |
| Aster, Rick | STUFF | | Seismological Society of America | |
| Athfield, Ian | TV & STUFF | Architect, ambassador for Christchurch | Not given | |
| Atkinson, Tara | STUFF | head keeper of native fauna | Orana Wildlife Park | |
| Attewell, Jason | STUFF | NZ GDP project manager | Statistics NZ | |
| Atwater, Brian | STUFF | scientist | USGS | |
| Avery, Hamish | STUFF | of | Canterbury Seismic Instruments | |
| Bagrie, Cameron | STUFF | chief economist at ANZ bank | ANZ bank | |
| Bagshaw, Phil/Phillip | TV & STUFF | Chair / *counselling (not given that Assoc Prof surgery or on Charitable hospital trust))* | Christchurch Hospital | Dr |
| Bagshaw, Sue | TV | counselling | Christchurch Charity Hospital | Dr |
| Ban, Shigeru | TV & STUFF | architect - Japanese/ world renowned architect - designed structures for Haiti and Italy, Japanese architect | International - Japanese | |
| Bardsley, Earl | STUFF | scientist/ Associate professor | Waikato University | Ass Prof |
| Barnes, Philip | TV & STUFF | Scientists, marine geology principal scientist | NIWA | Dr |
| Barry, Bernard | TV & STUFF | a specialist at GNS science specialising in radition - senior scientist | GNS Science | |
| Batchelor, Judith | STUFF | environmental manager | Hurunui District Council | |
| Beacher, Annette | STUFF | head of research | TD Securities | |
| Beavan, John | TV & STUFF | geophysicist | GNS / GNS Science | Dr |
| Beavan, Peter | TV & STUFF | architect | Not given | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Becker, Julia | STUFF | disaster researcher | GNS Science | |
| Becker, Nathan | STUFF | oceanographer | PTWC | |
| Beddington, Prof Sir | TV | Chief Scientific Advisor to UK | | |
| Beetham, Dick | STUFF | engineering geologist | GNS | |
| Begg, John | STUFF | scientist | GNS | (Dr) |
| Bell, Caroline | STUFF | psychologist - co-ordinates the Canterbury District Health Board's psycho-social response | CDHB | |
| Bell, Dave/David | TV & STUFF | Canterbury University Geological Sciences geotechnical consultant/geologist | University of Canterbury | |
| Bell, Warwick | TV | not specified but comment in relation to architecture | Fabric Structure Systems | |
| Berkland, Jim | TV | geologist | USGS (former) | |
| Berrill, John | STUFF | Christchurch civil engineer/earthquake engineer | Not given | Dr |
| Berryman, Kelvin | TV & STUFF | natural hazards manager and earthquake geologist/ the country's top seismologist -principal seismologist/principal scientists, manager, Natural Hazards Research Platform/ earthquake geologist/natural hazards manager/earthquake expert/ principal scientist | GNS Science | Dr |
| Beuzenberg, Alan | STUFF | duty chief engineer | CCC | |
| Biggs, David | TV | US-based structural engineer | | |
| Bilham, Roger | STUFF | professor of geological sciences | University of Colorado | Prof |
| Bland, Lara | TV & STUFF | Seismologist / duty seismologist | GNS / Geonet | |
| Blanks, Ross | TV | | NZ Vet Association | |
| Blick, Graeme | STUFF | chief geodisist | LINZ | |
| Bluck, Brian | STUFF | building control manager | CCC | |
| Bonning, John | STUFF | clinical director of Waikato's emergency department | Waikato Hospital | |
| Boon, Terry | STUFF | multi-award winning architect | Not given | |
| Borkin, Phillip | TV & STUFF | economist | Goldman Sachs & Partners New Zealand | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Boschi, Enzo | STUFF | a scientist who heads the [Italian] National Institute of Geophysics and Volcanology/ then-head of the National Institute of Geophysics and Volcanology | National Institute of Geophysics and Volcanology | |
| Bowman, Ian | STUFF | conservation architect | Not given | |
| Bowman, Lis | TV | geotechnical engineer | | |
| Boys, Alistair | TV | structural engineer | Holmes Group | |
| Bray, Jonathon | TV & STUFF | Californian geotechnical expert | Not given | |
| Brimble, Margaret | STUFF | Rutherford Foundation chairwoman | Rutherford Foundation | Prof |
| Briskie, Jim | STUFF | professor biological sciences | University of Canterbury | Ass Prof |
| Brockenshire, Simon | TV | clinical director, 24 hour surgery (Bealey Ave) | Pegasus Health | |
| Brown, Andrew | STUFF | structural engineer | OPUS | |
| Brown, Charlotte | STUFF | PhD researcher | University of Canterbury | |
| Brownlee, Alison | STUFF | research assistant - marine ecology research group | University of Canterbury | |
| Buchanan, Andrew/Andy | STUFF | professor of Civil and Natural Resources Engineering, Canterbury University staff / research director of consortium Sustainable Buildings of the Future, | University of Canterbury/ Sustainable Buildings of the Future | Prof |
| Buchannan, Sean | STUFF | data centre spokesman | Geonet | |
| Buis, Rob | TV | | Thermal Imaging NZ | |
| Bull, Des | STUFF | USAR engineer, Canterbury university staff | USAR/University of Canterbury | |
| Callan, John | STUFF | spokesman - GNS | GNS | |
| Campbell, Darral | STUFF | Alzheimers Canterbury manager | Alzheimers Canterbury | |
| Campbell, Hamish | TV & STUFF | geologist | GNS Science | Dr |
| Campbell, Jocelyn | STUFF | structural geologist and active tectonics specialist | University of Canterbury | |
| Carr, Athol | TV | Prof | Canterbury University | Prof |
| Carswell, Sue | STUFF | independent researcher | Not given | |
| Caruso, Paul | STUFF | Geophysicist | USGS | |
| Cattaway, Chris | TV | Emergency response expert | Save the Children | |
| Caulay, Tom | TV | Civil engineering Canterbury | UC | Prof |
| Cave, Murray | STUFF | geologist | University of Canterbury | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Chadwick, Mark | STUFF | duty seismologist | GNS science | |
| Challenger, Neil | STUFF | school of landscape architecture head | Lincoln University | |
| Chaplow, David | STUFF | Ministry of Health's direcotor of mental health | Ministry of Health | Dr |
| Chapman, Bruce | STUFF | Chief executive | NZ Historic Places Trust | |
| Chapple, Simon | STUFF | economist - who analysed the economic impact of the [Napier] quake in a 1997 paper for the New Zealand Institute of Economic | Not given | Dr |
| Chinn, Debbie | STUFF | chief executive | Standards New Zealand | |
| Chittoc, Don | STUFF | pollution prevention manager | ECAN | |
| Christensen, John | STUFF | environmental services manager | SDC | |
| Christenson, Bruce | STUFF | geochemist | GNS | Dr |
| Christey, Grant | STUFF | Waikato Hospital's trauma director | Waikato Hospital | |
| Christison, Mark | TV & STUFF | Christchurch City Council City water and waste manager/ unit manager | CCC | |
| Clark, Win | STUFF | executive officer | NZSEE | |
| Clarke, Seve | STUFF | CAENZ chief executive | CAENZ | |
| Clements, Judy | TV | | Mental Health Foundation | |
| Clements, Robin | STUFF | senior economist - UBS/Canterbury economist | UBS New Zealand | |
| Clifton, Charles | TV & STUFF | Assoc Prof Civil Engineering, civil engineering professor | University of Auckland | Ass Prof (Dr) |
| Coates, Kim | STUFF | Wellington organisational psychologist | recruitment company Momentum | |
| Comeiro, Mary | TV | architecture | Berkley University | Prof |
| Cookson, John | STUFF | Professor John Cookson concludes his series on history and the remaking of Christchurch, looking at the city's heritage. | Not given | Prof |
| Cooper, Justice Mark | TV & STUFF | Royal Commissioner | Royal Commission of Inquiry | |
| Coppola, Jennifer | STUFF | data centre technician | GNS Science | |
| Costa-Scorse, Brenda | STUFF | research leader for paramedical and emergency medicine | AUT | |
| Cox, Brady | TV | not specified but geotechnical story | University of Arkansas | Dr |
| Cox, Simon | STUFF | geologist | GNS | Dr |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Craig, Thom | STUFF | Athfield's core group consists of | Not given | |
| Crighton, Anna | TV | not specified by story about heritage | Earthquake Heritage Building Trust | |
| Crossland, Andrew | STUFF | ranger & ornithologist | CCC | |
| Cubrinovski, Misko | TV & STUFF | associate professor of civil and natural resources engineering | University of Canterbury | Ass Prof |
| Cummins, Mike | STUFF | health controller | Nelson Marlborough District Health Board | |
| Curran, Bryan, | STUFF | anaesthetist | Not given | |
| Curran, Malcolm | STUFF | an advanced paramedic with St John, Mr Coker's brother Malcolm, | Not given | |
| Currie, Ann | STUFF | Community and public health adviser | CDHB | |
| Currie, Kevin | STUFF | Ministry for the Environment director of environmental regulation | Ministry for the Environment | |
| Cvetanova, Tamara | STUFF | victim | Not given | Dr |
| Dalman, Richard | STUFF | Athfield's core group consists of | Not given | |
| Darwin | TV | | | |
| Davidson, Barry | TV | structural engineer, former lecturer and president of NZ's Structural Engineering Society | NZSEE | |
| Davidson, Peter | STUFF | groundwater scientist | Marlborough District Council | |
| Davies, Tim | STUFF | surface water resources and eco-systems manager | ECAN | |
| Davy, Bryan | STUFF | senior research scientist | GNS | |
| De Bernadinis, Bernardo | STUFF | then-vice chief of the technical department of Italy's civil protection agency | technical department of Italy's civil protection agency | |
| de Lange, Willem | TV | not specified - implicit expert - item about tsunami | University of Waikato | |
| de Terte, Ian | TV & STUFF | clinical psychologist, at Disaster Research Centre | Massey University/(JCDR) | |
| Dekker, Dave | STUFF | Opus Architecture senior structural engineer Dave Dekke | Opus Architecture | |
| Densmore, Alex | STUFF | at the Department of Geography and Institute of Hazard, Risk and Resilience, at Durham University | Durham University | Dr |
| Devereux, Carl | TV & STUFF | structural engineer | USAR / Aurecon | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Dhakal, Rajesh | STUFF | associate professor in structural and earthquake engineering, Canterbury university staff | University of Canterbury | |
| Dickerson, Andrew | STUFF | health board member | CDHB | |
| Douglass, Malcolm | STUFF | FNZPI, FIPENZ, town planner and transportation engineer, life member of both the Planning and Engineering Institutes | Not given | |
| Dramov, Boris | STUFF | Renowned urban planner of San Francisco ... which also designed Auckland's Viaduct Harbour | Roma Design | |
| Duncan, Philip | STUFF | head weather analyst | WeatherWatch.co.nz | |
| Duthie, Struan | TV | Christchurch Trauma Counsellor | | |
| Dwiyono, Safari | STUFF | scientist who has been monitoring the volcano | Not given | |
| Eadie, Charles | STUFF | city planner | San Francisco | |
| Eagar, Jarrad | STUFF | Wellington registered psychologist | practitioner | |
| Eaqub, Shamubeel | TV & STUFF | principal economist | NZIER, Institute of Economic Research | |
| Ebert, Craig Ebert | STUFF | senior economist - BNZ | BNZ | |
| Eccles, Jennifer | TV | research fellow | University of Auckland | |
| Elder, Don | TV | former geotechnica, engineer | | |
| Elliot, John | STUFF | from the Department of Earth Sciences at the UK’s prestigious University of Oxford | Oxford University | Dr |
| Elmey, Phil | STUFF | civil engineer and builder | Not given | |
| Enoka, Gilbert | STUFF | All Blacks sports psychologist | All Blacks | |
| Erikson, Kai | STUFF | American disaster sociologist | Not given | |
| Evans, Noel | TV | structural engineer | Opus, International | |
| Ezzy, Tim | STUFF | hydrogeology team leader | ECAN | |
| Fehl, Peter | STUFF | expert in construction | Not given | |
| Fenaughty, Kevin | STUFF | Data centre manager | Geonet | |
| Fenwick, Richard | TV | earthquake engineer | | Dr |
| Fenwick, Rob | TV | | Fenwick's Pharmacy - Kaiapoi | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Fergusson, David | TV | | University of Otago | Prof |
| Ferris, Brian | STUFF | duty seismologist | Geonet | |
| Fleischer, Dominic | TV | | | Dr |
| Flight, Victoria | STUFF | GP who owned the medical practice | Not given | |
| Fournier, Nico | STUFF | volcanologist | GNS Science | |
| Freeman, Malcolm | STUFF | structural engineer | Not given | |
| Fritz, Charles | STUFF | disaster sociologist | Not given | |
| Fry, Bill | TV & STUFF | expert, seismologist, publication co-author | GNS / GNS Science | Dr |
| Fulton, William | STUFF | Athfield's core group consists of | Not given | |
| Furlong, Kevin | TV & STUFF | visiting American expert/ visiting United States geologist/seismologist/ geophysicist/ professor/ on sabbatical / visiting fellow in Canterbury University's geological sciences department when the September quake struck / Expert from Pennsylvania/ international expert/ scientist/ world-renowned geophysicist from Pennsylvania State university. He came here to spend his sabbatical studying earthquakes and he's done plenty of that. | Pennsylvania State University | Prof (Dr) |
| Gale, Nora | STUFF | tsunami expert/duty seismologist | GNS Science | |
| Galileo | TV & STUFF | other scientists - Galileo and Gall | Not given | |
| Gallo, Patricio Quintana | TV | PhD student - engineering | Canterbury University | |
| Gardner-Stephen, Paul | STUFF | technology creator Adelaide's Flinders University | Flinders university | |
| Geddes, Andrew | TV | | University of Otago | Ass Prof |
| Gerstenberger, Matthew/ Matt | TV & STUFF | seismologist/ hazards modeller | GNS Science | |
| Gibson, Gary | STUFF | principal research fellow in earth sciences | Melbourne University | |
| Giuliani, Giampaolo | STUFF | scientist - who in the preceding days tried to warn the local population of an imminent quake -- though officials say he was wrong about its precise location. | Not given | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Glaesser, Edward | STUFF | economist | Harvard university | *Dr?* |
| Glassey, Steve | TV | researcher | Massey university | |
| Glavovic, Bruce | STUFF | associate director of the Joint Centre for Disaster Research at Massey University | Massey University Joint Centre for Disaster Research | Prof |
| Gledhill, Ken | TV & STUFF | science advisor | GNS | |
| Gledhill, Ken | TV & STUFF | Geonet project director/manager/science advisor | GeoNet/GNS | |
| Gluckman, Sir Peter | TV & STUFF | Prime Minister's chief science advisor | | Prof |
| Godoy, Pablo | STUFF | clinical leader | Relationship Services Whakawhanaungatanga's (RSW) | |
| Goff, James | STUFF | co-director of the Australian tsunami research centre and natural hazards laboratory | Australian tsunami research centre and natural hazards laboratory | |
| Gordon, James | STUFF | an American psychologist and former adviser to US President Bill Clinton | Not given | Dr |
| Gordon, Mary | STUFF | acting chief executive CDHB | CDHB | |
| Gordon, Mr | STUFF | | Mines Department | |
| Gorman, Andrew | STUFF | a leading geologist. ...University of Otago Geology Department senior lecturer | University of Otago | Dr |
| Grant, Helen | STUFF | geological hazards analyst/ geologist | ECAN | |
| Green, Russell | TV | | Virginia Polytech Institute | Dr |
| Grennell, Corina | STUFF | clinical psychologist | practicing | |
| Grimshaw, Michael | STUFF | sociologist | University of Canterbury | |
| Gulkan, Polat | STUFF | president of the International Association for Earthquake Engineering | International Association for Earthquake Engineering | Prof |
| Gullery, Carolyn | STUFF | General manager planning and funding | CDHB | |
| Haast, Julius | STUFF | provincial geologist and founder of the Canterbury Museum | Canterbury Museum | Dr |
| Haigh, Paul | STUFF | Fellow of the Institution of Chemical Engineers and an independent nuclear consultant. | Fellow of the Institute of Chemical Engineers | |
| Haines, Chris | TV | regional manager | St Johns | |
| Hale, John | TV | structural engineer | | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Hancox, Bob | STUFF | medical director - Asthma Foundation medical director | Asthma Foundation | |
| Hancox, Graeme | STUFF | researchers | GNS Science | |
| Hannah, John | STUFF | former dean of the National Surveying School at University of Otago | Not given | |
| Hannah, Roger | STUFF | spokesman for the | US Nuclear Regulatory Commission | |
| Hansen, James | STUFF | adjunct professor of earth and environmental sciences at Columbia University and the director of Nasa's Goddard Institute for Space Studies. He was one of the first scientists to raise the issue of global warming, in a now famous testimony to the US Congress in 1988. In | Columbia University | Dr |
| Harding, Jon | STUFF | freshwater biologist | University of Canterbury | |
| Hare, John | STUFF | civil engineer, Structural Engineering Society president, Holmes Consulting Group director | NZSEE/Holmes Consulting Group | |
| Hasting, Michael | TV | seismic consultant (AFDP) | | |
| Hay, Andrew | STUFF | Clinical director | Not given | |
| Hayward, Bronwyn | STUFF | political scientist | University of Canterbury | |
| Henrys, Stuart | STUFF | senior research scientist/geophysicist and project co-ordinator | GNS Science | Dr |
| Heslop, Ian | TV | *(principal river engineer)* | ECAN | |
| Hicks, Murray | STUFF | river and coastal expert | NIWA | (Dr) |
| Hindle, Richard | TV | asbestos removal specialist | | |
| Holdaway, John | STUFF | Canterbury University doctoral student, physics postgraduate student | University of Canterbury | |
| Holden, Caroline | STUFF | seismologist | GNS | Dr |
| Holdren, John | STUFF | science adviser - White House | White House | (Dr) |
| Hopkins, David | STUFF | earthquake engineer - earthquake engineering adviser to the Department of Building and Housing | DBH | |
| Hopkins, John | STUFF | School of Law senior lecturer | University of Canterbury | |
| Houghton, Rosalind | TV | domestic violence researcher | | Dr |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Howard, Bruce | STUFF | Denver-based international expert on disaster recovery | Not given | |
| Hughes, Glen | TV | Southern area general manager | Opus Engineers | |
| Hughes, Miriam | STUFF | sociologist/ an adviser | Massey University/Joint Centre for Disaster Research | Dr |
| Humphrey, Alistair | TV & STUFF | Canterbury Medical Officer of Health | Not given | Dr |
| Hunter, Peter | STUFF | Marsden Fund Council chairman | Not given | |
| Hurst, Chris | TV | structural engineer | | |
| Hurst, Tom | STUFF | duty officer _ GNS Science | GNS Science | |
| Hutcheson, Gail | STUFF | PhD candidate | Not given | |
| Hutt, Shevelle | STUFF | Master's student, marine ecology research group | University of Canterbury | |
| Hutton, Prof | STUFF | Dawson's predictions were discredited by a Professor Hutton | Not given | Prof |
| Hyland, Clark | STUFF | structural engineer | Hyland Fatigue and Earthquake Engineering | Dr |
| Igaraschi, Shunichi | STUFF | Japanese expert | Not given | |
| Ingerson, Jonno | STUFF | research director | Quotable Value | |
| Ingham, Jason | TV & STUFF | Expert, Associate Professor of Structural Engineering, report co-author - speaking on the report he co-authored entitled The Performance of Unreinforced Masonry Buildings in the 2010/2011 Canterbury Earthquake Swarm. | University of Auckland | Ass Prof |
| Ion, Dame Sue | STUFF | nuclear engineer and Fellow | Royal Academy of Engineering | Dame |
| Irving, Andrew | STUFF | Nelson architect of firm | Irving Smith Jack | |
| Jacka, Mike | STUFF | a principal and geotechnical engineer at the commission's consultant engineers Tonkin & Taylor | T&T (Tonkin & Taylor) | |
| Jackson, John | STUFF | construction economist brought in to help Darwin after Cyclone Tracy, now heads New Zealand construction monitoring company Pacifecon. | Pacifecon | |
| Jackson, Nicola | STUFF | demographics scientist | Not given | Prof |
| James, Colin | TV | | Stardome observatory | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Johansson, Jon | TV | political scientist | Victoria University | |
| Johns Putra, Lydia | STUFF | urologist | Not given | Dr |
| Johnson, Bill | TV | *(business development manager)* | Ceres New Zealand | |
| Johnson, Laurie | STUFF | San Francisco consultant ... a veteran of re-buildings from Chile to China | Not given | |
| Johnson, Sue, | TV | ChCh Coroner | | |
| Johnston, David | STUFF | Associate Professor and director of JCDR | Joint Centre for Disaster Research | |
| Johnston, Mike | STUFF | environment and planning committee geologist, Hazards task group member, a geologist in the region since 1970 | Tasman District Council | Dr |
| Jones, Aaron | TV | | Urban Function Architecture | |
| Jones, Jo | STUFF | Aucklander, of firm Fraser Thomas/land damage assessor | Fraser Thomas | |
| Jordan, Jenny | STUFF | clinical psychologist | University of Otago | |
| Jury, Rob | STUFF | structural engineer | Beca Consultants | |
| Kaiser, Anna | STUFF | seismic microzoning scientist | GNS | Dr |
| Kaku, Michio | TV | PhD theoretical physicist | | |
| Kalkan, Eric | STUFF | manager, USGS strong motion seismic network/ guest editor | USGS | |
| Keenan, Tim | STUFF | partner in ChCh office | Grant Thornton | |
| Keith, Hamish | STUFF | MSc in Hazard and Disaster management thesis submitted in 2008 | Not given | |
| Kelly, David | TV & STUFF | *(deputy chief executive building quality - Director Canterbury Rebuild and Recovery),* 'of the Department' | DBH | |
| Kench, Paul | TV & STUFF | Detective Inspector | NZ Police | |
| Kiddle, Grant | STUFF | Wellington orthopaedic surgeon | Not given | |
| King, Andrew | TV & STUFF | civil and structural engineer Andrew King (engineering risk specialist) | GNS Science | |
| King, Geoff | STUFF | lecturer | Brunel University | |
| King, Michael | STUFF | structural engineer, senior associate | Miyamoto International | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Kingham, Simon | STUFF | air quality and health expert, associate professor of Geography | University of Canterbury | Ass Prof |
| Kirwan, Jeff | STUFF | clinical director of older persons' health - CDHB | CDHB | |
| Kono, Ryutaro | STUFF | chief economist at BNP Paribas, who sat on the reconstruction panel | BNP Paripas | |
| Kroger, Chris | STUFF | research manager | GNS Science | |
| Kumano, Hideo | STUFF | chief economist at Dai-ichi Life Research Institute. | Dai-ichi Life Research Institute. | |
| Lacey, Cameron | STUFF | senior lecturer - Christchurch | University of Otago | Dr |
| Lamb, Charles | STUFF | Study author Associate Professor (not given - is professor of maths and econometrics - statistical economics) | Lincoln university | Prof |
| Lambie, Ian | STUFF | professor of clinical psychology | University of Auckland | Prof |
| Langford, Corry-Ann | TV | hatchlings manager | Willowbank | |
| Latta, Nigel | TV & STUFF | psychologist so well-known for dispensing good common-sense advice | | |
| Latta, Nigel | TV & STUFF | New Zealand's leading clinical psychologist | Not given | |
| Leahy, Allan | STUFF | convenor of judges - annual innovate awards | Association of Consulting engineers | |
| Lees, Jonathon | STUFF | professor of geosciences at Uni North Crolina - journal editor-in0chief | University of North Carolina | Prof |
| Leonard, Graham | STUFF | volcanologist | GNS | |
| Lesse, Sir Richard | STUFF | who oversaw the 10-year regeneration of Manchester after the 1996 IRA bombing | Not given | |
| Lester, Jamie | STUFF | structural engineer | Opus | |
| Levick, Shaun | TV | (landscape ecologist, remote sensing, GIS, ) | GNS Science | |
| Levy, Viv | TV | forensic dentist/forensic Odontologist | | |
| Lindsay, Jan | TV | volcanologist | University of Auckland | |
| Little, Mark | STUFF | of Cairns | Cairns Hospital | Dr |
| Littler, Gary | STUFF | report by Timaru engineer | Not given | |
| Loan, Jonothon | TV | | NZ Association of Counsellors | |
| Lochhead, Ian | STUFF | art historian, expert in Gothic Revival architecture | Not given | Dr |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Loeffler, Ullrich | STUFF | country manager - IDC Research | IDC Research | |
| Long, Julius | TV | structural engineer | | |
| Love, Tom | STUFF | of Australasian consulting firm | Sapere Research Group | |
| Lucas, Di | STUFF | Christchurch landscape architect | Not given | |
| Lunday, James | STUFF/TV | architect, planner and urban designer | Not given/ Kaitiaikitanga - Common Ground | |
| Luxat, John | STUFF | Professor and Industrial Research Chair in Nuclear Safety Analysis at McMaster University says | McMaster university | |
| Ma, Quincy | STUFF | lecturer - civil and environmental engineering department | University of Auckland | |
| Macey, Michael | STUFF | Cornell sociologist and co-author Michael Macy | Cornell university | |
| Macfarlane, Don | STUFF | Port Hills geotechnical group team leader/ senior principal | URS | |
| MacLean, Judge Neil | TV & STUFF | Chief Coroner | Not given | |
| MacRae, Greg(ory) | STUFF | associate civil engineering professor, Canterbury uni staff | University of Canterbury | Ass Prof |
| Makhlouf, Gabriel | STUFF | Treasury Secretary | Treasury | |
| Manson, Steve | TV | *(emergency management officer)* | Red Cross | |
| Mansoor, Athir | TV | structural engineer | | |
| Marshall, Peter | TV | | Warren & Mahoney | |
| Martin, Jean | STUFF | southern general manager | Department of Labour | |
| Martin, Sam | STUFF | a London-based international landscape architect | Not given | |
| Maru, Josh | STUFF | marine geologist | NIWA | |
| Massey, Chris | STUFF | engineering geologist/scientist | GNS Science | |
| Matenga, Gordon | TV & STUFF | Coroner/ Waikato Coroner/Acting Chief Coroner | Not given | |
| Matthews, Jock | TV | clinical psychologist | | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| McCahon, Ian | TV & STUFF | Christchurch geotechnical engineer | Not given | |
| McCallum, Wayne | STUFF | regional co-ordinator | Biodiversity Steering Group | |
| McClure, John | STUFF | professor of psychology, has done research on preparedness for earthquakes for 20 years/ associate professor of psychology | Victoria University | Ass Prof |
| McCue, Kevin | STUFF | an Australian seismologist - director of the Australian Seismological Centre in Canberra | Australian Seismological Centre | |
| McDonagh, John | TV | property lecturer | Lincoln University | Prof |
| McKay, Pippa | STUFF | Christchurch GP | Not given | Dr |
| McKenna, Eoin | STUFF | psychiatric nurse | Not given | |
| McKie, John | TV | Dr, head orthopaedic surgeon | Christchurch Hospital | Dr |
| McKie, John | STUFF | orthopaedic surgery department clinical director | Christchurch Hospital | |
| McLean, Calum | STUFF | Geovert works manager Calum McLean said the company had been working non-stop along the cliffs since February | Geovert | |
| McNeil, Lisa | STUFF | senior lecturer in geology | University of Southampton | Dr |
| McVerry, Graeme | STUFF | one of authors of the GNS report, | GNS Science | Dr |
| Meates, David | TV & STUFF | chief executive | CDHB | |
| Meates, David | TV & STUFF | Canterbury District Health Board chief executive David Meates | CDHB | |
| Memon, Ali | STUFF | planning and environmental management professor | Lincoln university | Prof |
| Michalanney, Karen | STUFF | field officer for the Amputee Society of Wellington | Amputee Society of Wellington | |
| Milicich, Rachael | STUFF | national accounts manager | Statistics NZ | |
| Milke, Mark | STUFF | research team member, civil engineering and natural processes associate professor | University of Canterbury | Ass Prof |
| Millar, Nigel | TV | | Christchurch Hospital | Dr |
| Millar, Paul | STUFF | Canterbury University professor who seized on an idea to create a digital archive of people's earthquake experiences (Head of School of Humanities) | University of Canterbury | Ass Prof |
| Millar, Peter | TV & STUFF | geotechnical engineer | Tonkin & Taylor | |
| Millar, Peter | STUFF | architect, former adjunct professor of design at Unitec | Marshall Cook | |
| Miyamoto, Hidecki | STUFF | expert, architect | Not given | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Miyamoto, Kit | STUFF | structural engineer | Miyamoto International | Dr |
| Molloy, James | STUFF | principal geotechnical engineer | GHD | |
| Monk, Mervyn | STUFF | chief executive | Artificial Limb Board | |
| Mooney, Maureen | STUFF | clinical psychologist | Not given | |
| Morrell, David | STUFF | board member | CDHB | |
| Mountjoy, Joshu | STUFF | part of team of 11 NIWA and GNS experts | NIWA | Dr |
| Nana, Ganesh | TV | chief economist | BERL | |
| Nicol, Andy | STUFF | structural geologist | GNS (Institute of Geological and Nuclear Sciences) | |
| Nightingale, Sue | TV & STUFF | chief of psychiatry /chief psychiatrist with the Canterbury District Health Board specialist mental health services | CDHB | Dr |
| Norris, Richard | STUFF | professor of geology/geologist | University of Otago | Prof |
| Noy, Ilan | STUFF | an expert in the economics of natural disasters at the University of Hawaii | university of Hawaii | Ass Prof |
| O'Connor, Frank | STUFF | president | New Zealand Psychological Society | |
| O'Hare, John | STUFF | heritage advisor | NZ Historic Places Trust | |
| O'Keefe, Mary | TV | | International Council on Monuments and Sites | |
| O'Neill, Kerry | STUFF | long-term planner | Victorian Bushfire Reconstruction and Recovery Authority | |
| O'Rourke, Tom | TV | civil engineer/ One of the world's leading civil engineer | | |
| Onishi, Takashi | STUFF | professor of city and regional planning | Tokyo university | |
| Orchiston, Caroline | STUFF | seismic thesis | University of Otago | |
| Page, Sara | STUFF | duty seismologist | GNS | |
| Palermo, Alessandro | STUFF | a senior lecturer in structural engineering/Canterbury University staff | University of Canterbury | Dr |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Pampanin, Stefano | TV & STUFF | structural engineer/associate professor/Canterbury University Staff "international authority on earthquake engineering" | University of Canterbury | Ass Prof (Dr) |
| Park, Bob | STUFF | seismic capacity design by | University of Canterbury | |
| Parker, Will | STUFF | structural engineer | OPUS | |
| Parkin, Prof | TV | Civil engineering Canterbury | UC | Prof |
| Patterson, Andrew | STUFF | eight-strong judging panel, which includes noted architect Andrew Patterson, the only New Zealand architect to be internationally recognised for Sustainable Innovation in Architecture | Not given | |
| Paulay, Tom | STUFF | seismic capacity design by Tom Paulay | University of Canterbury | |
| Pearson, Scott | STUFF | Emergency physician | Not given | Dr |
| Pender, Michael | TV | Prof, geotechnical engineer | UC | Prof |
| Peri, Kathy | STUFF | research from X and others | Not given | Dr |
| Perriam Esther | TV | | Eldernet | |
| Perrin, Nick | STUFF | research scientist | GNS | not given |
| Petrie, Neville | STUFF | Science Alive! chief executive | Science Alive! | |
| Pettinga, Jarg | TV & STUFF | geologist/ geological science Canterbury University geological sciences Professor / from Government's Natural Hazards Platform | University of Canterbury | |
| Phillip, Stuart | STUFF | doctor/ urologist | Not given | Dr |
| Pink, Ramon | TV & STUFF | Canterbury medical officer of health | CDHB - Canterbury District Health Board health office | |
| Porter, Lisa | STUFF | intensive care nurse | Not given | |
| Potangaroa, Regan | TV | disaster recovery expert, involved in 17 international disasters | Unitec School of Architecture | |
| Power, William | STUFF | tsunami scientist/geophysicist | GNS Science | |
| Price, Charlie | STUFF | firm's principal geotechnical engineer | URS New Zealand | |
| Price, Jeff | STUFF | engineer | Orion | |
| Priestly, Nigel | STUFF | Californian expert - former professor of structural engineering | Not given | Prof |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Priestly, Rebecca | STUFF | science historian who has completed a PhD on New Zealand's nuclear and radiation history | Not given | Dr |
| Pring, James | STUFF | Aucklander, engineer | Mitchell Vranjes Consulting Engineers | |
| Putts, Gary | TV | project manager | *(University of Auckland)* | *(Dr)* |
| Quigley, Mark | TV & STUFF | expert/ earthquake expert from Canterbury university/geologist/scientist/ senior lecturer | University of Canterbury | Dr |
| Quigley, Mark | TV & STUFF | | | |
| Read, Barry | TV | of | 3D.co.nz | |
| Reay, Alan | TV & STUFF | structural engineer , principal - Alan Reay Consultants, the structural engineers who designed the CTV building, | Alan Reay consultants - structural engineers | Dr |
| Rehrer, Nancy | STUFF | physical education senior lecturer | University of Otago | |
| Rennie, Paul | STUFF | from | Department of Conservation | |
| Restrepo, Jose | TV & STUFF | professor of engineering / not specified- articles in respect of structural engineering | was 15 years at UC, now California / University of California in San Diego | Prof |
| Reyes, Agnes | STUFF | geochemist | GNS | Dr |
| Reyner*(s)*, Martin | TV & STUFF | from/seismologist | GNS Science | Dr |
| Reynolds, Keith | TV | chief executive | Beca group chief executive | |
| Rhoades, David | STUFF | earthquake statistician | Not given | |
| Ring, Ken | TV & STUFF | Auckland Predict Weather director/controversial weather forecaster/pseudoscientist/moon-man/eccentric weatherman / Moon Man | Auckland Predict | |
| Ristau, John | TV & STUFF | earthquake expert expert/seismologist | GNS Science | |
| Robinson, Andrea | STUFF | St George's Hospital nurse | St George's hospital, Australia | |
| Robinson, Bill | STUFF | pioneer of earthquake protection technology | Not given | Dr |
| Robinson, Kelly | TV | physiotherapist | Burwood spinal unit | |
| Rogers, Nick | TV & STUFF | geotechnical specialist/technical expert | T&T (Tonkin & Taylor) | |
| Rollo, Frank | TV | liquefaction expert | | |
| Ronan, Kevin | STUFF | Clinical psychologist ... of Australia's Central Queensland University | Central Queensland University | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Rosenberg, Bill | STUFF | economist-CTU | CTU | |
| Ross, Ian | STUFF | vet | Not given | |
| Rout, Paul | STUFF | chief executive Adanz | The Alcohol Drug Association of New Zealand (Adanz) | |
| Rout, Paul | STUFF | chief executive | Alcohol & Drug Association (Adanz) | |
| Rucklidge, Julia | STUFF | lead investigator | University of Canterbury | Ass Prof |
| Rutter, Helen | STUFF | hydrologist | Aqualinc | |
| Saeid, Arif Dr | TV | psychologist | | Dr |
| Salmond, Dame Anne | STUFF | heritage expert | Not given | Dame |
| Sapir, Debarati Guha | STUFF | director for the World Health Organisation's Centre for Research on the Epidemiology of Disasters | WHO | |
| Sassen, Saskia | STUFF | sociologist | Columbia University | |
| Savage, Martha | TV & STUFF | Lecturer / geophysicist | Victoria University | Prof |
| Sawrey, Richard | STUFF | Kapiti Coast clinical psychologist - post-disaster work with children and families during the aftermath of the September 2009 tsunami in Samoa and the Christchurch quakes. | practicing | |
| Scarry, John | TV & STUFF | Auckland structural engineer | *(John Scarry Engineering)* | |
| Schiel, David | STUFF | heads the university's marine ecology research group | University of Canterbury | Prof |
| Scott, Brad | TV & STUFF | Volcano Surveillance Co-ordinator | GNS | |
| Scott, Brad | TV & STUFF | volcano surveillance co-ordinator/ volcanologist | GNS Science | Dr |
| Seers, Martin | STUFF | Pegasus Health CEO | Pegasus Health | |
| Selway, Susan | STUFF | clinical psychologist & lectured in psychology at the University of Canterbury and was chairwoman of the STOP Trust | practicing & University of Canterbury | |
| Seville, Erica | STUFF | co-leader of the Resilient Organisations research programme | University of Canterbury | *Dr* |
| Sharpe, Richard | TV & STUFF | Engineer / earthquake engineer, technical director | BECA | Dr |
| Sheppard, David | STUFF | Athfield's core group consists of | Not given | |
| Sibson, Rick | STUFF | Retired Otago University Professor of geology | University of Otago | Prof |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Sinclair, Cameron | STUFF | chief executive of the international agency Architecture for Humanity | Architecture for Humanity | |
| Sinclair, Martin | STUFF | geotechnical engineer | unnamed | |
| Singhal, Raj | TV | | Burwood spinal unit | Dr |
| Skilton, Jennifer | STUFF | flame-haired University researcher | Not given | |
| Skimming, George | STUFF | director of special projects | Wellington City Council | |
| Slatter, Shirley | STUFF | spokesperson | Department of Conservation | |
| Smith, Euan | TV & STUFF | geophysics professor/ earth sciences professor | Victoria University | Prof |
| Smith, Gavin | STUFF | chief | US Centre for the Study of Natural Hazards and Disasters | |
| Smith, Julian | TV | | MYOB business monitor report | |
| Smith, Ken | STUFF | Harvard University Graduate School of Design & Architectural League of NY board member | Harvard University | |
| Smith, Mark | STUFF | economist, ANZ | ANZ bank | |
| Smith, Peter | STUFF | structural engineer who has reviewed the building's performance (for the Royal Commission) | Not given | |
| Smith, Rhys | TV | structural engineer in charge of the assessment of St Elmo Courts | *(O'Loughlin Taylor Spence)* | |
| Smith, Rob | STUFF | Nelson City council environmental information officer Rob Smith | Nelson City Council | |
| Smith, Ron | TV | director of the international relations and security programme | Waikato University | Dr |
| Smith, Warwick | TV & STUFF | of | GNS Science | Dr |
| Smyth, David | STUFF | Clinical director of cardiology | Not given | |
| Squance, Hayley | TV | Veterinary emergency response | | |
| Stagpoole, Vaughan | STUFF | Project leader - seismic survey/researcher | GNS Science | |
| Stannard, Mike | TV & STUFF | chief engineer | DBH (now MBIE) | |
| Stefansson, Bergur | STUFF | at Christchurch Hospital when the February 22 earthquake struck | Christchurch Hospital | Dr |
| Stephens, Dominic | TV & STUFF | senior economist - Westpac | Westpac | |
| Stern, TIm | STUFF | geophysics professor | Victoria University | Prof |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Stevens, Matthew | STUFF | duty seismologist | Geonet/GNS | |
| Stevenson, Michele | STUFF | surface water-quality scientist | ECAN | |
| Subandriyo | STUFF | senior government volcanologist | Not given | |
| Sullivan, Louisa | TV | Clinical nursing director | *(Pegasus Health)* | |
| Sutherland, Rupert | TV & STUFF | project manager/co-leader (Alpine Fault drilling) | GNS Science | Dr |
| Sutton, Geoff | TV & STUFF | Canterbury SPCA manager | SPCA | |
| Swaffield, Simon | STUFF | Professor of Landscape Architecture | Lincoln University | Prof |
| Syamsul Rizai | STUFF | state volcanologist | Not given | |
| Tan, Alex | TV | political scientist | | |
| Tan, Martin | STUFF | Research leader | Not given | Dr |
| Tappenden, Vanessa | STUFF | Christchurch geologist | Not given | |
| Taylor, Ken | STUFF | director of investigations and monitoring | ECAN | |
| Taylor, Nick | STUFF | Rangiora based social scientist | Not given | |
| Taylor, Tony | STUFF | psychologist, trauma researcher | Victoria University | |
| Tennant-Brown, Chris | STUFF | economist | Not given | |
| Thomas, Geoff | STUFF | school of architecture senior lecturer, an expert on retrofitting safer foundations on residential homes, report co-author | Victoria University | Dr |
| Thomas, Murray | STUFF | DoC programme manager | Department of Conservation | |
| Thornton, Adam | TV & STUFF | structural engineer, on Royal Commission panel | Dunning Thornton Ltd | |
| Toh, Bernard | STUFF | Wellington seismic structural engineer | Not given | |
| Tolley, David | STUFF | a consultant urinary surgeon and president of the Royal College of Surgeons of Edinburgh, was in Christchurch for a conference in February. | Royal College of Surgeons of Edinburgh | |
| Toplis, Stephen | STUFF | BNZ head of research | BNZ | |
| Townend, John | STUFF | Victoria University's | Victoria University | Dr |
| Townsend, Suzanne | STUFF | deputy chief executive of policy sector | DBH | |
| Townsend, Tony | STUFF | Royal New Zealand College of General Practitioners | Royal New Zealand College of General Practitioners, Deputy president | Dr |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Toy, Virginia | TV & STUFF | Dr - core and facilities manager / Otago lecturer | University of Otago | Dr |
| Traylen, Nick | STUFF | Geotech's nick Traylen | Geotech | |
| Trengrove, Hugh | STUFF | Wellington dentist, member of New Zealand's national disaster victim identification team and national forensic dentistry adviser to the police | New Zealand's national disaster victim identification team | Dr |
| Trewinnard, Tony | STUFF | weather forecaster | BlueSkies | |
| Tuffley, Nick | TV & STUFF | ASB chief economist | ASB | |
| Turnbull, Rose | STUFF | assistant lecturer in igneous petrology at the university's geological sciences department | University of Canterbury | |
| Turner, Jane | STUFF | economist | ASB | |
| Vale, Lawrence | STUFF | professor of urban design and planning | Massachusetts Institute of Technology | Prof |
| Vallance, Suzanne | STUFF | urban studies lecturer | University of Canterbury | Dr |
| van der Heijden, Frank | STUFF | archaeologist | NZ Historic Places Trust | |
| van der Lingen, Jasper | STUFF | chairman of the Christchurch branch of the NZ Institute of Architects chairman | NZ Institute of Architects - Christchurch branch | |
| van Dissen, Russ | STUFF | GNS Sciences Its Our Fault project head | GNS Science | Dr |
| van Gruting, Belinda | TV | clinic doctor/GP | *(Pegasus Health)* | |
| van Heughten, Kate | STUFF | dean of the faculty of creative arts, humanities and social sciences at the University of Canterbury (is with resorgs though this not stated - Psych) | University of Canterbury | |
| Vavasour, Kris | STUFF | not in article - Professor, International Crisis and Risk Communication conference - tutor, NZ Broadcasting school | University of Canterbury | Dr |
| Vertue, Fran | TV & STUFF | clinical psychologist and part-time university lecturer | practicing + University of Canterbury | Dr |
| Vesey, Ross | STUFF | regional engineer | ECAN | |
| Villeneuve, Marlene | STUFF | engineering geology lecturer | Not given | |
| Wada, Akira | STUFF | professor | Tokyo Institute of Technology | Prof |
| Wallace, Laura | STUFF | geophysicist | GNS Science | |
| Ward, Stella | TV | | CDHB | |
| Warren, Sir Miles | TV & Stuff | architect | Not given | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Watson, Alan | STUFF | sewers unit manager (former) | CCC | |
| Webb, Terry | TV & STUFF | Director, Natural Hazards division / Natural hazards manager | GNS Science | |
| White, Gavin | STUFF | research director | UMR New Zealand | |
| White, Paul | STUFF | senior groundwater scientist | GNS | |
| Whitehead, Neil | STUFF | research scientist | various past incl GNS | Dr |
| Whiteside, Mark | TV | structural engineer | *Holmes Group* | |
| Wilkinson, Grant | STUFF | structural engineer | Ruomoko Solutions | |
| Williams, Kate | STUFF | senior engineering geologist | T&T (Tonkin & Taylor) | |
| Williams, Phillipa | STUFF | physiotherapist | Wellington Artificial Limb Centre | |
| Wilmot, Charles | STUFF | engineering director at the Institution of Professional Engineers | Institution of Professional Engineers | |
| Wilson, Karen | STUFF | senior groundwater scientist | Environment Southland | |
| Wilson, Tom | STUFF | geologist | University of Canterbury | |
| Winn Thomas, Simon | STUFF | senior clinical director | Pegasus Health | Dr |
| Wong, Clarence | STUFF | Chief economist for Asia with Swiss Re, | Swiss Re | |
| Wong, Marie | TV | Food scientist | | Dr |
| Wood, Peter | STUFF | president NZSEE & | NZSEE/CDEM | |
| Wooley, Rex | TV | | Christchurch Animal Shelter | |
| Wotherspoon, Liam | TV & STUFF | Senior research fellow ... from the civil and environmental engineering department, are travelling with the students to the earthquake engineering event / *(civil engineer/EQC Research fellow)* | University of Auckland | *(Dr)* |
| Wright, Anthony, | TV | director | Canterbury Museum | |
| Wright, Mike | TV | Inspector, dvi commander operation earthquake | NZ Police | |
| Yates, Anne | TV | president | College of Midwives | |
| Yeats, Robert | STUFF | international earthquake expert/ professor emeritus at Oregon State university/ author many earthquake books | Earth Consultants | Prof |
| Yetton, Mark | TV & STUFF | geologist | *(Geotech Consulting)* | |
| Yetton, Mark | TV & STUFF | engineering geologist/ consulting engineering geologist | Geotech Ltd | |

| Name | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| Yokoyama, Hirofumi | TV | | Japan Meteorological Agency | |
| Young, James | TV | Business School | University of Auckland Business School | |
| Zeldis, John | STUFF | marine ecologist | NIWA | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unidentified architect - 2129 | TV | architect - 2129 | | |
| unidentified assessor | TV | engineering assessor | | |
| unidentified engineer | TV | engineer | | |
| unidentified engineer geotechnical 2751_foundations thought by researcher to be Ian McCahon from hearing date | TV & STUFF | engineer geotechnical/foundations thought to be Ian McCahon from hearing date | | |
| unidentified engineer geotechnical, male - 2751 known by researcher to be Misko Cubrinovski | TV | engineer geotechnical, male in TV2751 - (known to be Misko Cubrinovski) | | |
| unidentified engineer geotechnical, male, american (2751 - from date of hearing known to be Jonathon Bray) | TV & STUFF | engineer geotechnical, male, American (2751 - from date of hearing known to be Jonathon Bray) | | |
| unidentified engineer structural, male - 2129 | TV | engineer structural, male in TV2129 | | |
| unidentified engineer, assessor, comment about measurement and recorded. | TV | engineer, assessor, comment about measurement and recorded. | | |
| unidentified engineer, building inspector | TV | engineer, building inspector | | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unidentified engineer, structural female- 2129 | TV | engineer, structural female in TV 2129 | | |
| unidentified engineering student in UC lab | TV | engineering student in UC lab | UC | |
| unidentified geotechnical engineer - 546 | TV | geotechnical engineer in TV0546 | | |
| unidentified nurse | TV | nurse | | |
| unidentified scientist 1 | TV | scientist | | |
| unidentified scientist 2 | TV | scientist | | |
| unidentified scientist lab | TV | scientist lab | Willowbank | |
| unidentified scientist male | TV | scientist male | | |
| Unidentified therapist Burwood spinal unit | TV | therapist Burwood spinal unit | | |
| unknown | STUFF | economic impact report | Treasury | |
| unknown | STUFF | | Statistics NZ | |
| unknown | STUFF | | IMF report | |
| unknown | STUFF | | Standard & Poors | |
| unknown | STUFF | economists | Deutsche Bank | |
| unknown | STUFF | economists | ANZ bank | |
| unknown | STUFF | economists | Not given | |
| unknown | STUFF | Grant Thornton 2011 Grant Thornton international survey. | Grant Thornton | |
| unknown | STUFF | water scientists | Not given | |
| unknown | STUFF | | ESR | |
| unknown | STUFF | developing a plan to measure the ecological effects of discharges into rivers and the Estuary/ incl beach water monitoring | ECAN/Environment Canterbury | |
| unknown | STUFF | guidelines | Ministry for the Environment/Environment Ministry | |
| unknown | STUFF | | EECA | |
| unknown | STUFF | environmental assessment | Not given | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | scientific testing (air) | Not given | |
| unknown | STUFF | environmental compliance team/ beachwater monitoring | CCC | |
| unknown | STUFF | scientists | Not given | |
| unknown | STUFF | re brown kiwi numbers | Department of Conservation | |
| unknown | STUFF | university scientists | University of Canterbury | |
| unknown | STUFF | scientists from | IGNS (Institute of Geological and Nuclear Sciences) - see GNS | |
| unknown | STUFF | scientists, researchers | GNS | |
| unknown | STUFF | geologists - no other at the conference thought there was a link | Not given | |
| unknown | STUFF | | LINZ | |
| unknown | STUFF | | Royal Institution of Chartered Surveyors | |
| unknown | STUFF | | NIWA | |
| unknown | STUFF | | Taiwan's weather bureau | |
| unknown | STUFF | | PTWC | |
| unknown | STUFF | NZ officials | Not given | |
| unknown | STUFF | an expert panel did all the assessments (tsunami) for New Zealand | Not given | |
| unknown | STUFF | resource management consultancy ( report from re ECAN approach to seismic risk) | Enfocus | |
| unknown | STUFF | said/ website/ the government's hazard monitoring agency. | Geonet | |
| unknown | STUFF | (government research institute) | GNS Science/ Geological and Nuclear Sciences IGNS/ GNS | |
| unknown | STUFF | | Arkansas Geological Society | |
| unknown | STUFF | | British Geological Survey | |
| unknown | STUFF | | Centre of Seismographic Information & Research at the University of Memphis | |
| unknown | STUFF | reported a quake | Geoscience Australia | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | | Japan's Meteorological Agency | |
| unknown | STUFF | Tehran University' seismological centre reported on its website. | Tehran university | |
| unknown | STUFF | | USEPA | |
| unknown | STUFF | | Seismological Society of America | |
| unknown | STUFF | | Americal Geophysical Union | |
| unknown | STUFF | | USGS | |
| unknown | STUFF | Canterbury Quake Live website reported | Not given | |
| unknown | STUFF | scientific analysis | Not given | |
| unknown | STUFF | LiDar survey | Not given | |
| unknown | STUFF | quake.crowe.co.nz | Not given | |
| unknown | STUFF | researchers | University of Otago | |
| unknown | STUFF | research team (mapping megathrusts) | Not given | |
| unknown | STUFF | Scientists and technicians from Canterbury University and Canada's Calgary University/ geologists closely studying | University of Canterbury | |
| unknown | STUFF | scientists | Victoria University | |
| unknown | STUFF | collaboration between GNS Science and | Stanford University | |
| unknown | STUFF | members of the national government's Great Risks commission | Not given | |
| unknown | STUFF | officials - US earthquake | Not given | |
| unknown | STUFF | | Italy's geophysics institute | |
| unknown | STUFF | Scientists and technicians from Canterbury University and Canada's Calgary University | Calgary University | |
| unknown | STUFF | 60 scientists from 10 countries gathering in Gisborne to discuss ways of studying silent earthquakes | Not given | |
| unknown | STUFF | members of the national government's Great Risks commission, | Not given | |
| unknown | STUFF | 5200 signatories of professors, seismologists, postdocs and researchers from New Zealand to Costa Rica, Japan to Martinique. | Not given | |
| unknown | STUFF | seismologists/scientists/geologists | Not given | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | | United Research Services | |
| unknown | STUFF | | Geotech consulting | |
| unknown | STUFF | | Geovert | |
| unknown | STUFF | | GNS | |
| unknown | STUFF | scientific advice' | Not given | |
| unknown | STUFF | geotechnical report(s) and expert advice | Not given | |
| unknown | STUFF | student of Misko Cubrinov | University of Canterbury | |
| unknown | STUFF | geotechnical group | Port Hills Geotech | |
| unknown | STUFF | international expert | Not given | |
| unknown | STUFF | 100 strong team of OPUS engineers | OPUS | |
| unknown | STUFF | geotechnical engineers/ engineering consultants/engineering firm | T&T (Tonkin & Taylor) | |
| unknown | STUFF | 300 geotechnical engineers and geologists from 35 consultancies around the country | Not given | |
| unknown | STUFF | geotechnical work/ geotechnical engineers (over 100 reporting each day) geotech specialists/assessment over 100 some from Australia/experts say | Not given | |
| unknown | STUFF | counsellors - treating traumatised quake survivors | Not given | |
| unknown | STUFF | injuries/drunkenness in EM dept | CDHB | |
| unknown | STUFF | | hospital | |
| unknown | STUFF | | St John | |
| unknown | STUFF | spokeswoman | Christchurch Hospital | |
| unknown | STUFF | staff | Christchurch Women's Hospital | |
| unknown | STUFF | doctors told him | Not given | |
| unknown | STUFF | paramedics | Not given | |
| unknown | STUFF | anaesthetist | Not given | |
| unknown | STUFF | doctors | Not given | |
| unknown | STUFF | urologist, female | Not given | |
| unknown | STUFF | police - were the lead agency in the aftermath of the earthquake, he said. Part of their operation was identifying the victims of collapsed buildings | NZ Police | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | dentists and other forensic experts | ESR | |
| unknown | STUFF | pathologists from New Zealand, Australia & Singapore | Not given | |
| unknown | STUFF | DVI team | Not given | |
| unknown | STUFF | odontologists (forensic dentists), forensic anthropologists/ DNA testing, fingerprints, forensic pathology/ dvi process, forensic science/ dental records/ pathologists/ victim identification teams | Not given | |
| unknown | STUFF | | NZ Food Safety Authority | |
| unknown | STUFF | | CDHB | |
| unknown | STUFF | funding available/funded by the Health Research Council of New Zealand and the Canterbury Medical Research Foundation | Canterbury Medical Research Foundation | |
| unknown | STUFF | | Health authorities/health service | |
| unknown | STUFF | | Brainwave trust | |
| unknown | STUFF | funding available/ funded by the Health Research Council of New Zealand and the Canterbury Medical Research Foundation | Health Research Council of New Zealand | |
| unknown | STUFF | spokeswoman | CDHB | |
| unknown | STUFF | staff | National Radiation Laboratory | |
| unknown | STUFF | spokesman | Ministry of Health | |
| unknown | STUFF | Chief/Canterbury Medical Officer of Health | Not given | |
| unknown | STUFF | group | The Researching the Health Implications of Seismic Events group (RHISE) | |
| unknown | STUFF | health officials/authorities | Not given | |
| unknown | STUFF | Christchurch GPs | Not given | |
| unknown | STUFF | testing by health officials | Not given | |
| unknown | STUFF | | UN Nuclear watchdog | |
| unknown | STUFF | | Japan's nuclear safety agency | |
| unknown | STUFF | expert | Not given | |
| unknown | STUFF | an official, officials | Japan's nuclear safety commission | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | | EECA - Energy Efficiency Conservation Authority | |
| unknown | STUFF | *Scientists and water monitoring staff* | Not given | |
| unknown | STUFF | | University of Canterbury | |
| unknown | STUFF | | Natural Hazards Platform | |
| unknown | STUFF | | MCDEM | |
| unknown | STUFF | | ECAN | |
| unknown | STUFF | Catastrophe modelling firm | EQCAT | |
| unknown | STUFF | Nelson-Tasman Engineering Lifelines natural hazards report, produced in 2009, quotes Geological and Nuclear Sciences | Not given | |
| unknown | STUFF | Trademe forum 'survey' re preparation | Not given | |
| unknown | STUFF | | Colmar Brunton survey (effectiveness of get Ready Get Thru) | |
| unknown | STUFF | researchers | University of Delaware | |
| unknown | STUFF | international and New Zealand experts who will provide professional advice on issues relevant to the inquiry | Not given | |
| unknown | STUFF | bm - scientists in Japan suggesting urban planners, architects and sociologists are seeing a unique opportunity to incorporate fresh elements for an ageing population in these places. | Not given | |
| unknown | STUFF | scientists and engineers | University & Crown Research Institute | |
| unknown | STUFF | | NZ Historic Places Trust | |
| unknown | STUFF | archaeologist | Not given | |
| unknown | STUFF | finger-printing | Not given | |
| unknown | STUFF | | Metservice | |
| unknown | STUFF | funding by | Foundation for Research Science and Technology. | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | funding | US National Science Foundation has funded further research in Christchurch to find out why the method failed. | |
| unknown | STUFF | scientists | University of Canterbury | |
| unknown | STUFF | panel of experts/ funding of research / (geoscientists & engineering disciplines) | Royal Society of New Zealand | |
| unknown | STUFF | university experts | Not given | |
| unknown | STUFF | advice from re calming pets, calming agents and using boiled water | Merivale Papanui Veterinary Clinic | |
| unknown | STUFF | specialised 12-member team from Massey University is on standby to provide emergency in-field veterinary treatment | Massey University | |
| unknown | STUFF | landscape architects | Not given | |
| unknown | STUFF | consultants | Hill Young Cooper and Resource Management Group | |
| unknown | STUFF | city planner | Not given | |
| unknown | STUFF | constitutional law experts from all six New Zealand law faculties | Universities | |
| unknown | STUFF | | Fairfax Media-Research International poll | |
| unknown | STUFF | design challenge at | Lincoln University | |
| unknown | STUFF | Danish firm Gehl Architects, A City for People | Gehl architects | |
| unknown | STUFF | | New Zealand Institute of Architects | |
| unknown | STUFF | latest architectural engineering techniques | Not given | |
| unknown | STUFF | certain architects and heritage lobbyists | Not given | |
| unknown | STUFF | engineer - design | Not given | |
| unknown | STUFF | 115 design professionals | Not given | |
| unknown | STUFF | panel of architects | Not given | |
| unknown | STUFF | | Centre for Advanced Engineering (CAENZ) | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | Building and Housing report: The Performance of Unreinforced Masonry Buildings in the 2010/2011 Canterbury Earthquake Swarm. | DBH | |
| unknown | STUFF | chair of | EECA | |
| unknown | STUFF | engineering lifelines study | Not given | |
| unknown | STUFF | river engineers | Not given | |
| unknown | STUFF | | The New Zealand Council for Infrastructure Development (NZCID) | |
| unknown | STUFF | engineering firm | Not given | |
| unknown | STUFF | inspection by x 1 | Holmes Consulting | |
| unknown | STUFF | | DBH | |
| unknown | STUFF | report | Opus Engineering/Opus International | |
| unknown | STUFF | new PhD in eq resistant building | Not given | |
| unknown | STUFF | 1992 EQC research paper | EQC | |
| unknown | STUFF | engineering inspection | CCC | |
| unknown | STUFF | Beca report for Building an housing | Beca | |
| unknown | STUFF | engineering of sculptures | Not given | |
| unknown | STUFF | engineers report(s)/ structural engineering report | Not given | |
| unknown | STUFF | engineering designers | Dunning Thornton | |
| unknown | STUFF | Chartered Professional (structural) Engineer | Not given | |
| unknown | STUFF | spokeswoman | DBH | |
| unknown | STUFF | engineers | Wiss, Janney, Elstner Associates Inc., of Northbrook, Ill., a firm specializing in earthquake damage | |
| unknown | STUFF | engineers | NZSEE | |
| unknown | STUFF | technical advisory group led by barrister Alan Dormer | Not given | |
| unknown | STUFF | engineering experts | Not given | |
| unknown | STUFF | building experts | Not given | |
| unknown | STUFF | engineering, safety, clearing, stabilise | Not given | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | STUFF | engineers - assessing/assessments/teams of structural engineers/to recheck/ structural engineers | Not given | |
| unknown | STUFF | IT engineer | Not given | |
| unknown | STUFF | experts warned (up to 1500 people could be killed) | unknown | |
| unknown | TV | | Pacific Tsunami Warning Centre | |
| unknown | TV | | International Financial Services firm estimates cost | |
| unknown | TV | international models for single events - not designed to calculate effects of multiple events | | |
| unknown | TV | engineers (international) | | |
| unknown | TV | expert(ise) - international | | |
| unknown | TV | advice from overseas | | |
| unknown | TV | scientists (Tohoku - evaluate) | | |
| unknown | TV | | Institute of Earth and Science Engineering (*University of Auckland*) | |
| unknown | TV | geological monitoring | | |
| unknown | TV | science advisors (tsunami) | | |
| unknown | TV | | Geonet | |
| unknown | TV | website | Geonet | |
| unknown | TV | website | GNS Science | |
| unknown | TV | seismologist (duty) | Geonet (714) | |
| unknown | TV | seismologists | GNS | |
| unknown | TV | expert | GNS Science | |
| unknown | TV | seismologist (duty) | GNS Science | |
| unknown | TV | expert (geoscientist) | | |
| unknown | TV | | GNS/ GNS Science | |
| unknown | TV | estimate/assessment | Treasury | |
| unknown | TV | economist /economic loss models | | |
| unknown | TV | | Warren & Mahoney architects | |
| unknown | TV | report by Department of Building and Housing | | |

| **Unidentified scientist** | **TV and/or STUFF** | **Media description(s) of position** | **Institution/Organisation** | **Title** |
|---|---|---|---|---|
| unknown | TV | | Aurecon | |
| unknown | TV | | Beca Engineering | |
| unknown | TV | | Holmes Consulting Engineer | |
| unknown | TV | expert panel | | |
| unknown | TV | (engineer) structural report | | |
| unknown | TV | architects | | |
| unknown | TV | | Tonkin & Taylor | |
| unknown | TV | engineers reports | | |
| unknown | TV | design | | |
| unknown | TV | *engineering* structural assessments | | |
| unknown | TV | engineers (structural - assessors) | | |
| unknown | TV | geotechnical report | EQC | |
| unknown | TV | testing the soil | EQC | |
| unknown | TV | geotechnical zoning decisions | | |
| unknown | TV | geotech assessments | | |
| unknown | TV | geotechnical report | | |
| unknown | TV | geotechnical engineer(s) | | |
| unknown | TV | neurologists having conference | | |
| unknown | TV | health authorities | | |
| unknown | TV | | CDHB | |
| unknown | TV | experts (health) | | |
| unknown | TV | | hospital, Christchurch Charity | |
| unknown | TV | | Ministry of Health/Health Ministry | |
| unknown | TV | medical officer of health (Canterbury's) | | |
| unknown | TV | doctor (hospital) | | |
| unknown | TV | | hospital | |
| unknown | TV | disaster victim identification (DVI) team/process | | |
| unknown | TV | | Royal Commission | |
| unknown | TV | heritage experts | | |

| Unidentified scientist | TV and/or STUFF | Media description(s) of position | Institution/Organisation | Title |
|---|---|---|---|---|
| unknown | TV | police - crime statistics | | |
| unknown | TV | nuclear experts | | |
| unknown | TV | other - chemistry changes - brewing process with loss of power | | |
| unknown | TV | | SPCA | |
| unknown | TV | | Metservice | |
| unknown | TV | planners (architects &) | | |
| unknown | TV | legal scholars (group of) | | |

-blank-

# Appendix 12: Prevalence of media headline story types

This Appendix contains one table (Appendix Table 12.1) over 4 pages.

**Appendix Table 12.1 Prevalence of earthquake-related media headline story types – ODT, TV1 and Stuff**

Numbers of articles in each of the earthquake-related story types identified in New Zealand online broadcast and print media before (pre) and after (post) the Darfield earthquake of 2010. Story types presented in alphabetical order. Totals are presented on the last page of the table.

| Media Headline Story Types | TV Pre | TV Post | STUFF Post | ODT Pre | ODT Post |
|---|---|---|---|---|---|
| (Animals) Sensing Earthquakes | | | 2 | | |
| (In)action | | 1 | 6 | 2 | 2 |
| (Un)employment in Response | | 4 | 1 | | 14 |
| (Un)employment in Recovery | | 4 | 2 | | 19 |
| (Un)prepared Citizens | 1 | | 3 | 2 | 3 |
| About or Assisting Animals | | 5 | 6 | 2 | 9 |
| Accommodation/Break Away | | 5 | | | 24 |
| Aftershock(s) | | 4 | 44 | 7 | 40 |
| Aid Issues | | 2 | | 7 | |
| Aid Projects in Recovery | | | | 3 | 5 |
| Antisocial Behaviour & Law Enforcement | | 23 | 6 | 6 | 115 |
| Area's History & Culture | | 6 | | | |
| Associated Natural Phenomena | 3 | 17 | 8 | 4 | 17 |
| At Risk: Buildings/Infrastructure | | 2 | 7 | 3 | 15 |
| At Risk: Cities, Regions/Scenarios | 1 | | 5 | 8 | 10 |
| Authorities Response Planning | | | 1 | 2 | 9 |
| Authorities Update | | | 3 | | 3 |
| Awards, Commendations or Thanks | | 6 | 7 | 1 | 31 |
| Background/Expectations | | 7 | 22 | 10 | 20 |
| Building Assessment & Decisions | 1 | 21 | 18 | | 36 |
| Burying Dead | | | | 3 | 1 |
| Business in Recovery | | | 5 | | 289 |
| Business or Industry Effects | | 36 | 3 | | 64 |
| Business Recovery Initiatives | | 16 | 5 | | 39 |
| Business Response Initiatives | | 3 | | 1 | 7 |
| Businesses Helping Out | | 3 | | 1 | 19 |
| Celebrity Involvement | | 18 | | 4 | 8 |
| Celebrity Visit | | 4 | | 1 | 8 |
| Change in luck | | | | | 4 |
| Citizen Awareness & Cultural Memory | | | | 1 | 1 |
| Citizens in Recovery | 1 | 4 | 1 | | 10 |
| Cleaning Up | | 3 | 1 | 3 | 4 |
| Closure | | | 2 | 2 | 11 |
| Code compliance | | | | 1 | 2 |

**Appendix 12.1 cont/-**

| Media Headline Story Types | TV Pre | TV Post | STUFF Post | ODT Pre | ODT Post |
|---|---|---|---|---|---|
| Codes, Standards, Policies | | 2 | 10 | 1 | 27 |
| Commemoration or Memorial | | 58 | 1 | 3 | 41 |
| Communication in Response | | | 2 | | |
| Community/Health Preparations | | | 3 | 1 | 6 |
| Construction Methods or Materials | | | 19 | 5 | 12 |
| Damage/Devastation | 7 | 75 | 10 | 4 | 54 |
| Death Toll or Injured | 6 | 7 | 9 | 39 | 38 |
| Development Hearings | | | | 2 | 1 |
| Disaster Occurrence | | 4 | 1 | | 2 |
| Disruption | | 10 | 4 | 2 | 363 |
| Doing Better/More in Response | | 26 | 5 | 4 | 43 |
| Don't Worry | | | 2 | | |
| Double Disaster | | 1 | | 5 | 12 |
| Drills | | | 5 | 5 | 6 |
| DRR is costly/Good investment | | | 4 | 1 | 4 |
| Economic Vulnerability | | 4 | 1 | | 1 |
| Economy in Recovery | 2 | 1 | 6 | 3 | 300 |
| Emergency Medical Treatment | | 8 | 15 | 3 | 15 |
| End of Year | | 6 | 3 | | 4 |
| Environment & Public Health | | 1 | 48 | | 4 |
| Environmental Rehabilitation | | | 1 | | |
| Fatalistic Beliefs | | 2 | 1 | 7 | 10 |
| Fear, Flee or Panic | 1 | 6 | 3 | 1 | 10 |
| Felt Occurrence | 3 | 4 | 99 | 156 | 98 |
| Felt Occurrence-multiple | | 1 | 24 | 14 | 6 |
| Financial Incentives | | | | | 9 |
| Financial Planning & Preparation | 1 | 1 | | | 2 |
| Forecasting or Prediction | 1 | 18 | 50 | 6 | 25 |
| Foreign Survivor/Victim Story | 3 | | | 8 | 4 |
| Fostering Awareness | | 6 | | 14 | 33 |
| Fundraising/Donations by NZers | 3 | 41 | 2 | 16 | 250 |
| Future Insurance or Reinsurance | 1 | 20 | 7 | 30 | 73 |
| GDP/Development Saves Lives | | | 1 | | 3 |
| General Emergency Management | 2 | 8 | 1 | 1 | 40 |
| Government Assistance | | 16 | 5 | | 37 |
| Government Recovery Initiatives | | 26 | | | 50 |
| Heritage Building Matters | | 20 | 12 | 12 | 29 |
| Historic Commemoration | | | | 1 | |
| Historic Event lists | | | 2 | 2 | 2 |
| Historic Events | | | 6 | 31 | 43 |
| Household Preparations | 1 | 4 | | 3 | 6 |
| Housing, Homelessness or Shelter | | 18 | 2 | 6 | 18 |

**Appendix 12.1 cont/-**

| Media Headline Story Types | TV Pre | TV Post | STUFF Post | ODT Pre | ODT Post |
|---|---|---|---|---|---|
| Impact on Economy | | 35 | 17 | 2 | 59 |
| Infrastructure & Public Health | | 30 | 12 | | 14 |
| Infrastructure & Public Health-Nuclear | | | | | 26 |
| Infrastructure Damage/Restoration | | 3 | 5 | | 21 |
| Infrastructure Upgrade | | | | 1 | 2 |
| Injury Rehabilitation | | 4 | 4 | | 1 |
| Inquest/Cause of Injury | | 11 | 9 | | 10 |
| Insurance Claim Numbers or Cost | | | 6 | 3 | 11 |
| Insurance Claim Process or Repairs | | 9 | 3 | | 30 |
| Insurance Problems | | 18 | | 1 | 11 |
| International Aid | | 3 | | 3 | 12 |
| Land Decisions | | 46 | 40 | | 22 |
| Land Use | | | | | 4 |
| Latest update | 5 | 64 | 13 | | 19 |
| Leader Condolences | | 2 | | | 16 |
| Leader Visit | | | | 5 | 21 |
| Leaders & Aid | | 1 | | 1 | 5 |
| Lessons or Reflections | 2 | 4 | 10 | 1 | 25 |
| Liability, Litigation or Inquiry | | 4 | 13 | 2 | 16 |
| Making the Natural Environment Safer | | | 8 | 1 | 3 |
| MFAT info/Missing NZer | 1 | | | 11 | 15 |
| Military or Police Relief/Aid | 2 | 5 | | 5 | 12 |
| Miscellaneous | | | | 21 | 25 |
| Monitoring or Warning Systems | 1 | | 3 | 4 | 3 |
| More to Come? Link? | | | 6 | 2 | 4 |
| NGOs & Aid | | 5 | | 9 | 22 |
| NZ Authorities Aid | 2 | 5 | | 13 | 27 |
| NZer Relief Volunteers | 2 | 31 | | 8 | 30 |
| NZers flown home | | | | 3 | 2 |
| Other Effect on NZ(er) | 2 | 2 | | | |
| Other Environmental Effects | | | 15 | 2 | 2 |
| Other Health Warnings | | | 6 | 2 | 13 |
| Other Social Effects | 2 | 37 | 17 | 4 | 112 |
| Outstanding International Individuals | | | | 4 | 1 |
| Pastoral Care | | | | | 11 |
| Political in Crisis | | 29 | | 5 | 8 |
| Political in Recovery | | 32 | 9 | 4 | 133 |
| Rational Reaction | | 1 | | 2 | 6 |
| Rebuild Logistics/Progressing | 1 | 11 | 4 | 3 | 24 |
| Rebuild: Plans & Vision | | 24 | 21 | | 23 |
| Recording for Posterity | | | 5 | | |
| Recovery Legislation | | | 7 | | 13 |

**Appendix 12.1 cont/-**

| Media Headline Story Types | TV Pre | TV Post | STUFF Post | ODT Pre | ODT Post |
|---|---|---|---|---|---|
| Recovery Progress | 2 | 10 | 14 | 1 | 20 |
| Recycling - or not | | 3 | 4 | | 1 |
| Reflecting on Cause | | | | 1 | 3 |
| Remembering | | 4 | | 3 | 21 |
| Research Findings | 2 | 3 | 31 | 3 | 13 |
| Research Plans | 2 | 1 | 8 | 6 | 4 |
| Researcher/Researching | 2 | 6 | 29 | 1 | 12 |
| Restricted Access | | 13 | 3 | 3 | 24 |
| Return to normal/resilience | | 39 | 2 | | 59 |
| Reviewing Authorities' Preparation | | | | | 5 |
| Reviewing Communication | 3 | 3 | 16 | 9 | 18 |
| Reviewing Construction & Codes | | 13 | 9 | 6 | 16 |
| Reviewing Land Use | | | 4 | | 3 |
| Reviewing Research | | 1 | 1 | | |
| Safety Assessments/Reports | | | | | 5 |
| Schools Closed, to Reopen | | 3 | | | 13 |
| Search & Rescue | 5 | 68 | 1 | 22 | 58 |
| Secondary Land Threats | | 2 | 16 | 5 | 4 |
| Securing Contents | | | | | 2 |
| Skills Shortage | | 4 | 1 | | 6 |
| Solidarity, Compassion & Community Spirit | | 11 | 1 | | 46 |
| Sport | | 6 | 1 | | 88 |
| State of Emergency | | 7 | 1 | | 12 |
| Staying or Going (not school students) | | 6 | 9 | | 63 |
| Strengthening | | 2 | 1 | 10 | 24 |
| Stressed, Scared, Struggling | | 30 | 22 | 3 | 54 |
| Students Staying or Going | | | | | 12 |
| Supporting Research - or not | | | 6 | 1 | 5 |
| Survivor/Victim Story | 4 | 25 | 4 | 13 | 134 |
| Sustainability | | | | | 2 |
| Technology! | | 4 | 4 | 1 | 2 |
| This Day in History | | | | | 4 |
| Tsunami Warning | 9 | 4 | 6 | 18 | 11 |
| Understanding Earthquakes/Aftershocks | 4 | 15 | 21 | | |
| Victim ID or Name Release | | 11 | 10 | | 29 |
| Volcanic Eruption | | | 1 | 1 | 5 |
| Ways to Feel Better | | 15 | 15 | | 23 |
| Weather Worries | | 3 | 4 | 1 | 12 |
| Grand Total | 91 | 1316 | 1000 | 689 | 1407 |

# Appendix 13: Example controversies involving science and the Canterbury earthquakes

This Appendix contains one table (Appendix Table 13.1) over 2 pages.

-blank-

**Appendix Table 13.1: Example controversies involving science and the Canterbury earthquakes**

Selected contentious issues related to aspects of earthquake-related science, New Zealand mass media September 2010-February discussed in this thesis

| **Topic area** | **NZ specific illustration** | **Science** | **Summary of issue** |
|---|---|---|---|
| Risk | Expectation of alpine fault rupture (AFR) or Wellington rather than Christchurch | Earth science | Focus on Wellington because of economic and political importance and less attention on potential consequences and ways of avoiding or mitigating these (Orchiston PhD thesis makes ref to – in her paper). not well-reported in mass media.<br>After the Port Hills earthquake it was reported in the media that there had been a television documentary in 1996 about the possibility of a major earthquake and the effect of liquefaction and building collapse but citizens including officials had not acted on this. The connection between this latter aspect and the former was not emphasised in the media. |
| Unknown fault | Darfield fault unknown (no surface expression) | Earth science | On-line comment – "What do geoscientists know anyway?" |
| Hazard knowledge<br>– effects & consequences | Liquefaction | Earth science/<br>Geotechnical Engineering | Earth scientists scientists had communicated the possibility of liquefaction to policy- and decision-makers, and it was the topic of regional council publication ECAN (2007a) but in the period April 2008 – September 2012 there were only four mentions of the word liquefaction. This latter point may account for citizen reaction after the Darfield earthquake – 'Why weren't we told about liquefaction?" |
| Predictions on the basis of lunar cycles | Whether to pay attention to Ken Ring 'the Moon Man' | Earth science | Pseudo-scientific 'prediction' and the value of scientific forecasting |
| Forecasting/prediction ongoing risk (risk appetite, alarm versus reassurance, economic implications, panic reactions, telling it like it is | Forecasting/prediction | Earth science | Earth scientists did not publicise possibiity of another event in particular the possibility of a damaging aftershock – see section 7.7 in particular tables and figures in section 6.7.3, aftershock risk. |
| Aftershock | Expectation – duration and number (belief that Canterbury unusual in both aspects) but | Earth science | See above |
| Post-eartquake survival – raised in survey and interview – not contentious in media) | Boiling water | Public Health | See section 6.9 |
| Science takes time | Time - DVI | Pathology | Time taken for the DVI process was commented on by Prime Minister John Key |

**Table 13.1 cont/-: Example controversies**

| **Topic area** | **NZ specific illustration** | **Science** | **Summary of issue** |
|---|---|---|---|
| What to do with 'earthquake-prone' buildings | Heritage (URM) buildings & old buildings not to NZ Code | Building science - engineering - codes | Enforcement – who should bear costs |
| Personal reponse advice | Drop cover & hold vs Triangle of life | Emergency Medicine | "Civil Defence spokesman John Hamilton said the email was circulating around New Zealand. It includes the "dangerous statement" that people who get under objects like desks or cars are crushed. That advice was wrong, he said." In Stuff article published in June 2008 "Earthquake advice a bit shaky" (The Press, 2008).<br>Officials expressed dismay in a MCDEM press release March 2010 that the email had resurfaced once again criticising the CDEM sector for advocating 'drop, cover, and hold'... It is unfortunate that people are so quick to doubt well-developed and researched official advice on the basis of unsolicited information from a self-professed expert (MCDEM, 2010). This adivce was updated on September 9 2010 when the email advice resurfaced after the Darfield earthquake. This was reported on the same day by the Press as "Earthquake email advice 'dangerous'" (Steward, 2010).<br>However it should be noted that the press release did not contain any details of the research or evidence basis simply that the adivce had been "developed collaboratively with expert agencies such as GNS Science, EQC and the Society of Earthquake Engineers" and was the "widely discredited by leading emergency management agencies throughout the developed world" (MCDEM, 2010).<br>Prof Ardagh (emergency medicine expert in Christchurch, Inteviewee I007) mentioned research relating injuries to what people were doing, however this was not translated into media comment.<br>It was only in an article published on March 11 2011 that there was comment that related directly to citizen's earthquake experience. |
| Engineering assessment – 'stickering', forced evacuation and reoccupation and post-earthquake safety | | Building science - engineering- assessments | What assessment involved, what stickers meant enforced evacuations and cordon. |
| Psychosocial | Coping/not coping | Psychology/health | Coping, and resilience (section 7.6.10) |
| Geotechnical land –use decision making | | Geotechnical | Transparency and trade-offs<br>Wanting right to make own decsions in respect of rock-fall risk<br>More people want red zoning when green zoned than red zone but want to stay.. Zoning decisions, and costs of foundation requirements in TC3 zone |

# Appendix 14: Survey and interview responses regarding aftershocks

This Appendix contains information sbout survey and interview respondents and their responses regarding aftershocks including:



Tables



## Appendix 14.1: "Aftershock" was the physical hazard most frequently mentioned in survey and interview

*"The whole experience of the Canterbury sequence has come as a traumatic experience for many, that were not prepared [for] the long-duration and intensity of the aftershock sequence, [and] the activation of a set of different faults"*[W227]

Of the physical earthquake hazard effects mentioned by name in survey and interview, 'aftershock' was the most frequently mentioned. This statement holds in relation to both of the primary questions[38]. Overall seventeen per cent (75) of the 442 respondents who answered Questions 2 & 3 mentioned aftershocks in some way[39]. Appendix 14.2 gives details of stakeholder type and science background of those respondents who mentioned aftershocks. Notes about the aftershock responses are provided in Appendix 14.3.

[38] The two open-ended questions were: Q2 "What do you believe people need to know about earthquakes and minimising earthquake-related disasters? Why?" Q3 "What do you think could have been better explained about earthquakes or minimising earthquake-related disasters, than it was before or during the Canterbury earthquakes?"

[39] These were unprompted, open answer questions replied to by *203 face to face and 229 web-based survey* respondents, and *29 interviewees.*

## Appendix 14.2: Respondent science background and association with DRR and or the Canterbury earthquakes

Seventy-two per cent of respondents who mentioned aftershocks are citizens, who while they may have some background in science, or interest in DRR do not have expertise in DRR (See Appendix Table 14.1). Seventy-seven per cent of the 75 respondents have either a lived experience of the Canterbury earthquakes (56%) or a significant association through family, friends, their work or business (19%).

**Appendix Table 14.1: Science background and association with DRR and the Canterbury earthquakes, of respondents who refer to aftershocks.**

| No. | Respondent Types | Science background |
|---|---|---|
| 15 | DRR Advocates who are 'scientific experts'. These are specialists in some DRR-related science. Three are in paid roles with a policy & decision-making interface, 7 others are paid advocates and 5 volunteer their time in DRR. | 'Experts' in some form of DRR-related science. Four are social scientists and 5 geoscientists, 2 engineers, 3 health scientists and 2 have multi-disciplinary DRR-science backgrounds. |
| 4 | Experts in some form of science who do not consider that they are advocates for DRR | Two health and two social scientsts whose backgrounds are in fields related to DRR. |
| 4 | Policy or Decision-makers (local, regional with DRR-related roles or national government) | None identified |
| 4 | Media or Communications - two of whom consider they are a DRR advocate through their work | Three have some science background. at undergraduate level. One is in Earth Science and another is in Maths/Stats. |
| 15 | Citizens who identify themselves as Community Advocates - variously involved in DRR in relatively even numbers from 'Some' through to 'High' DRR involvement - those with High mostly Canterbury Recovery) | None identified |
| 31 | Other citizens - 13 of these respondents have lived experience of one or more Canterbury earthquakes, and a further 6 have a moderate to high association with the Canterbury earthquakes through affected family and friends, work or business. | 8 of these have science backgrounds and are variously prepared at home or work |
| | | 12 have no science or media or communications background and are prepared at home or work |
| | | 11 have no science or media or communications background and consider themselves 'unprepared' |
| 2 | No response | |

Sixty-nine per cent of interviewees mentioned aftershocks. This perhaps indicates that had other respondents spent the same time in reflecting on, and answering the questions, more mentions of aftershocks might have been made.

## Appendix 14.3: Notes responses about aftershocks in Table 6.10

Whilst 18 respondents mentioned aftershock in both answers, 25 included some aspect of aftershocks only in their response to what people need to have communicated, and 32 answered that one or more aspects of aftershocks should have been better communicated, without having mentioned aftershock in Q2 (see Table 2).[40]

There are far fewer mentions of the need to communicate or better communicate (Q2 & 3 combined) hazard characteristics and cause, and aftershock-related DRR solutions than requests for information, or better information about a) the potential exposure to aftershocks (and in particular a lengthy seismic sequence), b) the specific consequences of aftershocks., and c) the potential severity of intensity of aftershocks.

The topics most commonly mentioned as needing to be communicated (Q2) were a) some aspect of potential exposure to, or likelihood of the aftershocks, including frequency and magnitude forecasts and b) the possible duration of the seismically active period following a major earthquake.

Aspects of aftershocks that respondents indicated could have been much better communicated (Q3) both before the Darfield earthquake and afterward were primarily; a) the possible duration of the seismic sequence, b) the potential for aftershocks and forecasting thereof (respondents want the facts, not reassurance), c) the nature of aftershock consequences (in particular the increased vulnerability of the built environment and the psychosocial effects of aftershocks), and d) the potential severity of aftershocks (intensity and general effects).

Of those who mentioned specific aftershock consequences as needing to be better communicated these were, in decreasing order to psychological effects, the increased vulnerability of buildings and infrastructure during, and due to aftershocks, and the effects on the natural environment. While a few respondents mention the need for better information regarding the potential impact of aftershocks on recovery timelines and decision-making in recovery, no one mentioned the economy.

The duration of the seismically active period has implications for psychosocial experience. Frequency of mention of both of ‘duration’ and ‘consequences on human community’ topics would likely not be as high in a population that had not experienced a sequence with Canterbury’s 2010-2011 aftershock characteristics. Nevertheless greater attention to communication of the potential psychosocial consequences of earthquakes, with particular mention of aftershocks is indicated (see also discussion in section 7.5.8).

As with responses relating to communication of seismic risk in general (see section 7.7) respondents are mixed in their request for general information relating to exposure, or desire for specific ‘likelihoods’ and forecasts. Twenty eight percent of this subset of ‘aftershock-mentioning’ respondents specifically referred to wanting to be told of the risk of aftershocks rather than being reassured. “*It’s important people be told the truth so they can make decisions based on reality rather than wishful thinking. If the risk [of aftershocks] is high people ought to be told*”[F198]. Alarm versus reassurance is discussed in section 7.7.2).

While a few of the twelve respondents who made reference to the limitations of aftershock forecasts implied in some way that scientists ‘did not know’ in a way that was not accepting of uncertainty in forecasting, most wanted the limitations of forecasts better communicated. A perhaps surprising observation is that there were not only a significant number of respondents who mentioned it being important to highlight the uncertainties inherent in forecasting, but that these respondents were almost all neither DRR-related scientists, or self-reported as not being involved in DRR outside of household preparations.

---

[40] Even where respondents made reference to aspect of aftershocks in Q3 that implied that these should be communicated but did not mention them in Q2, these were only coded in Q3. An example is W168 who in response to Q3 while referring to information provided having been ‘what was known at the time’, and going on to mention one aspect of aftershock that could have been better communicated made no reference to anything to do with aftershocks in response to Q2. Similarly where respondents gave responses in answer to Q2 that alluded to something that could have been better communicated but did not refer to them in Q3, these have not been coded twice, even when this was in interview (eg I010).

Not only were there far fewer requests for hazard cause and consequence-related information but it is interesting to note that there was no mention by survey respondents, [or in the media analysed] of the general rule of thumb that aftershocks will occur "*near to the main shock and often within a distance of slightly more than the fault length of the initial rupture*" (as was discussed in the Royal Commission of Inquiry Final Report (Royal Commission, 2012a, pp. 39-40). (See also section 7.7.14 for brief mention of treatment of foreshocks in the New Zealand mass media).

From a DRR perspective it is interesting to note that there were far more references to awareness or definition of aftershock-related 'problems', than DRR solutions. Not only that, but the references that were made to 'being prepared for aftershocks', knowing the approriate response to aftershocks, or 'safety' and aftershocks are typically even briefer and not as articulate as those made in regard to aftershock 'problem definition'. These findings are generally consistent with overall references to DRR actions made by survey respondents – that is they are focussed on preparedness or 'actions in response'. Whether this is because respondents consider the possibilities in reducing seismic risk to aftershocks are the same as for earthquake in general and not worthy of specific mention is unknown. Given that few respondents answered the "Why?' aspect of Q2 in relation to aftershock it is not particularly clear what value respondents place on aftershock-related information, and what, if any DRR actions or outcomes they associate with its' provision.

## Appendix 15: Poster on media education of the public

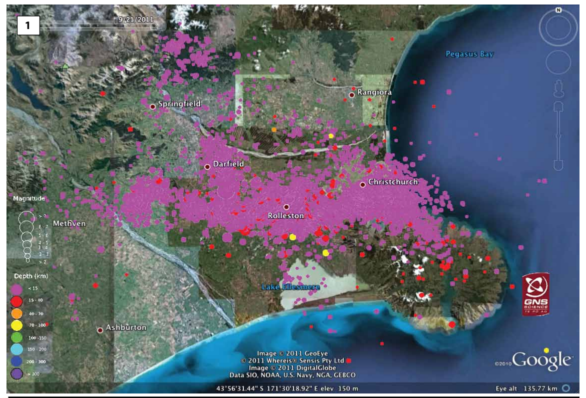
-blank-

# Appendix 15.1: Poster "Getting the message right" (Oates et al., 2012)

# GETTING THE MESSAGE RIGHT: A MEASURE OF HOW WELL THE MEDIA EDUCATED THE PUBLIC on GEOSCIENCE DURING THE 2010 -2011 EARTHQUAKE SEQUENCE IN CHRISTCHURCH, NEW ZEALAND

**Oates, Kaylyn[1], Pinkey-Drobnis, Aurora[2], Reeves, Jonathan[2], Wilson, Thomas M.[3], and Gravley, Darren M.[3]**

(1) Department of Geosciences, Smith College, Northampton, MA 01063, (2) Department of Geosciences, Skidmore College, 815 N. Broadway, Saratoga Springs, NY 12866, (3) Geological Sciences, University of Canterbury, Private Bag 4800, Christchurch, 8140, New Zealand



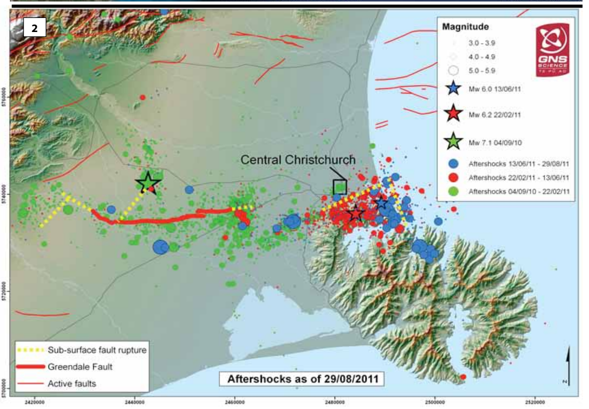



Figure 1: Map of Canterbury Region, aftershocks from September 2010-2011. Courtesy of GNS.
Figure 2:

## Context

Informing the public how science interprets the events can reduce uncertainty, fatalism and promote a greater sense of control. This understanding ultimately allows individuals and communities to make sense of their traumatic experiences. However, this lofty responsibility relies on media sources to communicate abstract principles, technical jargon, and complex scientific information about the event in an accurate, appropriate and accessible manner.

This research used the M7.1 September 4 2010, M6.3 February 22 2011 and M6.3 June 13 2011 earthquakes in Christchurch, New Zealand as a case study to test whether public knowledge of earthquakes and their associated hazards improved, and whether the media was effective in educating the public on the earthquake science.

The results of this research could be used to advise the media on how best to accurately portray scientific information, and conversely, how scientists should present information to the media. Both approaches aim to develop a well-informed (and hopefully prepared) public that makes effective and informed decisions to reduce disaster risk. The survey will be repeated in the future to measure the public's memory of the Christchurch earthquake, thus inherently measuring their ongoing education and preparedness.

Since September 4, 2010 there have been earthquakes greater than magnitude 3 every day in Christchurch, New Zealand. Earthquakes have become a part of everyday life for those living in Christchurch. Illustrated in Figure 6.

Given this circumstance of this reality, living in a place with such frequent earthquakes the public has developed a knowledge base of earthquake science.


Image courtesy of Mark Quigley

Figure 5: Photograph of the 4 Sept 2010 fault rupture indicated by arrow. "No Fault Here", is a statement mown into the feild by the owner.

### Why educate the public about scientific concepts behind earthquakes?

Public Education: A long-term approach to natural disaster resilience and hazard mitigation

An Educated Public:

- Understands why earthquakes occur
- Understands the risks and hazards associated with earthquakes.
- Has the skills needed to cope with the impacts of an earthquake event.
- Has the capacity to make long-term informed decisions to improve resiliency. and mitigate environmental, social, and economic impacts to their community.

(Hattori et. al. 2006; Mileti, 1999)

### Who has the responsibility to educate the public?

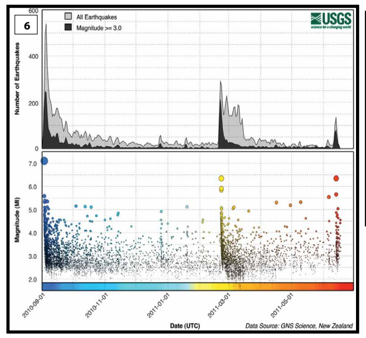



Figure 6: Aftershock decay rates for 2010-2011 Earthquake sequence in Christchurch, NZ.

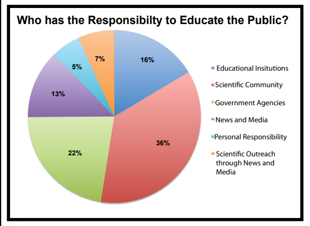



Figure 7: Survey response to the question, "Who has the Responsibility to Educate the Public". Results were qualitatively grouped into seven separate categories.

Priorities of the news and mass media shape how the public perceives the risks posed by natural hazards. These perceptions influence the set of strategies employed by the public for the mitigation of future vulnerability.
(Miles and Morse, 2007)

## Methods

1) Qualitative analysis of representative media sources and media response covering earthquake science after the events.

2) Anonymous Survey of New Zealand residents
   a. Questions regarding personal earthquake experiences, knowledge of earthquake geologic concepts, sources of information, and individual opinions of media and scientific community outreach.
   b. Distributed using a "snowball" chain email to contacts and Facebook.
   c. Demographics of the Survey:

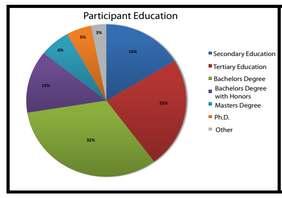



Figure 3: Representation of the highest level of education completed for survey participants.

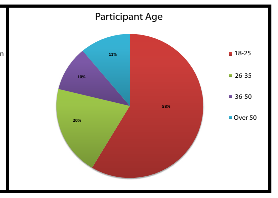



Figure 4: Age distribution among survey participants.

3) Google Trends search volume analysis of popularly searched geologic terms during the past year.

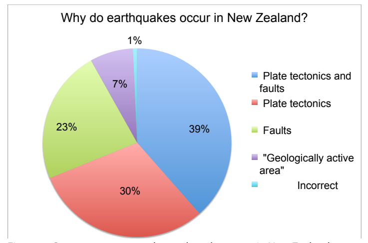



Figure 7: Survey response to why earthquakes occur in New Zealand.

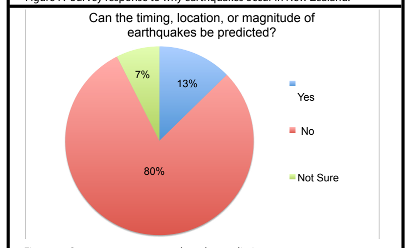



Figure 8: Survey response to earthquake prediction.

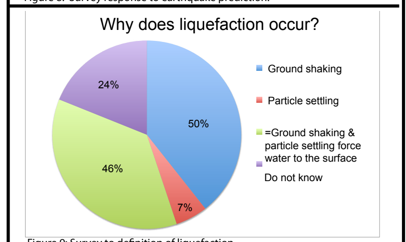
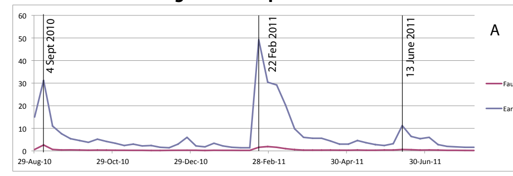
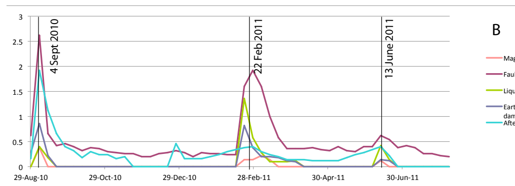



Figure 9: Survey to definition of liquefaction.

### Google Trends Analysis: What knowledge does the public seek for themselves?




A) Comparison between the number of searches for "earthquake" and "fault" within New Zealand scaled around the average number of searches per day from September 2010 to September 2011 as a base level of 1.0.

B) Close up comparison of scientific search terms related to earthquakes from Google Trends*. Each line is scaled relative to the search term "fault" with the average number of searches per day on Google from September 2010 to September 2011 as a base level of 1.0. Large increases in the number of searches regarding earthquakes are concurrent with major earthquake events, indicated with a black line.

## Results

**Earthquake Mechansims**

All but 1% of the surveyed population had some concept of why earthquakes occur in NZ. This knowledge, especially, knowing the term, "plate tectonics", comes from living in a geologically active area. Place based knowledge of earthquakes influenced by direct effects on the public and general understanding nationwide of basic geologic science behind natural disasters.

**Earthquake Prediction**

The legitimacy of earthquake prediction was hotly debated in the media due to predictions by a local weathercaster, Ken Ring, who claimed to be able to predict quakes based on the position of the moon (Tan and Wade, 2011).

Media hype around earthquake prediction highlights how the mass media often shape the public knowledge. We hypothesize that the media hype around the issue of earthquake prediction led the public to a heightened understanding of earthquake prediction limitations. (Miles and Morse, 2007). In this case the debate was coupled with significant outreach from the scientific community, thus turning misinformation into public education (GNS Science, 2011).

**Liquefaction**

127 responses to this question were analyzed based on explanations of liquefaction described in factsheets for the public from Geonet (Christchurch Earthquake Reponse, 2011). 57% mentioned one of the two main mechanisms causing liquefaction, but may not have had a full understanding of how the process occurs. 46% of responses had a full understanding of both mechanisms and their results, while 24% of responses were incorrect or did not know.

Liquefaction occurred in much of Christchurch and the surrounding suburbs after both the February and June earthquakes, as depicted in Figures 11 and 12. We hypothesize that most public knowledge of the term liquefaction comes from the firsthand experience and media coverage of the damages from liquefaction.

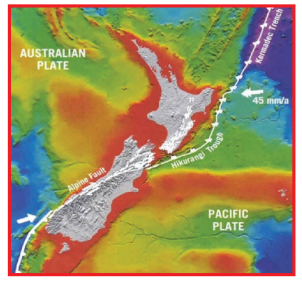



Figure 10: Bathymatery image illustrating New Zealand's postion along a plate boundary.

Image courtesy of Mark Quigley

Figure 11: A) Liquefaction after 4 Sept earthquake. b) A suburb of Christchurch

## Limitations

-Reduced sample size due to time constraints deemed necessary for accurate recall of events.
-Voluntary survey, rather than random sample, resulting in possible selection bias.
-Internet distribution method led to an specific age and education level, likely not representative of general population.

## Conclusions

Survey participants believe that it is the joint responsibility of the media, individuals, and scientists to educate the public about earthquake preparedness and response. The majority of individuals surveyed have at minimum a basic scientific understanding of earthquakes, why they occur, and the risks and hazards associated.

We attribute this to:
-Availability of educational resources and public institutions in New Zealand

- Place based learning in a country located on an active plate boundary

- Public dialogue of geologic topics in both the news and within the community

- Direct impacts to the community's social and economic structure contributing to the necessity for individuals to educate themselves

-Outreach of the scientific community to the news media and Internet availability

We believe that the level of public awareness about earthquakes in Christchurch, New Zealand have improved the long-term community resiliency, the ability of individuals to cope with earthquake hazards, and the potential for Christchurch to make informed decisions about city planning and rebuilding in the future. Christchurch can serve as a model for the importance of public education in other communities located in natural disaster prone areas.

## References

Christhurch Earthquake Reponse: Liquefaction factsheet. 2011. Earthquake Commission and GNS Science. http://canterburyearthquake.org.nz/science/

"Can Earthquake be predicted?" GNS Science. http://www.gns.cri.nz/Home/Learning/Science-Topics/Earthquakes/Monitoring-Earthquakes/Other-earthquake-questions/Can-earthquakes-be-predicted

Miles, Brian and Morse, Stephanie, 2007. The role of news media in natural disaster risk and recovery. Ecological Economics, v. 63, pp. 365-373.

Tan, L., Wade, A., 2011. 5.1 Earthquake, but moon-man link ruled out. New Zealand Herald. 21 March 2011. http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10713891

### Acknowledgements

A special thank you to Victoria Swords-Daniels from Massey University for helping with survey development, Mark Quigley for his input and use of photographs, to all New Zealand residents who participated in our survey and the Geology departments at University of Canterbury, Smith College, and Skidmore College for continued support.

- blank –

# Appendix 16: What's to be learnt from earthquake-related DRR from New Zealand women's magazines

This Appendix explains the value in analysing womens' magazines, and the results of that analysis are presented, unconventionally, in storied form.

-blank-

## Appendix 16.1: Explanation of representation of results of detailed analysis of womens' magazines

The appended 'stories' have been compiled from magazine articles relating to the topic 'earthquake' in the period 04 September 2007 – 04 April 2012, three years before the Darfield earthquake on 04 September 2010, and a year after the Port Hills earthquake on 22 February 2011.

Four different 'stories have been compiled; the 'Awareness of Earthquakes' Story, the 'Story of Seismic Risk' and the 'Earthquake-related DRR Story' and the "Science, Earthquakes and DRR' story.

What science-related information was presented in the New Zealand Women's Weekly (NZWW) over the five-year period is summarised in 'Science; Earthquakes and DRR (Appendix 16.2 p. 801).

The New Zealand awareness of earthquakes story covers information about earthquake characteristics, consequences, the earthquake's contribution to the disaster, and any other comment on disaster cause, published in the NZWW before (Appendix 16.3 p. 803) and during (Appendix 16.4 p. 805) the Canterbury earthquakes

The New Zealand seismic risk story (from coverage of the Canterbury earthquakes (Appendix 16.5 p .809) covers risk identification and risk analysis, where risk identification includes knowledge of exposure, including earthquake history/catalogue, probability and vulnerability and resilience, and risk analysis includes knowledge of the processes that lead to risk judgments that inform decision-making, e.g. levels of acceptable and tolerable risk and cost-benefit trade-offs

The New Zealand DRR story before the Canterbury earthquakes (Appendix 16.6 p. 811) and in coverage of the Canterbury earthquakes (Appendix 16.7 p.813) covers activities across the 4Rs of the DRR cycle and includes any mentions of DRR actions - mitigation, preparation, legislation, adaptation, innovation, communication and leadership.

As few words that were not part of the original text as was possible were used in creating these 'stories'. The thematic headings used relate to the key topics discussed throughout the thesis and were not part of the published material. Each statement is referenced back to it's originating text and communicative source (see Appendix Table 16.8 p17). In a few instances it was necessary to use the same sentence twice, as it referred to more than one element of DRR (e.g. evacuation is a form of dislocation, a consequence of disaster, but also a DRR action in response). This was because the sentence could not be deconstructed to convey the meanings in separate places without repetition. The Stories of Seismic Risk present Earthquake Catalogue, Risk Exposure, the Probability of Earthquake and any Predictions, material relating to risk identification, assessment, and discussions of vulnerability to and resilience from earthquake-related disasters.

(Note since only earthquake-related articles have been analysed references to general vulnerability- and resilience-building that were unrelated to earthquake articles will not have not been captured).

-blank-

# Appendix 16.2 Science, earthquakes and DRR in women's magazine coverage before and during the Canterbury earthquakes

This 'story' was generated from New Zealand women's magazine (New Zealand Women's Weekly) articles published before and during the Canterbury earthquakes (September 4 2010 - April 4 2012). This story is what readers would know of the contribution of science and scientists to earthquake-related DRR from reading these articles. *References to science and scientists are underlined*

**Emergency medicine and public health**

*[Summer] was seriously injured, [her] injuries include a fractured pelvis and a crushed sciatic nerve, giving her pain and hypersensitivity through her legs and feet ... Summer was being evacuated to Wellington Hospital ...was in hospital [WW062] for four months ... Doctors can give her no estimation of how much longer the pain will last[WW064]... [Brian Coker's] legs were amputated at the scene ... in order to save his life[WW045]. People were rushing in those who needed urgent* ***medical attention****[WW043]. Ann was stable in hospital[WW036].*

An **apparent spike in the number of babies born** at the time of the first Canterbury earthquake on 4 September 2010 may simply have been due to the fact that it happened on a Saturday … 21 births that day was not unusual in a hospital which typically sees over 100 new arrivals every week So far we've seen no increase in the number of births after the second quake either[WW047 – Media liaison Amy Milne].
Child psychologist David Stebbing says **anxiety in children** is common in such situations… David advises parents to reassure kids and watch their behaviour, as anxiety is contagious. Monitor behavioural changes, such as kids becoming withdrawn. Nightmares and a pounding heart may need to be seen to by a professional, David says[WW034].
[Citizen survivor in [WW044] has] degree in psychology and post-graduate training in psychotherapy [but gave no related quake advice].
**5 stages of grief** - Moving on from a traumatic event can be difficult. Grief is a major emotional event and letting that emotion come to the surface is vital for moving on. …. Grief is generally considered to be a process with five distinct stages – shock, denial, anger, mourning and acceptance. At first, there is intense shock and numbness, which is quickly followed by denial – we can't believe that such a terrible thing has happened to us. The third stage is anger. This can be directed at God, the universe, the owners of buildings that weren't as safe as they should have been at an ambulance that was slow arriving or a bus that was running late that day. The mourning phase is a long one. Those left behind can suffer depression, sleeplessness, panic attacks and sometimes illness. And finally comes acceptance. Life will never be the same but we are able to move on[WW049].
After other [New Zealand disasters] bereaved relatives quietly went about their lives again … taking place in an era of instant global communication … 24/7 news feeds, text messaging and social networking sites [allow] people to mourn together in public. … Relaxation expert Tania says breathing stretching and moving all help to dissipate the adrenalin that keeps us functioning in times of crisis – allowing us to relax and recover[WW045].

Pseudoscience

If there has been an **increase in hauntings**, then Anton explains one theory for this that relates to electromagnetic fields (EMF) in the region. It's believed that when a spirit starts showing itself, it releases a type of electromagnetic energy and we know the earthquakes generate a massive amount of this energy as well. We are asking if this could be powering them or giving them energy, he says. On another level we know that high levels of EMF in humans can make us hyper-sensitive – our skin will crawl, we will see things an d hear things. Research into EMF has a long way to go. Another belief is that the earthquakes and rebuilding in the city could be disturbing mysterious forces. They can wake up something that's believed to be dormant…. The most scientific explanation is that resident's nerves have been so shattered by the instability, that they've become spooked. … When the claims started happening, with the stress levels as high as they were it didn't surprise me. And we had to take into consideration those stress levels ... we had to take a psychological stance and look at what was really going on … Sometimes you felt people were grasping at straws for it to be something other than their life breaking down. … Nigel Latta … is a very good psychologist and part of psychology is spirituality and how we deal with it … widespread damage to Christchurch's historic buildings will make it even harder to find scientific evidence of the paranormal … Anton believes earthquakes are shaking up more than just the city's buildings[WW052].

# Appendix 16.3: The New Zealand awareness of earthquakes story in women's magazine coverage before the Canterbury earthquakes

This 'story' was generated from New Zealand women's magazine (NZ Women's Weekly) articles published before the Darfield earthquake (September 4 2007- September 4 2010). Many researchers refer the importance of 'awareness' of earthquakes. This story is the sum total that readers would know about earthquakes from reading these articles.

<u>The Event</u>

An earthquake measuring 8.3 on the Richter scale strikes in the Pacific Ocean at a depth of 33km, 205km from Samoa at 6.48am New Zealand time[WW010]. The terrifying earthquake had woken me[WW002]. Chrisanna … and her husband were woken that morning by a violent earthquake that pre-empted the tsunami… it went on for ages and kept rumbling[WW009].
bm_tsunami - no mention earthquake [WW001, **002, 006 – 008lots, 012**]
*Although the Pacific **Tsunami** warning centre in Hawaii reports that it issued an alert the giant waves reach Samoa so quickly that residents have only 10 minutes to respond. They hit the south coast, ... waves four to seven metres high, reaching 1.5km inland[WW010]. The terrifying tsunami of 30 September[WW009].* The first wave ebbed … but then we saw the second wave coming in[WW009]. Gary was also carried out to sea …Alfie's mother Gill was dragged inland by the waves[WW006]. People were sucked out to sea[WW010] … Entire villages destroy[ed] … Whole villages are destroyed and cars are lodged in treetops from the force of the waves. The wiped-out villages include Salepaga, Ttaufua, Lalomanu, Lefaga, Poutasi and Lliili[WW010]. Just after the Samoan tsunami, a hellish scene of devastation and tragedy with rubble and dead bodies strewn across the sand[WW023], the once idyllic beach rendered unrecognisable … [there were] injured people all around them … injured people … broken bodies were found amid the rubble of the homes … in the flattened village of Lalmanu … [a] heartbreaking loss of life and devastation[WW009]. Thousands of families were affected by the disaster including that of boxer David Tua whose beloved aunt was taken by the massive wave … Other sporting stars whole lives were affected by the quake include former All Black Inga Tuigamala and Manu Samoa star Peter Fatialofa[WW001]. Waikato sisters [Petria and Rebecca died] … South Auckland grandmother Tauaavaga Tupuola … died in the tsunami. Her daughter Bula Okei and three-year-old granddaughter Sima … were also swept to their deaths … Raglan woman Mary Ann White also lost her life in Samoa … Aucklander Simon Anae died of a heart-attack after escaping the waves[WW007]. All I have left is my lava-lava[WW002]. Alfie Cunliffe … was swept away by the waves[WW006].
Residents and tourists flee to higher groundWW010. I heard a little girls screaming Tsunami! Mum, Dad, quick, quick! … Abby Wutzler (10) from Wellington, the little girl who had warned us about the tsunami[WW002]. friends say Alfie's parents blame themselves for the tragedy because they tried to escape in their rental car instead of fleeing on foot to high ground with other holidaymakers[WW007]. where earthquakes are so common that they went back to their desks.
Chrisanna noticed the pond water lapping from side to side and voiced her concerns to Hugo about the possibility of a tsunami. We both laughed it off. …they heard an alarm sounding No-one knew what is was says Hugo... a guy started yelling ... we ran down some steps, that's when we heard the roar of the ocean.[WW009]
I ran … desperate for higher ground I started climbing, grabbing rocks and tree roots and anything that would hold me ... [he] climbed the cliff with Amy[WW002].
I looked behind me to see the wave crashing below[WW002].
I watched fales, cars and people being thrown up in the air. The toilet block I had just been in was completely demolished and our two other travel companions, Stephanie Hauiti and Sharon Adams were both sucked out to sea but then washed back in again – thankfully alive[WW002]. 14 injured Kiwi tsunami victims … Friday 2 October … the death toll reaches 150 and is expected to climb further still[WW010].

<u>Response</u>

The Samoan people affected by the tsunami are sheltering in squalid conditions with some too terrified to leave higher ground and return home[WW010]. I can't sleep at night. I keep on having nightmares[WW002].

-blank-

# Appendix 16.4: The New Zealand awareness of earthquake story in women's magazine coverage of the Canterbury earthquakes

This 'story' was generated from New Zealand women's magazine (New Zealand Women's Weekly) articles published during the Canterbury earthquakes (September 4 2010- April 4 2012). Many researchers refer the importance of 'awareness' of earthquakes. This story is the sum total that readers would know about earthquakes and their causes and consequences from reading these articles.

**Earthquake Characteristics**

'When the earthquakes happened in Christchurch'[WW052]. 'the two earthquakes'[WW057].
The first earthquake struck Christchurch on September 4[WW061]. The first Canterbury earthquake on 4 September 2010[WW047]. The September quake[WW040,060x2,063], the earthquake on September 4[WW022], the Christchurch earthquake[WW020,022], the earthquake[WW018], the quake[WW010,017,021]… lasted over a minute[WW010] - only took a minute but it seemed to last forever. Our dog Russell woke us at 4.33am, just a couple of minutes before the quake [then] we heard the rumbling. It was like a freight train coming from deep below us[WW048]. The house started shaking furiously[WW015]. At 4.35am, we experienced the violent shaking[WW019] violent **shaking**[WW017,044]. We were woken up by the shaking[WW021]. It was a sort of rolling shake, a weird **sensation**[WW021]. The **7.1** earthquake[WW011]) was nothing like the shakes I'd experienced in Wellington it really was a big jolt [WW020].
**Six months later, on February 22**, the **fault** line shifted again [a] 6.3-magnitude quake[WW061, 063.]
The day of the disaster[WW034], one of the worst disasters in the country's history[WW027]. **The February 22 disaster[WW064],** February's quake[WW060], the February earthquake[WW058], February's horrific earthquake[WW063]**.** The Big One[WW025,026]**,** the 6.3-magnitude earthquake[WW027,061,063], or 'the 6.3 quake'[WW044], 'the earthquake'[WW033,035,037,430,049,050,051,053,056,057,062x2,064,066] 'the quake'[WW034,036,050,052,053,056,060] or 'the Christchurch earthquake'[WW064] or 'Christchurch quake'[WW029,057], [even though there was another] 6.3 magnitude aftershock on June 13 [WW056].
When disaster struck[WW041], when the killer earthquake struck[WW030,043], last Tuesday's quake[WW029], the quake on 22 February[WW041], 'the jolt][WW043], 'this second shake'[WW025], [was] felt from Nelson[WW038]. Shocked 2 hear news of that big shallow quake., [Helen Clark tweeted]. [WW038] [Journalist Louise Richardson refers generically to] 'the epicentre in Christchurch'[WW045]. In Lyttleton – at the heart of the destruction … the ground moved three times more than last time which probably explains why everything's broken[WW030].

**Earthquake Disaster Consequences**

*Damage to built environment*

Most [quakes in New Zealand] do no damage[WW010]. [On Sep 4] the **shaking** was so violent the water in the toilet cistern blew the lid off and flew clean out the top. We weren't able to use the showers or the toilet. Surveying the **damage** I was relieved to find that apart from a beautiful Buddha, it was only my spice collection I'd lost … 106 spices on the kitchen wall … had been flung all over the place[WW017]. The children [were] in the dark … told us the TV and picture frames had fallen off the walls … Driving through town was like a disaster move – streets were pushed up, roads had turned to gaping holes. It was really shocking … I still can't believe the magnitude of the disaster[WW019]. The roads and footpaths were damaged and we had no running water or electricity[WW018]. The props were untouched. The lights were still suspended from the ceiling [but] the theatre is closed to the public[WW020]. The house lost it's chimney and the front wall fell down but thankfully it is still habitable … Their new home was damaged but luckily the two restaurants … escaped unscathed … You go through places where it's picture perfect, then suddenly you're in an area that looks like it's been hit by a bomb[WW022]. To see all your memories destroyed is surreal [WW046.]. [John McCombe's] house was devastated by the quake – the top storey twisted one way and the bottom twisted the other – and is in danger of collapsing at any moment[WW011,] almost destroyed [WW029]. I lost my studio[WW060]. [Our] house is … on piles so we had quite a bit of movement. But there wasn't any structural damage … Inside we lost a photo from on top of the tallboy … we came through it completely unscathed, and … our power was still on … I really feel for the people who were in the thick of it and have lost their homes and businesses[WW021]. Nobody died[WW011]. [Anne] was just a bit shaken around like everyone else was[WW022]. Amelia was one of 21 babies to be born at

Christchurch Women's in the 24 hours following the earthquake – the hospital's most prolific Saturday ever[WW015]. The Government estimates $4billion worth of damage to the Canterbury region[WW010]. The consequences of a major natural disaster[WW022]. … changed the region for good[WW011].

[On June 13 2011] - Although a bookcase threatened to fall on the babies, it moved across the floor but thankfully stayed standing. … 'Gary's floor has so many bends in it he feels sick when walking over it[WW056].

[Then] the country's most devastating earthquake[WW043]. New Zealand was plunged into it's first ever **national state of emergency[WW027]**, national state of emergency[WW042]… the earthquake had left Christchurch in devastating chaos[WW027]. Stephanie was just moments away from having the anaesthetic inserted into her spine… Everything went flying across the room. The bed definitely moved – brakes and all. Nothing fell over, which was good because I was on drips and things.[WW043]. Marie grabbed a Sacred Heart statue for some heavenly protection, but the **shaking** knocked poor Jesus' head off and I rolled across the floor[WW067]. Jan Currie] lay on the floor as the **violent shaking** brought down the chimney surrounding them in **falling bricks** [WW044]… bricks and debris [WW030]. She was crushed by dust, rubble and electrical cables. . as the ceiling fell on top of her[WW026]… buried in rubble[WW048]. When the shaking stopped, the desk was beside her[WW048]. The walls swayed, the lights shattered, raining glass on the room… [outside] things were coming off the roof. Two buildings … turned to dust[WW037]. It looks like a bomb has gone off .. lifted off its foundations, everything inside was smashed[WW034]. The house was thrown 15cm off it's foundations. The front and back stairs collapsed .. leaving the house with no access[WW044]. [Brenda's] house suffered serious damage[WW035]. I lost my second studio[WW060]. [The] newsroom at the Christchurch Star was devasted[WW029]. Cracks appeared in the walls [WW043]. The roof collapsed [WW040, 052]. Two buses had their whole left sides crushed[WW028] crushed bus[WW027].

**Selective damage**

[Meanwhile] the only thing that suggested to me there'd been a massive earthquake was helicopters … flying everywhere[WW043]. My brother's place in the Heathcote valley is undamaged[WW044]. Her building is still standing but it's in the CBD[WW050]. There was no major damage to [Reuben's] house[WW053]. the buildings were smashed to bits[WW052]. [Simon's] home in Mt Pleasant is damaged but habitable[WW059].

Gary and Katherine's house … it's a terrible mess[WW030]. The devastation was far worse than [I] anticipated[WW044]. It was like a scene from one of those terrible movies, like 2012[WW025].

It was like we were in a war zone[WW015]. … **all but demolished** the Lyttleton area, flattening buildings, pulverising roads and houses[WW027]. The widespread damage to Christchurch's historic buildings [means] we've lost … history and heritage within the destroyed and demolished buildings[WW052]. The rubble of **collapsed** buildings[WW035]. The iconic CTV building was one of the worst hit in the quake[WW033] . the ruins of the CTV building[WW045]. [It] collapsed within seconds of the quake, while many other multi-storey buildings in the area remained standing[WW063]. The Pine Gould Corporation building had [also] collapsed[WW062]. [The] building collapsed[WW064]. The devastated Pine Gold Corporation building[WW048]. People were trapped[WW027]. Tracey Stanners was trapped in the Pyne Gold Corporation Building[WW066]. Emma Howard was trapped in the Pyne Gold Corporation building[WW051]. [Summer was] trapped under a concrete beam and debris from the three floor above her which had collapsed[WW064]. When the [PGC] building collapsed … [Bronwyn was] trapped under rubble for hours … under two storeys[WW048]. Two of the guys were trapped and couldn't move[WW037]. Kirsten was pulled from the wreckage [ruins[WW045]] of the Pyne Gould Corporation building[WW042].

Without power and water[WW044]. They had **no power or water, and the sewage system** was only repaired two weeks ago[WW060]. The lifts weren't working [in the hospital][WW043]. The power went out and we were in total darkness[WW026].

When her colleague regained consciousness it was clear he'd been **badly injured** [WW048]… [Brian Coker's] legs were amputated at the scene[WW045] [Summer] was seriously injured [WW062], [her] injuries include a fractured pelvis and a crushed sciatic nerve, giving her pain and hypersensitivity through her legs and feet … her legs were severely crushed … [she] almost lost her legs[WW064]. [Robyn's mum] survived with broken bones[WW036]. Bronwyn's colleague [was knocked out] is recovering from his injuries and she is still covered in bruises. I have stitches in my head. [WW048]. Although Yvonne suffered a cut to the head, the family escaped otherwise unscathed[WW030]. I'm so lucky [though] I got out and didn't have a scratch on me. Some people had their limbs cut off and some are not coming out at all[WW026]. … in the Pine Gould corporation building up to **18 people died**, including Summer's aunt Jane Marie Aberts and 10 of her work colleagues … Killed my auntie and my 10 workmates[WW064]. Thirty of the 200 workers who were trapped are believed to have died[WW048]**.** Four Marac staff on the other side of the office didn't make it out[WW048]. Shawn was one of 116 people who lost their lives in the CTV builing[WW063]. [Elsewhere the quake] knocked [Gary] to the ground twice, damaging his hip[WW030]. Ryan Nelson['s] sister… took a wee bit of a tumble after the earthquake, fell a wee bit ..[and] gave birth just after the earthquake hit, three weeks early[WW046]. Baker Shane Tomlin died[WW045]. Donna Manning, lost[WW045]. A crushed bus claimed three lives[WW027] … dead – crushed by a big block of concrete[WW028] …[It took] **181 lives**[WW061]. [Emily's] husband Emmanuel and two of her daughters …perished in the calamitous Haiti quake in January last year[WW045].

The family live in the beachside suburb of New Brighton so they were concerned there might be a **tsunami** threat as they made their way to the hospital[WW015].

Masterchef winner Brett McGregor watched in horror as the earth turned to liquid after the quake … Sand erupted through concrete, then mud and water the earth started weeping[WW032].[there was] silt at Windsor, one of the worst hit **liquefaction** zones[WW046]. Outside, cars have been swallowed by the road. You look straight into the bowels of the earth[WW034]. The rock shattered and crumbled … Jan has to climb 10m boulders to reach her front door[WW044].

As we go to print there have been almost 270 **aftershocks** since the initial quake[WW010]. Marie's survived dozens more shakes since then – she survived the past year of earthquakes[WW067]. Since then thousands of aftershocks have rocked the city[WW061]. Gary says the 6.3 magnitude aftershock on June 13, in which 46 people were injured, was especially disturbing for residents[WW056]. [Other people refer to] 'two [big] earthquakes'[WW052,057]. A 5.4 quake that shook Samoa on the anniversary of the tsunami - only days before Shari's wedding- wasn't enough to give the bride-to-be any wedding jitters[WW023].

Ironically that [Feb 22 2001] morning Stephanie and her family had remarked on the absence of recent aftershocks, but immediately regretted saying it, thinking they could be jinxing their luck[WW043]. Gabrielle Bone looked over her shoulder to see the building she'd just come out of crumbling in an aftershock. When it stopped we got out and ran down the stairs. Just after, there was an aftershock and the building started to move. Two buildings around it were turned to dust[WW037].

Stephanie decided to go ahead with the epidural, despite the danger from the ongoing aftershocks…fortunately there were no tremors during the delivery. I didn't really want to have a C-section with aftershocks going on, but the hospital staff were fantastic, they were confident it was going to be fine[WW043]. We've been getting Mum's things out, facing the threat of strong aftershocks[WW044]. Whenever there are aftershocks I get scared, but I do feel Dad's presence.[W061].The aftershocks were ongoing and still are. And they feel really strange…. [but] the dog's recovered – now he sleeps right through the aftershocks![WW017] The couple … won't miss the aftershocks. No-one in their right mind would.[W058]. The quakes don't bother me that much. It's pretty good at the moment. There have been no significant earthquakes for a while[WW066]. There's a possibility of another earthquake, but we're feeling like we might have seen the back of it[WW059].

The fact that there have been fewer tremors in the past weeks has made life easier.[WW059]

**Grief & Fear and other psychosocial effects**

People everywhere are just getting on with it and life is getting back to normal[WW022]. Every New Zealander will have its own story about February 22, many of them too difficult to share[WW02]9. A nation mourns and tributes poured in[WW039]. I was glued to the TV from morning till night, waves of shock, disbelief, grief and hope shared with the people of the area[WW011]. [Donna Manning's] children's grief and devastation [was] so raw it was almost unbearable to watch … Lots of children have lost a parent in this disaster[WW045]. I can imagine how terrifying the recent quake must have been[WW054]. No-one who hasn't experienced a huge earthquake can understand how terrifying an event it is[WW060]. This has been harder because last time it was the middle of the night and everyone was with their family[WW025]. People are still very jumpy[WW020]. It's been a tough six months for Summer's mum Trish who has been nursing her daughter while also grieving the tragic loss of her sister … who died [WW062]. [Sue knew] three of the victims[WW045]. Losing 11 people close to me is too

many[WW064]. Families continue to grieve[WW061]. Radio host Simon Barnett says his four daughters are still traumatised [WW040]. No New Zealander will ever forget[WW061]. [Anton] says there's been a big jump in the number of people reporting supernatural activity in the region since it's two big earthquakes[WW052].
The elderly have it the hardest in the wake of the quake[WW059]. John and Cheryl know of several marriages that have broken up[WW060]. As a small and close-knit country, we're all affected to some degree, but those … in Christchurch face the hardest task: farewelling loved ones, rebuilding damaged homes, restarting businesses and coming to terms with a future unlike anything they had ever imagined[WW045]. Amid the grief many Cantabrians are experiencing there's also a lingering fear. … I've heard of children sleeping under tables and an older woman who's still sleeping in her car – she's too scared to go back in her own home which is really sad[WW062]. I'm still on edge if a large truck goes past[WW057]. resident's nerves have been so shattered by the instability … It's been a crazy time for the people of Canterbury … with the stress levels as high as they were … lives turned upside down by the quake[WW052]. Gary likens life in Christchurch since the quake to being in a warzone. It's fair to say the average citizen in Christchurch is trudging along from day to day[WW056]. A lot of it is accumulated stress. They've had no decisions on their property[WW060]

***Disruption, dislocation and relocation***

After Saturday it became difficult to find good rental property[WW022].
My car was stuck in the CBD[WW042]. Such limited access to the few buildings we have left[WW052]. [Summer] was in hospital for four months[WW064]. Jason's radio show is now broadcast from a motel unit in Riccarton … put a major damper on their social lives as well[WW057]. While the earthquake did mean the cancellation of several weddings in Christchurch, other determined brides felt that going ahead was the right thing to do, [WW051], despite the obstacles presented by the quake [WW042]. A lot of their [wedding] guests would likely be very grateful for a few nights of power and water[WW050]. There was a rush to find a new place for [Jasmine and Enzo] as their planned venue was damaged. Emma Howard was trapped in the Pyne Gould Corporation building only to marry her groom Chris Greenslade three days later. Eliza Braithwaite also had to rescue her wedding gown from an inner-city seamstress for her big day last week. [WW051]. [Simon's] wife Jodi and the girls had to leave their badly damaged home. [WW040] John's daughter … Jessica and her family … were left homeless after the February quake [WW054]. Christchurch-based Sue has lost her home in the quake[WW045]. [Simon's home, damaged but habitable] can't be rebuilt so and his family will have to move on[WW059]
I don't know what will happen to us now – whether I'll continue my job, whether we'll move, what will happen with the house… I just want my family out[WW030]. John McCombe is leaving the city he loves … [his] elderly parents were evacuated from Christchurch following the quake ... they have friends who have moved away because of other problems related to the disaster ... they've had no decisions on their property, and they can't bear the status quo anymore[WW060]. In March, Ange and Peter packed their bags. I resigned in February for reasons related to the earthquake Ange says … [she] has decided to leave the disaster zone … but Tracey is toughing it out … apart from a fanatical need to bake which helps her to relax, Tracey has suffered no ill effects … but she says she still misses her workmates who didn't make it out[WW066]. I've heard of families who are shipping their kids out of the city for the meantime, but I'm staying put … my folks are here[WW020]. Whole suburbs lie deserted[WW061]. Would you ever consider leaving Christchurch? I asked [my Auntie Marie, aged 88]. Good Lord, no she said. I was told later that many of the elderly in the city feel the same. Having survived wars, depressions and a lifetime of ups and downs, they won't let natural disaster drive them out of home[WW067].

**Cause of Disaster**

How blessed the city was that nobody died[WW011].Gods We feel so lucky I'm incredibly[WW021] lucky[WW020]
Luckily, the Court theatre … is largely intact[WW020]. Luckily the two restaurants … escaped unscathed[WW022]. …had a close call with a falling roof. She's extremely lucky'[WW032]. Jason admits he'd like to have a chat with Mother Nature and really read her the riot act[WW025]

Tohoku – still haven't decided how to deal with…..primary effects & DRR actions…or DRR actions only?

… [and the] last catastrophic quake and tsunami in Japan[WW053]. Things were falling off the shelves[WW053]And his heart goes out to the people of Japan.WW053

# Appendix 16.5: The New Zealand seismic risk story in women's magazine coverage of the Canterbury earthquakes

This 'story' was generated from New Zealand women's magazine (New Zealand Women's Weekly) articles published during the Canterbury earthquakes (September 4 2010- April 4 2012). This story is what readers would know about seismic risk from reading these articles.

Earthquake catalogue – Risk Exposure

Bring earthquake catalogue statements down into here

*calamitous Haiti quake in January last year*[WW045]

One of the worst disasters in the country's history[WW027]

[Internationally there was] the calamitous Haiti quake in January last year[WW045]

In northern Japan … earthquakes are so common[WW055]. and there was the

You see earthquakes on the news in places like Haiti and Chile, then when you see the pictures of Christchurch you think But that kind of thing doesn't happen here in New Zealand[WW021]. I never expected to experience this, especially in Christchurch. I lived in Wellington for seven years so I'm kind of used to waking up in the middle of the night to the bed shaking a little bit[WW0017]. When he said there'd been an earthquake in Christchurch I said 'Oh, ha ha'[WW022].

I remember there being earthquakes … The whole building used to sway[WW054]. Maybe they [the audience] will be scared of sitting in a theatre in a heritage building[WW020].

The family live in the beachside suburb of New Brighton so they were concerned there might be a tsunami threat as they made their way to the hospitalWW015.

[Sep 4 was] one of the country's biggest earthquakes[WW015] and is the most destructive since the 1931 Napier disaster that killed 256 people … There are over 250 quakes in New Zealand each year but most do no damage[WW010].

Usually the quakes [in Wellington] have been small enough to think, Oh that's nice – sort of comforting, and then you forget about them afterwards [WW020]. Stephanie and her family had remarked on the absence of recent aftershocks, but immediately regretted saying it, thinking they could be jinxing their luck[W040]. When Bronwyn Lilley announced .. I do hope there's not going to be an earthquake tody, she had no idea how prophetic her words would become … she is thanking her sixth sense for telling her not to hold a business meeting in the boardroom [of the PGC building][WW048]

There's a possibility of another earthquake, but we're feeling like we might have seen the back of it[WW059]. It's a sensational place to live. But one of the **fault** lines is right under South Shore[WW060].

Trish says many people think twice before driving into car parking[WW062]. I want to take care of my family and keep them safe. That's not going to happen in Christchurch[WW030]

-blank-

# Appendix 16.6: The New Zealand earthquake-related DRR stories in women's magazine coverage before the Canterbury earthquakes

This 'story' was generated from New Zealand women's magazine (New Zealand Women's Weekly) articles published before the Darfield earthquake (September 4 2007- September 4 2010). This story is what readers would know about earthquake-related DRR from reading these articles.

## Reduction

### Structural Mitigation

They hoped the building's supports would withstand the torrent of water crashing against them … but then one of the poles holding the tree-house snapped ... Amazingly the damaged tree-house managed to withstand the power of the second wave[WW009].

## Readiness

*the Pacific Tsunami **warning** centre in Hawaii reports that it issued an alert*

## Response

### Survival and Actions in immediate response

**[Gary]** survived clinging to a coral reef[WW006]. 'the damaged tree-house had managed to withstand the power of the second wave. but the couple knew it would crumble if another wave hit and that the only chance they had was to move to higher ground immediately[WW009] ......... Seeing he was trapped … we got him up [later] Chrisanna and Hugo bravely joined a search party to find missing people[WW009]
Her father had gone in to the waves looking for her brother[WW002]. Rescuers have still to find his body[WW006]. [Shari] immediately began assisting survivors … after each hard day of helping out they would talk … their rebuilt … resort was reopening… if it wasn't for the tsunami … I wouldn't have met the person I love[WW023].
The couple were reunited at the Motootua Hospital[WW006]. Thursday 1 October A New Zealand airforce Hercules departs for Samoa carrying water containers and a **temporary morgue**. Police with **victim identification equipment, communication support and engineers** are also on the flight. That afternoon Air New Zealand **send a plane** carrying much-needed **supplies**, and larger aircraft are put on to accommodate more passengers and **aid** … Saturday 3 October – An early-morning flight arrives in New Zealand bearing 14 injured Kiwi tsunami victims … John Key arrives in Apia to assess the damage and meet with the Samoan Prim-Minister and aid workers. … **International aid** is pouring into the affected regions but more help is needed[WW010]. … their bodies flown back to New Zeland[WW007]. **HOW YOU CAN HELP** – Pacific Cooperation Fund – Deposits can be made at any Westpac branch. All the **money raised** will go to the Samoan government. Red Cross – secure online **donation** send cheques to , Call to make an automatic $20 donation, make a donation at any Red Cross office. ANZ Bank – make a donation or any ANZ branch or donate directly o the ANZ appeal account Oxfam – Make a secure on-line donation [or] phone to make an automatic 420 donation[WW004]. People concerned about family members in Samoa should try to make contact with them in the first instance. Those with ongoing concerns can call 0800… Anyone worried about the safety of non-New Zealand relatives in Samoa should contact the Samoa High Commission in Wellington[WW003]. Waikato sisters … have been **formally identified**[WW007].

-blank-

# Appendix 16.7: The New Zealand DRR story in women's magazine coverage of the Canterbury earthquakes

This 'story' was generated from New Zealand women's magazine (New Zealand Women's Weekly) articles published during the Canterbury earthquakes (September 4 2010- April 4 2012). This story is what readers would know about DRR from reading these articles.

### *Fatalism rather than DRR*

Hugo believes it was pure luck that saved them. There is no instruction manual for surviving a tsunami. You can't prepare for something like this.[WW009].
Saved by her sixth sense [WW045or8].

## Reduction

**Structural Mitigation**

When you see houses moving around like they're made of Lego it's a massive reminder not to get too complacent about getting prepared[WW020].

## Readiness

**Planning, Preparing earthquake kits & evacuation bags Stocking Supplies**

Luckily, 10 days earlier my daughter Lily had been learning about disasters at school, and came home insisting we put together an emergency kit. In my heart I was thinking, we really don't need to do that. But it meant the children were able to crawl downstairs to get the radio and listen to Civil Defence, and find their torches and snacks[WW019]. I'm not familiar with that place - no idea where there are torches, water, candles![WW020]- but I'm relieved that all that advice that gets drummed into you by schools and parents and the Civil Defence immediately jumps into your head [WW020]. [My folks] they've got all the stored water[WW020]. [she was ] lying under a table.[WW026].
BEFORE IT HITS – Have a household plan and a survival kit ready, identify safe places in your home or workplace, lie a strong table or desk, and secure heavy items of furniture to the floor or wall. Make sure the house is secured to its foundations and check your household insurance policy[WW016]. Jason's wife … still goes to bed with extra clothes and a torch handy, in case they have to leave during the night[WW057].
a bookcase … moved across the floor but thankfully stayed standing. … The couple felt unable to relax until they had ensured wee Bridie and Florence's cots could withstand another earthquake. We built extra-strong cots with iron-beams surrounding them. So if there's another earthquake, the babies will be protected, Gary explains[WW056]. children sleeping under tables[WW062].. A warning sounded (did not react)WW055.

## Response

***Survival and other Actions in immediate response***

I'm kind of used to waking up in the night to the bed shaking a little bit. But even then I've probably only raced to the doorway once or twice in my life. …. [this time] I got straight in the doorway - I braced myself against it while the whole house shifted from side to side. I began to think, Okay, how bad is this going to get? Do I need to get under a table. Am I going to be able to get to my phone, to my jacket and my shoes?[WW018]. DURING A QUAKE – If you're inside head for the nearest place, drop, cover your head and hold on – to a table leg or a door frame. If you're outside, get away from buildings before you drop, cover and hold[WW016]. [Bronwyn] attempted to dive under desk[WW048]. So we quickly got under the doorway[WW009]. Her son .. was bravely shielded by his au pair when the roof collapsed[WW040]. Everyone in the common room squashed under the tables[WW037]. We grabbed the kids and huddled under the doorframe[WW053]. AFTERWARDS – Get outside to a safe open space – don't go sightseeing. If you smell gas, turn off the outside mains, If you see sparks or broken wires, turn off the electricity at the fuse box – only if it is safe. Take notes and photos for insurance purposes[WW016]. [They] ran outside after the quake[WW037]. Spotted [my cellphone] flashing from under the rubble ... and we used it to get light and to call 111, but the network was busy. [WW026]. The first thing I did was check on [my kids] and they were all good[WW024].We checked for damage[WW021, 053]. Many of us got out on the streets to survey the damage[WW017].

***Actions in Response***

We were being contacted by people telling us things like, My sister's trapped, we're alive but not rescued. I felt a weight of responsibility. We're performing a public service and it's vital for us to give clear, concise messages[WW027].

**Search & Rescue**[WW048]. Mike's brother became a hero himself, rescuing a woman from a crushed bus[WW027]. There were people trying to help[WW028]. Those working round the clock rescuing are our heroes[WW036]. Brenda Wooley and her search dog, Easy (9), swung into action looking for survivors … Easy has been trained to sniff out the signs of life and managed to detect some survivors under the rubble … she says that sniffer dogs are taught with the use of toys[WW035]. The rescuers struggled to retrieve bodies[WW033]. We heard rescue dogs and rescuers[WW026]. They heard the welcome voices of rescuers yelling … and after six hours Bronwyn spied the torch of one of hundreds of fire-fighters who were helping to dig people out … Her husband Neil was glued to the TV watching victims being rescued praying that his wife would be the next one out[WW048]. I would keep thinking … they'll rescue her…previous disasters I'd read about in the world inspired me to hold on to that hope[WW062]. I hoped he was trapped in the rubble and that he'd be rescued a week later.[WW063]. Kristy Clemence [was] rescued[WW045]. Another five were rescued from the building after Browyn[WW048].I pulled out 6 alive … it was 200mm thick reinforced concrete but we broke through … we had hammers, pliers and a hacksaw … I guess I got through it on adrenalin, Carl says[WW024]. After hours of searching rescue teams (and her sister's fiancé … a **volunteer** fire-fighter from Culverden) finally pulled Tracey and those with her from the [PGC] building[WW026,064 066]. Baker Shane Tomlin's … family saw newspaper shots of his rescue. [WW045]. The New Zealand Fire Service says it's a priority to save lives, and in dangerous situations risk assessments are carried out to consider the danger. This includes how many people need to be rescued, what injuries are obvious, the degree of danger the person is in, the equipment available, the number of fire-fighters immediately available to perform the rescue and what dangers the rescuer could involve[WW065]. To free [Summer] was deemed impossible because of the chance it could cause more damage and injure more people[WW064].

Bm rescue 034

[The Government] are pledging $2.4 million to help those who have suffered trauma as a result of the quake. The police and the army came to the rescue by escorting [wedding] dress designer Robyn into the cordon[WW050]. Jan spent the following five days **evacuating** her most precious possessions … fear[ing] that any moment the police would insist we evacuate [WW044]. their elderly parents were evacuated from Christchurch following the quake[WW060]

Kevin moved from Tokoroa to Christchurch to be with his family and help with the **relief efforts**[WW058]. All Whites Captain …Ryan Nelson **volunteered** to shovel silt at Windsor[WW046]. She went off and did some work for Civil Defence[WW022]. We can all cope better by helping people[WW033]. We spent days trying to contact [John][WW029]. Neighbours in her street had already popped around to see how Jean was coping with the damage to her home, and to help with the lack of water[WW041]. Like so many in this amazingly resilient city, his first instinct was **to help**[WW027].

**Risk assessment – (building stickering etc in other ones)**

*Gary's house is considered safe [WW056]*

**Emergency medicine and public health**

[Brian Coker's] legs were amputated at the scene .. in order to save his life[WW045]. People were rushing in those who needed urgent **medical attention**[WW043]. Ann was stable in hospital[WW036]. Summer was being evacuated to Wellington Hospital …was in hospital [WW062] for four months … Doctors can give her no estimation of how much longer the pain will last[WW064].

**Community building & resilience …. More actions in response - solidarity & fundraising**

We talked, [my seven-year old girl and I] about the importance of community and what makes Kiwis so great in times of crisis … reaching out to the old, the weak and the homeless … Kia kaha Canterbury[WW011]. Thoughts and prayers are with you (x5)[WW038]. The heart of the nation is with them[WW027]. It's amazing how the community has rallied around. Our neighbour came over early on

Saturday and said 'Look, I've dug a big hole in my backyard. If you'd like to use it that's okay' [WW017]. If there's one good thing to come out of this, it's support and kindness. Everywhere you turn, you see the best of human nature. It's inspiring.[WW040]. The spirit of the people here is amazing, the tenacity[WW022].

most emphatic message those who have been bereaved and those wishing to support them is Don't suppress[WW045].The onus is on us to get alongside [the elderly] and support them[WW059]. [Sue] has set up an on-line forum to help people grieve. I've gifted a page on the website for each victim for 10 years so their families and people who knew them can share the grief.[WW045].

Many Kiwis have been wondering how they can help those in need in Christchurch … our parent company APN News & Media vowed to put it's weight behind the Canterbury Earthquake Appeal. We're encouraging donations to the Red Cross-administered cause and making a $100,000 contribution[WW011]. We here at the Weekly have made donations to the Red Cross … I hope you will donate too[WW029]. We at the Weekly are throwing our collective weight behind a couple of major fundraisers beginning this month with Simon Gault's Masterchef dinner in Auckland … all of last year's Masterchef finalists [will] pitch in … with every dollar from the event being sent to those in need[WW041]. Sporting greats teamed up to raise money for the quake victims by auctioning their gear[WW031]. [Ryan]'s already called on Fifa … to sanction an international earthquake relief fund game … saying he's behind anything that might help.[WW046]. HOW TO HELP PN News & Media, which owns the Weekly, has made a $100,000 donation to the fundraising effort, and we'd like to encourage readers to help out wherever they can[WW013]. The long-time TV news presenters are headlining a major fundraising event for the earthquake-stricken city …To Christchurch with Love, a fundraising concert … It's the love for their family in Christchurch and others struggling in the city that has motivated [John and Judy] to lend their support to the fundraising concert. … It's a great way to help those in need, says Judy. It's a wonderful was to tell people of Christchurch that we care and we're with them[WW054]. On 1 March, just a week after the Christchurch quake, Purple Cake Day was launched by Nelson woman Emily Sanson-Rejouis, in honour of her husband and two of her daughters who perished in the calamitous Haiti quake[WW045] . [What's] important is being surrounded by friends and family and knowing that they're safe.[WW050]. It's that sense of neighbourliness – a selfless desire to help others – that has defined life after the quake, not only in Christchurch, but around the countr [WW041]. Reuben is confident that his fellow Cantabrians will overcome the devastation. …. They will bounce back. They come together at times like this, and I'm sure they'll fight their way through.[WW053].

People phoned the Weekly offices, wanting to connect with people in Christchurch as offering help. Wondering if reporters and readers knew anything of their missing friends and family[WW029]. Our parent company, APN New Zealand, has also swung behind the relief effort. Since the day after the quake, they have published an emergency edition of The Star newspaper, delivering it daily to as many parts of the city as possible. There is free advertising being offered to the Red Cross and Salvation Army in all out publications and next week the Weekly will publish a special magazine with advice for anyone wh finds themselves caught up in this terrible event. Watch our pages over the coming weeks for more ways to help - and the amazing Kiwis who are using their star power and creativity to get Christchurch back on it's feet[WW041]. Cantabrians are picking up the pieces of their shattered lives[WW040].

## Recovery

### Insurance, Recovery & Reconstruction

There are plans to reopen as soon as possible[WW020] After receiving an insurance payout on their house[WW060]; The sewage system was only repaired two weeks ago[WW060].

*reconstruction[WW059]. They've had no decisions on their property[WW060]. There are some wonderful ideas out there about how the city will look [but the elderly] might not be around to see the rebuild [WW059]*

the rebuild[WW045], rebuilding … the rebuild of our city[WW052]. We need to find out why this happenedshe says If it prevents other buildings from falling down in this kind of situation, and prevents families from losing loved ones, then it'll be worth it' [WW063].

[Simon's home, damaged but habitable] can't be rebuilt[WW059]. There is a bit of uncertainty about the **land**[WW059].

-blank-

## Appendix 16.8: List of women's magazine articles

Table of earthquake-related articles in he New Zealand Women's Weekly 04 September 2007 to 04 April 2012

| ID | Journalist | Article Date | Article identifier |
|---|---|---|---|
| WW001 | unattributed | 12-Oct-09 | Tsunami Tragedy p2 |
| WW002 | Vicky Tyler | 19-Oct-09 | All I Have Left is My Lavalava' p42-43 |
| WW003 | unattributed | 19-Oct-09 | For Information on Missing Loved Ones p43 |
| WW004 | unattributed | 19-Oct-09 | How you can Help p43 |
| WW005 | unattributed | 19-Oct-09 | Inset - untitled and unattribtued p42 |
| WW006 | unattributed | 19-Oct-09 | Inset - untitled and unattributed p41 |
| WW007 | unattributed | 19-Oct-09 | Little Alfie was swept to his death in the tsunami p43 |
| WW008 | unattributed | 19-Oct-09 | Tragedy for Kiwi Families p43 |
| WW009 | Vicky Tyler | 19-Oct-09 | Tsunami Honeymoon - "We Ran for Our Lives" p41-42 |
| WW010 | unattributed | 19-Oct-09 | The Tsunami & it's Aftermath p42 |
| WW011 | Sido Kitchin | 20-Sep-10 | Editorial |
| WW012 | unattributed | 20-Sep-10 | Fact File p13 |
| WW013 | unattributed | 20-Sep-10 | How to Help p15 |
| WW014 | unattributed | 20-Sep-10 | How to Help  - Fund p90 |
| WW015 | Aroha Awarau | 20-Sep-10 | Shake, Rattle and Roll |
| WW016 | unattributed | 20-Sep-10 | Survive a Quake p15 |
| WW017 | unattributed | 20-Sep-10 | The Shock of Our Lives: Animal Instinct p14 |
| WW018 | unattributed | 20-Sep-10 | The Shock of Our Lives: Court Unawares p15 |
| WW019 | unattributed | 20-Sep-10 | The Shock of Our Lives: Rocky Romance p12-13 |
| WW020 | unattributed | 20-Sep-10 | The Shock of Our Lives: Shaky Performance p14-15 |
| WW021 | unattributed | 20-Sep-10 | The Shock of Our Lives: Topp Terror p13 |
| WW022 | Donna Fleming | 18-Oct-10 | Kate's Sister Act p6-7 |
| WW023 | Aroha Awarau | 18-Oct-10 | The tsunami brought me love p 28-29 |
| WW024 | unattributed | 7-Mar-11 | I pulled 6 out alive' p8 |
| WW025 | unattributed | 7-Mar-11 | My Wife's Spooky Premonition' p11 |
| WW026 | unattributed | 7-Mar-11 | The Text That Saved My Life' p9 |
| WW027 | unattributed | 7-Mar-11 | Breaking News and Broken Dreams p6-7 |
| WW028 | unattributed | 7-Mar-11 | Bus Rescue: Hero Kerry's Horror p7 |
| WW029 | Sarah Stuart | 7-Mar-11 | Editorial p2 |
| WW030 | unattributed | 7-Mar-11 | Gary: 'Saving my 11-day old twins" p6 |
| WW031 | unattributed | 7-Mar-11 | Good Sports p11 |
| WW032 | unattributed | 7-Mar-11 | Liquid Disaster p11 |
| WW033 | unattributed | 7-Mar-11 | Losing Loved Ones p10 |
| WW034 | unattributed | 7-Mar-11 | Psychological Trauma p10 |

| | | | |
|---|---|---|---|
| WW035 | unattributed | 7-Mar-11 | Sniffing Through the Rubble p8 |
| WW036 | unattributed | 7-Mar-11 | Star's Desperate Search p10 |
| WW037 | unattributed | 7-Mar-11 | Teens Terrifying Escape p9 |
| WW038 | unattributed | 7-Mar-11 | Tweets p8 |
| WW039 | unattributed | 14-Mar-11 | A Nation Mourns p32 |
| WW040 | Donna Fleming | 14-Mar-11 | Back in Business p7 |
| WW041 | Sarah Stuart | 14-Mar-11 | Editorial |
| WW042 | Nicky Dewe | 14-Mar-11 | From the Rubble to the Altar p27 |
| WW043 | Vicky Tyler | 14-Mar-11 | I Gave Birth in the Quake p28-29 |
| WW044 | Jo Knowsley | 14-Mar-11 | My Home on the Rubble p34-35 |
| WW045 | Louise Richardson | 14-Mar-11 | Overcoming the Quake: Grief & Loss p32-33 |
| WW046 | Catherine ilford | 14-Mar-11 | Ryan Nelsen's Mercy Dash p7 |
| WW047 | Vicky Tyler | 14-Mar-11 | Saturday's Child p29 |
| WW048 | Vicky Tyler | 14-Mar-11 | Saved by her Sixth Sense p30-31 |
| WW049 | unattributed | 14-Mar-11 | Stages of Grief p32 |
| WW050 | Vicky Tyler | 14-Mar-11 | Army rescued my Wedding Dress" p26-27 |
| WW051 | unattributed | 14-Mar-11 | The Show Must go on p27 |
| WW052 | Vicky Tyler | 21-Mar-11 | City's Spirit Lives On p34-35 |
| WW053 | Aroha Awarau | 28-Mar-11 | All Black Legend's Lucky Escape p10-11 |
| WW054 | Aroha Awarau | 28-Mar-11 | Charity Champions - John & Judy: Together Again p8-9 |
| WW055 | Kathryn Powley | 28-Mar-11 | Kiwi Survivor: 'My Tsunami Terror' p10-11 |
| WW056 | Vicky Tyler | 5-Sep-11 | 'A Shaky Start' p25 |
| WW057 | Vicky Tyler | 5-Sep-11 | I'm Still on Edge' p24 |
| WW058 | Aroha Awarau | 5-Sep-11 | 'The Quake Brought us Back Together' p 28-29 |
| WW059 | Vicky Tyler | 5-Sep-11 | You Can't Live in Fear' p24 |
| WW060 | Vicky Tyler | 5-Sep-11 | Christchurch Couple's Broken Dreams p29 |
| WW061 | Sarah Stuart | 5-Sep-11 | Editorial - Christchurch Quake: 12 Months On |
| WW062 | unattributed | 5-Sep-11 | Holding on to Hope p27 |
| WW063 | unattributed | 5-Sep-11 | Holly's Brave Stand 'My Dad didn't die in vain' p29 |
| WW064 | Vicky Tyler | 5-Sep-11 | I'm Learning to Walk Again p26-27 |
| WW065 | unattributed | 5-Sep-11 | Inset Coming to the Rescue |
| WW066 | Vicky Tyler | 5-Sep-11 | Tracy Toughs it Out p25 |
| WW067 | Sarah Stuart | 7-Mar-12 | Editorial |

# Appendix 17: Article "Christchurch three months on" (Cate, 2011)

## Christchurch three months on

CATE BRETT Last updated 05:00 22/05/2011

**Cantabrian Cate Brett explains how the internet, buckets of clay and learning to tango are helping her community heal after the February 22 quake.**

Having survived the quake, we now risk being crushed by the weight of numbers.

In his aptly named "financial stability report" the head of the Reserve Bank, Dr Alan Bollard, described the February 22 quake, with its $15 billion price tag, as "one of the biggest natural disasters in relative terms to befall an OECD country since World War II".

As a proportion of New Zealand's domestic economy, Bollard tells us, the impact of the Canterbury quake was twice that of the Japanese quake.

Up close, the figures are no less mind-numbing: beneath our feet, we are told, lie more than 300km of damaged sewers, leaking 37 million litres of sewage each day at one stage; within the Four Avenues that frame the central city are 900 crippled buildings awaiting demolition; within the suburbs are 20,000 homes which have sustained close to, or more than, $100,000 worth of damage.

But these figures do not begin to capture or quantify the brutal editing of our lives that has occurred in the aftermath of February 22. The 181 killed; the dozens learning to live without limbs or coping with pain and trauma; the many thousands whose daily existence and livelihoods are in limbo behind the central city cordon; the tens of thousands whose entire life's asset now depends on the decisions of the loss adjusters and geotechnical engineers pouring over the city.

And now that the oddly anaesthetising effects of adrenalin are fading, we are beginning to take stock of the personal losses which no actuary could ever factor into an insurance premium: the family heirlooms swept unceremoniously into wheelie bins; the dusty boxes containing hand-drawn birthday cards, Plunket books, trophies and certificates, irretrievably lost beneath tonnes of bricks and mortar; a lifetime's collection of books and CDs scooped up in a demolition bulldozer's bucket; a beloved grandparent's needle-point cushion lying rain-soaked on a child's bed now exposed to the night sky.

As a community we are going through what Canterbury University political scientist Bronwyn Hayward describes as a collective experience much like grief. From studying how citizens, especially children, cope with such change, Hayward says it is possible to chart a process through which we will progress as a community.

"We've gone through the surge of mutuality or goodwill and we are currently starting to experience the period of intense anger and tension and blame. Then, they tell us there will be a phase of vision, followed usually – but not inevitably – by a reassertion of the old power."

But Hayward also talks of the transformative possibilities of such events. The "new insights that grief brings into our past and our future" and the "opportunity to rethink what really matters amidst the turmoil of the earth cracking and in the rubble of stone buildings, an

English delusion we should never probably have built but we loved anyway".

How we respond, says Hayward, is influenced by what's gone before: our relationships, our experience, our cultural and our spiritual depth.

This, then, is the story of how an ordinary little community, hunkered down on the west-facing flank of the Port Hills, has responded in the 90 days since the earth convulsed beneath it.

In that period we have learnt a great deal more than we could ever have imagined wanting to know about the state of each other's ring foundations, piles and sewage pipes. We have also surprised ourselves – and others – by marshalling a labour force capable of averting rock hazards and applying 30 tonnes of "fill" to our damaged hillside. And we have rediscovered the joys of the war-time Saturday night dance in the local church hall, where, last month, about 80 of us took our first tentative tango steps.

But perhaps most importantly we have begun to realise the potential of the internet as a tool for connecting people at a time when reliable information is in such short supply and an active and engaged community has never been so vital to our survival.

OUR FORAY into "virtual community" began almost exactly a year ago on May 23, 2010, as half a dozen neighbours experimented with OnlineGroups.Net. The site, developed by Dan Randow, provides easy access to software which allows Luddites like ourselves to set up private or public internet groups centred on the simple functions of group email exchanges, discussion threads and file sharing.

OnlineGroups' stated goal is to facilitate "collaboration" and "knowledge sharing". Our motivation was a little less high-minded.

Sheltered from Christchurch's "beastly easterly" and two minutes from the Christchurch three months on | Stuff.co.nz

Port Hills' tussocky tracks, we shared the usual middle-class preoccupations with preserving the peace and tranquility of our neighbourhood; swapping gardening and running tips; sharing a glass of wine in the late summer sun on each other's verandahs and marking the seasons and family celebrations with the occasional party or pot luck dinner.

Before February 22, 2011, our discussion topics were dominated by subjects such as babysitting, gardening, book and clothing swaps. Our most ambitious project had been a weekly fish delivery in which we took turns at collecting a standing order from the local Greek fishmonger and depositing the packages out of cat-reach in one another's letterboxes.

With just 10 households online, we sensed we needed a critical mass in order for our virtual community to become less needy and more self-sustaining. So we dropped leaflets to the 60 households on our street and, on a searing Sunday afternoon in mid-January, hosted a street party, explaining to a group of about 50 locals what we were attempting to do and gathering about a dozen new recruits.

But it took the February 22 earthquake to really bring this virtual community to life – and to begin to fulfil its promise as a tool for "collaboration and knowledge sharing". Unlike the September quake, which left this neighbourhood relatively unscathed, the February quake was seated almost directly below us, and caused major damage. Since this quake, the number of households connected online has grown to 40, which represents the majority of dwellings in our immediate area.

And over this time our vocabulary and preoccupations have developed an altogether tougher edge. Neighbours still harvest and share their excess courgettes, pears and feijoas, but online discussions are reserved almost entirely for the rich exchange of information about the myriad earthquake-related issues which now dominate our lives: the latest snippet of geotechnical information about our land; the comings and goings and musings of umpteen loss adjustors, insurers and engineers; the urgent action needed to ameliorate the latest hazard from rock outcrops or broken sewage pipes; the upcoming community meeting; the need for temporary and not-so-temporary accommodation.

This vital exchange of information and support began to flow within days of the February 22 quake. Remarkably, given the severity of the damage to many homes, nobody in our immediate neighbourhood was killed. But, like many hillside suburbs, our proximity to the quake's epicentre resulted in extensive damage to the land, the infrastructure beneath it, and the many gracious old brick homes perched on its back.

In the first weeks after the quake, our community, like much of the city, was on its knees, without power and water and jolted by hundreds of aftershocks.

Christchurch three months on | Stuff.co.nz

Many houses were uninhabitable; many took refuge with friends and family in other parts of the city or country. But many also stayed, and, one by one, households came online and joined hands. Through these raw and emotional shorthand accounts of how each household had fared and what they knew of their neighbours' fate, we began to piece the street back together.

Some who had left the city and logged on from their temporary homes describe how these early posts acted as a psychological life-line and spurred them to return home. Then, after a week or so, those who had remained, and those making daily forays to their shattered homes, began to organise themselves to address the most urgent needs: access to water for humans and animals; the safety of homes threatened by rock fall; help for those needing to salvage essential belongings; emotional support for the grief- stricken.

ON TUESDAY, March 29, our online group received an email: "Working bee this Saturday – large hillside cracks." Written in an unusually authoritative and forthright style, the email originated from an adjoining street where residents were confronting the prospect of a long wet winter with significant land cracks running through the back of some of their properties.

Like many Port Hills suburbs, the land on which we are perched has been violently shaken, resulting in a raft of novel "features" of intense interest to geologists and geotechnical engineers. The woman responsible for first introducing these engineers to the most significant crack in the suburb's lower slopes was Mara Apse, a long-term resident of the area. Mara and her neighbour Stephen Beuzenberg had co- authored the "working bee" email.

Mara has made it her business to become a conduit of information between the army of consultants and scientists scouring the Port Hills and the residents whose fate these experts would determine.

An intelligent, engaging and tenacious person, Mara succeeded in capturing, and holding, the attention of three men who were closely involved in the consortium of public and private organisations advising Civil Defence and EQC on land stability and remediation issues: James Molloy, the principal geotechnical engineer with GHD; Dave Bell from the University of Canterbury's Natural Hazards Research Centre and consultant geologist Mark

Yetton.

Accompanying various experts on field trips around the neighbourhood, Mara had been warned to brace herself to deal with the inevitable divergence in the robust "expert opinions" that would be debated in her presence. She took great heart, however, from the opinions of one such expert – Dave Bell, who believed there was an immediate temporary solution available for this neighbourhood's hillside crack: bentonite.

Bentonite is a naturally occurring clay which is often used as an environmental sealant due to its swelling properties. Because of the potential for water to infiltrate the hillside cracks and cause slippages or landslides, it was essential that these cracks were at least temporarily sealed before winter.

However, as James Molloy explains, at the time these discussions were taking place, resources in Christchurch were so stretched there was little capacity to organise such an exercise for one small pocket of homes.

Except that Mara Apse was determined that this small pocket of homes was capable of undertaking the work itself: "Right from the start we had been saying to these guys, look, the people who live here love this place and they want to go on living here. So what can we do to help? And eventually they came back and said, well there is something you can do, fill the cracks with bentonite."

So, with the backing of the geotechnical experts, the project was signed off by Civil Defence and Mara arrived home on Friday, March 25, to find about 30 tonnes of materials, comprising seven tonnes of bentonite and 23 tonnes of sandy gravels with which to mix it, deposited in large sacks at various junctures down the street.

Fulton Hogan agreed to provide concrete mixers and two contractors to assist, so all that remained for Mara to do was recruit dozens of labourers willing to work in two-hour shifts over a weekend hauling 10- litre paint buckets through the backs of about 40 private properties to fill in the hillside crack. Hence the "working bee" email.

Miraculously, the worker bees – described by Mara as "bent and buggered like me" – came swarming from all over the hillside and neighbouring streets and, during the course of a long hard day, succeeded in mixing and shifting 24 tonnes of materials up on to the hillside. A second wave of workers took over the following weekend to complete the project. Those unable to carry buckets kept the workers fed and watered.

Despite periods of quite heavy rainfall in the past month, James Molloy says the initial signs all point to success with the bentonite fill providing the temporary bridge allowing water to move over, rather than down, through the cracks.

For Mara and her community, the project restored a sense of purposefulness and some small measure of control, countering the sometimes overwhelming sense of powerlessness that most have experienced in the wake of the quake.

"Probably what I learnt most from this exercise is that a community can be so remarkable, pulling together with a sort of selfless commitment that you didn't know was really possible beyond your own little familiar corner of it.

"Here we had people wandering through the backs of other people's properties, working alongside total strangers. People have learnt to trust each other in whole new ways. It has been totally transforming."

AFTER THE labouring came the music and the dancing. On an unusually mild evening in late April, about 80 locals and friends descended on the nearby Anglican Church hall bearing food and drink to share. The local cafe, Fava, loaned us tables and glassware.

For several hours Christchurch's fabulous six-piece band, Tango La Luna, transported us from our ravaged city and dislocated lives. Perhaps it is indicative of just how far outside our comfort zones many of us are living, that when asked by tango teacher Kerry Mulligan to stand and take our first tango steps, everybody in the hall stood and did precisely that.

Now winter is at our door. And, just as political scientist Bronwyn Hayward described, there is a growing sense of frustration as we struggle to negotiate the labyrinthine systems of public and private insurers while holding together jobs and families in houses that are not our own.

The story of our first 90 days will be mirrored by the stories of communities all over Christchurch – communities which paradoxically are now healthier and stronger than they were on February 21. However, the question Hayward poses is whether we are capable of maintaining this new trajectory and incorporating these new lessons about what really matters into how we rebuild our lives, homes, neighbourhood and city.

=====

Cate Brett was editor of the Sunday Star-Times from 2003-2008 and is now a senior researcher and policy adviser for the Law Commission. Her family home fared better than most of her neighbours' and she and her family hope to return to it before the end of winter. Three other households in their extended family, including her parents, are currently out of their homes.

Neighbourhoods wanting to set up an online group go to www.onlinegroups.net

Individuals and communities wanting to discuss whether bentonite filling may be a suitable option for their area are advised to contact the CCC Helpline to arrange an engineering assessment.

**- Sunday Star Times**

(Brett, 2011):

http://www.stuff.co.nz/national/christchurch-earthquake/5037194/Christchurch-three-months-on
Page 4 of 5

-----

-blank-

# Appendix 18: 100 recommendations made in Chapters 5, 6 and 7