Consequences of communicating climate science online: The effects on young people's reactions to climate science

Submitted by Phillip Scott Passmore, to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Politics, October 2017.

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature: …………………………………………………..

Abstract:

This thesis reveals the potential pitfalls of relying on the Internet to communicate serious environmental issues. This exploratory research examines the consequences of aspects of the information society focusing on the effects of the Internet upon three reactions to climate communication: public understanding, perception of risk and support for climate change mitigation. It examines the implications of the rise of the information society on young people's (18-25 year olds) consumption of media and climate science information. The information society literature emerged before the Internet, but predicted the increasing access to information that has arisen in the past two decades and its significant impacts on society and communication. An analytical framework is developed focusing on the sharing of information and the consequences of both misleading information and competition for the user's attention. To explore the impact of the Internet upon public perception of risks posed by and their understanding of climate change, this research uses a mixed methodological approach. The qualitative approach of focus groups has been selected to establish how young people use the Internet and whether they share and actively engage with climate change information online. A quantitative approach of the experimental method has critically examined the impact of junk information (climate sceptic material) and information overload (competition for users' attention) on reactions to climate science. The original contribution to knowledge of this thesis was the key finding that the lack of engagement with climate science online poses a more serious issue than the risk of climate sceptic information being virally shared. Simply having the information accessible is not enough when there is so much competition for users' attention and the ease with which they can filter out climate change information.

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Chapter 1 Introduction

This thesis is an exploratory study into young peoples' (18-25) understanding, perception of risk, and support for mitigation of climate change in the context of the information society. In contemporary times, the information society is mostly hosted on the Internet. The concept of an information society emerged in the 1970s, before the development of the Internet, and predicted economic and social shifts in society as a result of the rise of information technology (See Bell, 1973, and Masuda, 1980). The information society theory (See Bell, 1973, Martin, 1995, Masuda, 1980) has been used to develop an analytical framework to assess the impact of the information technology upon public understanding, perception of risk, and support for climate change mitigation. This research draws on the broader definition of information society put forward by Martin (1995, p. 3) which incorporates the social impact of the rise of the Internet. It does this to shed light on the dark side of the information society because the information society theory that emerged in the 1970s was very utopian and optimistic of the benefits that increasing information would have on society which I refer to as the light side[1]. Instead the information society has had unexpected negative consequences, which I call the dark side and to the best of my knowledge I have coined the terminology of dark-side and light-side (See chapter 2). The information society theory by key theorists (See Bell, 1973, and Masuda, 1980) was visionary and has been used to generate an analytical framework despite the significant differences in consequences of the Internet predicted. The Internet is a key area of interest as it has had a range of impacts and consequences with how young people engage with information generally and potentially with climate science more specifically, so this research takes an exploratory approach. These are centred on the ease of the sharing of information through social networks, the potential consequences of information overload (information competition) and the risk of spreading junk information. Junk information refers here to false information created to mislead the public.

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[1] The light side and dark side of the information are discussed in chapter 2.

The sharing of information has become increasingly easier with social media websites built around the idea of users sharing and creating content, allowing for the democratisation of information (Grignou and Patou, 2004, Kaplan and Haenlein, 2010). However, the development of an information rich environment has the potential consequence of information overload which is caused by unprecedented amounts of information competing for our attention (See Schumann, 2004). Alongside this there is also the problem of junk information that can be spread to deliberately mislead the public (See Kien, 2013). In the case of climate change I consider junk information to be climate sceptic material which seeks to undermine public perception of scientific consensus by making climate science appear debated (See Boykoff, 2011, Nerlich, 2010). Information overload and junk information are not isolated aspects. They overlap since on the one hand of junk information is shared virally through social networks and on the other hand virally shared content distracts users from important issues.

The emphasis is on public engagement with climate change in an era of high information consumption, and how this affects individuals' understanding, perception of risk, and support for climate mitigation. Engagement with climate change can come in range of ways including changing consumer behaviour, participatory democracy, or decarbonising behaviour with the media being the main engagement with climate change the public has (O'Neill and Nicholson-Cole, 2009, pp. 356-337). I take the approach of examining whether there is engagement with climate change media reporting rather than behaviour change, as the competition for attention of users means there is a risk that people will simply filter out coverage entirely (See Chapter 3) and the viral spread of information requires users to decide to share to other users (See chapter 2). In particular, engagement in this context refers to the reading/watching of climate change information and also whether young people are willing to share climate science over social networks. Public understanding is a concept debated among academics, as 'understanding' can be defined as a basic understanding of terminology or defined as an in depth understanding of concepts or events (Miller, 2004). I take the former approach, conceptualising public understanding as a form of 'scientific literacy' (Miller, 1983). Scientific literacy is often argued to be the basic understanding considered necessary to comprehend debates in media

coverage, as the media is the key way the public engages with science (Miller, 1983, Miller, 1998, Miller, 2004, Sturgis and Allum, 2004). In addition to public understanding there is also the issue of how the public perceive risk from climate change. The public are not rational and emotions shape how they engage with information and our perception of risk is informed through other means such as personal experience (Roeser, 2012, Marx et al., 2007, Weingart et al., 2000). Support for climate change mitigation relies upon both the public developing understanding climate science, such as the causes, and also viewing climate change as a threat to the extent that they are willing to alter their carbon intensive lifestyles (Semenza et al., 2008).

The rest of this introduction is structured into four sections. The following section focuses on the rationale for this research. This section will explain the rationale of the study focusing upon communication of climate change, as well as the significance of the emergence of the Internet, and the importance of effective public communication. It will also justify the focus of the study on young people's engagement with climate change. The second section introduces the overarching research questions and hypotheses for this thesis. This section also breaks down the overarching research questions into the supplementary research questions. The third section focuses on the contribution my research will make to existing literature. Finally, this introduction gives an outline of the thesis chapter structure.

1.1: Rationale

1.1.1: The importance of the media

The media has an important role in communicating and building the public perception of the complex issue of climate change as well as developing public understanding of the facets of the debate to enable engagement in policy debates (Boykoff, 2011, Carvalho and Burgress, 2005). There has been a range of previous research examining the portrayal of climate change and the impact that media framing has upon public perception. Media framing has been an important focus in previous research as the selection of information to portray climate

change is considered to influence public perception of the issue (Boykoff, 2011, Muschert, 2009).

1.1.2: Why focus on the Internet?

There has been a significant societal change with the rise of information technology. This has allowed for people to interact with the media entirely differently and has enabled users both the ability to select the information they receive and the capability they have to share information with other users through social networks. The active role the user has in engaging and sharing information has increased with the number of Internet users in the UK rapidly increasing from 7.39 per 100 people in 1997 to 87.02 per 100 people in 2012 (The World Bank, n.d.). Previous research by Anderson (2009, p. 177) has shown that the Internet has become a key way that the public find out about climate change. Interestingly the Internet has also become the main source of journalists' information on climate change (Anderson, 2009).

The Internet is also increasingly absorbing all other forms of media including traditional media, as well as the emergence of new forms of media with user created content, essentially becoming the first meta-medium (See Agre, 1998, Fortunati and Taipale, 2014, p. 318). The development of Web 2.0[2] meant that the Internet was not just an imitation of paper, but the new website design philosophy meant that users were creating content (Barassi and Trere, 2012, Kata, 2012, Ryan, 2010). This change has allowed for the emergence of huge quantities of user created content. For example the video hosting site Youtube has one hundred hours of video uploaded every minute onto its website (Youtube, n.d.-b). Alongside the ability to host user created content there has been the emergence of social media, such as Facebook, which has enabled the sharing of content and information to other users in a social network (Gruzd et al., 2011, Kaplan and Haenlein, 2010, Kata, 2012). The growing use of social media sites can be illustrated by Facebook, which has grown from 145 million monthly users

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[2] Webb 2.0 is discussed later in chapter 2

in 2008 to 1.35 billion monthly active users by September, 2014 (Facebook Newsroom, n.d).

There has not been simply the creation of new forms of media, but also the absorption of traditional media. US newspapers, for example, had an online presence since the early 1990s but this was originally a basic introduction to the newspaper (Li, 2006, p. 1). However, from a basic web presence, online newspapers have evolved to be more than equivalent to their print counterparts. Even as far back as 2006, Li (2006, p. 2), highlighted that audiences rely more on the Internet versions of these newspapers "… because they are more accessible, updated more often, and richer in content than print newspapers". Due to this accessibility they also reach a wider range of people with *theguardian.com* achieving an average daily unique browsers of 8,016,000 accessing it in July 2015 - far greater than daily circulation of *The Guardian* (Ponsford, 2015).

Another example of the absorption of traditional media can be seen through television with on demand services, such as 4oD [Channel 4 on Demand], that allow users to catch up on missed television programming, and Netflix which allows for people to view films and series online (4 Press, 2006, Netflix, n.d.). Research by Liebowitz and Zentner (2012) has shown that Internet users, particularly, young people, have reduced the amount of time they spend watching traditional television. The shift from traditional media to the Internet is argued by Gaskins and Jerit (2012, p. 206) to be due to the Internet offering a greater range of entertainment and information to the individual.

The growing use of and dependency upon the Internet, along with the decline of traditional media, means that it is of great significance and importance to examine the impact the Internet has had upon reactions to climate change information. In particular, the Internet not only offers a greater range of information and entertainment from both traditional media sources and new media created by users. The Internet has enabled access to a wide range of information about science, but also risks the potential of the public being misled by inaccurate information as anyone can create content (Britt et al., 2014). It has also enabled greater potential for the self-selection of information, with the

freedom for users to completely disengage with news and science communication if they so wished (see Smith and Searles, 2014, p. 71).

However, greater opportunity of self-selection is not the only manner in which the Internet differs from other forms of media. A key aspect of the Internet experience is personalised for the user based on previous browsing history and data received through trackers which track user activity providing a personalised web experience (Lee and Cranage, 2011, p. 987). Mass collection of personal data is used by marketers to attempt to increase sales through targeted advertising, for example attempting to predict a potential customer's needs through location data (See Xu et al., 2011), and also used by websites to direct to what users are more likely to buy. The collection of user data is undertaken by most social media websites and search engines, such as Facebook and Google, to tailor results for items you are more likely to click on. Google stores data of what is searched for and clicked on for 180 days or forever if their user is logged in with a Google account (Sullivan, 2009). Google also has become dominate with increasing numbers of users with the number of searches being carried out exponentially increasing year upon year with 22,000,000 searches in 2000 to 2,834,650,000,000 by 2015 (See Figure 1.1). Personalisation means that some users may not straight forwardly reach climate change information, as they have not engaged with it in the past.

Figure 1-1: Annual number of Google searches
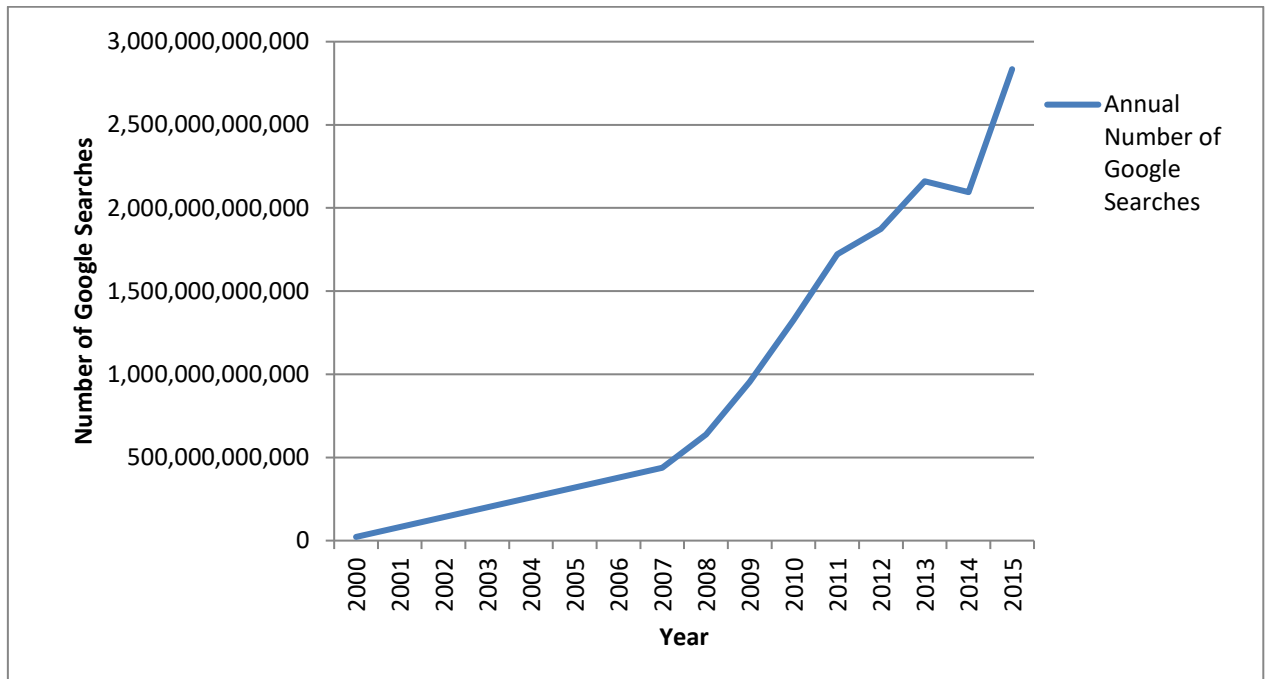
Note: Data taken from Statistic Brain (2016). There is missing data for 2001 through to 2006 so a trend line has been added.

There has been a lack of research on how the changing interaction with information has shifted towards the use of the Internet. Therefore, this thesis will explore how users perceive their Internet use and how they view their engagement with climate change material online. In particular, this thesis seeks to critically examine the consequences of information overload and junk information on the publics' reactions to climate change and the implications the Internet has for science communication.

1.1.3: Why focus on young people's use of the Internet?

This thesis focuses upon young people because previous research suggests that technological advancements and electronic communication have become normalised in their lives (Eynon and Malmberg, 2011). Therefore, an examination of young peoples' engagement with climate change information and the impact that junk information has upon their reactions to climate change allows us to investigate how people absorb and react to information from the Internet. While the results will focus on young people, there is the potential that these

results can be generalised to broader society as the Internet and social media is increasingly adopted and normalised by a wider user base.

The adoption of social media in the UK can be seen in Figure 1.2 where young people were the rapid adopters of social media with a sharp increase from 54% of Internet users aged between 18 to 24 in 2007, to 90% by 2011 (Ofcom, 2015, p. 32). The graph shows a slower increase of adoption by Internet users between 35 to 44 year olds from 12% in 2007 to 58% by 2009 (Ofcom, 2015, p. 32). The adoption of social media continues to increase in society with the average age of users jumping "… from 33 in 2008 to 38 in 2010" as a wider range of people adopt the technology (Hampton et al., 2011a, p. 3). Social media has been growing in use with young people being early adopters and continuous users. Along with being early adopters this enables young people to be participants in the new forms of digital democracy (See chapter 2) with the potential of social media to inform others and in the potential produce rich discussion of issues in society or the potential to scrutinize and hold government and decision makers to account (Loader et al., 2016)[3]. Previous research on young people has found that there is awareness of climate change and young people are going to experience the consequences within their lifetimes (Ojala, 2011).

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[3] The new forms of participatory democracy are discussed in chapter 2 in the optimistic predictions of the information society.

Figure 1-2: Percentage of UK Internet users using social media by age groups
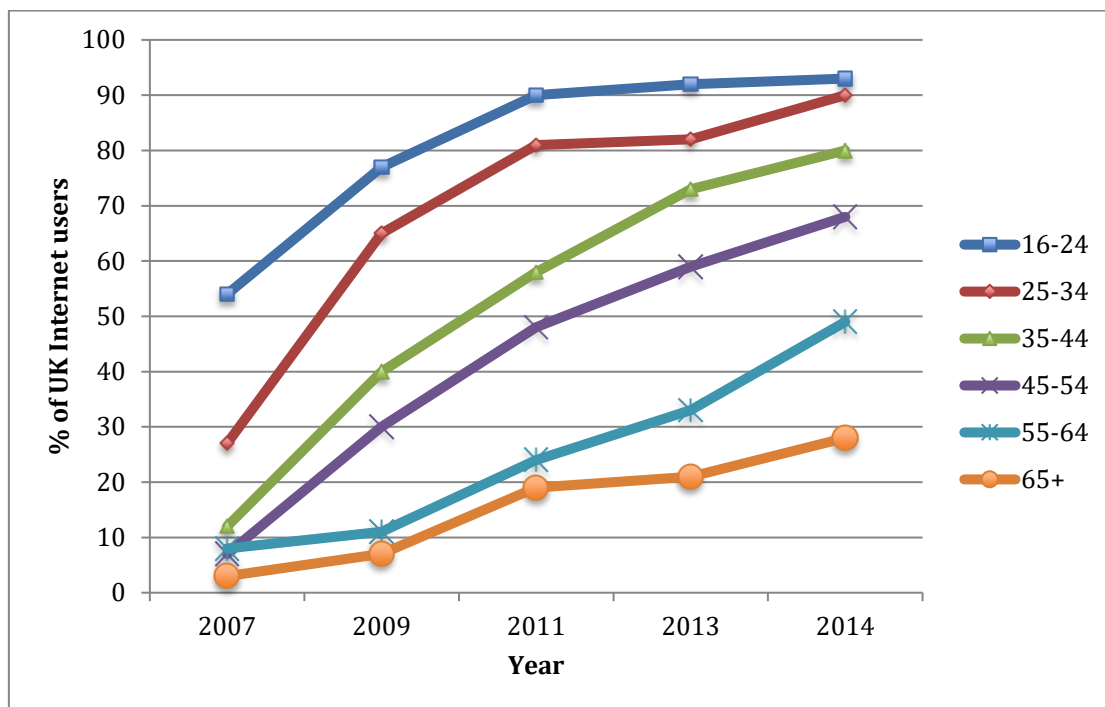
Note: Data from Ofcom (2015, p. 32).

By focusing on young people my work can reveal the potential consequences upon public reactions to climate change within the context of broader normalisation of social media and the Internet within society and the challenges that the Internet poses for communicating climate change to the public. It is important to explore whether young people access climate change information and how the Internet has shaped their engagement considering the Internet and social media is seen as a normalised aspect of their lives.

1.1.4: Communication for action

It is important to study communication of climate change because effective communication of the issue is required to produce an informed public (Moser, 2010). An adequately informed public is argued by Moser (2010) to not simply produce pressure on politicians for political solutions, but can change normative behaviours. Normative behaviour consists of internal mental processes that have significant influence on human behaviour in society (Steg et al., 2014, Beheshti et al., 2015, Mead et al., 2014). While the chance of political

action and normative change is highlighted by Boykoff (2011, p. 2) as a potential outcome of an informed public it "…does not determine engagement…".

However, effective communication that instils belief in anthropogenic climate change has proved difficult to achieve despite anthropogenic climate change reaching scientific consensus and being regarded as a scientific fact (Pidgeon, 2012, p. S85). This is illustrated by the UK Energy Research Centre [UKERC] face to face survey of the British public in which 91% answered that they thought the world's climate was changing in 2005, but in 2013 the same question received a result of only 72% (Poortinga et al., 2013). The changing public perception of climate change is particularly interesting to examine. Why has public belief decreased while climate change has achieved scientific consensus? Perhaps this is due to the fact that the Internet has become increasingly significant in peoples' lives perhaps this distracts or misleads the public that the science is still contentious. This makes it prudent to explore contemporary youth engagement with climate change information and the impact that the Internet has had upon reactions to climate change.

1.2: Contribution to the literature

This research contributes to four key areas. I am using an interdisciplinary approach to analyse the impact of the Internet beyond simply public concern for the environment. Firstly, this research explores the information society and develops an analytical framework to allow for an analysis of the Internet upon young people. Secondly, I am focusing on public understanding of climate science, perception of risk, and support for climate action, to develop an understanding of the consequences on the Internet on young people's understanding of the causes and consequences of climate change. This draws upon the public understanding of science research that has emerged from the social sciences. In addition, it also draws from research into risk perception and public support for climate mitigation. The third contribution is to apply insights from the media effects literature to the case study of the Internet when previous research has predominately focused upon newspaper and television communication. In this endeavour, I use communication studies literature to examine engagement with online material and the consequences of the Internet.

I also apply information processing literature to examine how young people interact with climate change information. This draws from psychology and neuroscience research to explore the processing of information and the consequences of the Internet on reactions to climate change. Finally, I am extending the state of the art in studies of climate change communication on the Internet, by applying the experimental method.

Firstly, although the information society literature emerged before the Internet, significant claims were made about the impact of increasing information on society (See Bell, 1973, Masuda, 1980). These claims have been used to produce a analytical framework of the information society, which represents a significant social shift due to information technology (See Martin, 1995), used to analysis the impact of the Internet on young peoples' reactions to the communication of climate change. However, the initial claims where inherently hopeful and utopian about the changes that information society would produce. While the work was visionary with regards to the ubiquity of information the consequences of information overload and junk information have been used to create an analytical framework for the 'dark side' of the information society (see chapter 2).

Secondly, the interdisciplinary approach enables my research to explore the impact of misleading climate sceptic information upon young peoples' understanding of climate science. The Internet has dramatically changed the way we communicate significant issues in society (Koteyko et al., 2015). In particular, content can be created by anyone and spread through networks of users with traditional gatekeepers of information communicated to the public completely bypassed (Singer, 2014). Gatekeeping has been traditionally seen as the role of journalists to select what information is worth the public's attention which Singer (2014) defines as essentially a regime of control that enables quality control of information the public received. However, with the loss of gatekeeping with Internet communication there is the potential for climate sceptic material and discourses to reach a wide public audience despite contradicting the scientific consensus of anthropogenic climate change. Therefore, while the traditional media has reduced coverage of climate sceptic discourses and arguments we

have seen new opportunities for climate sceptics to mislead the public with the increasing importance of the Internet in society.

The third area in my thesis extends previous media effects literature, which predominately focuses on self-selection of newspaper and television content onto the use of the Internet. The Internet has changed our engagement with information with users able to generate content and share it across social media networks. The nature of information consumption had changed. The public once had limited outlets to receive news sources that provided similar messages but conflicting political viewpoints (Mutz and Martin, 2001, p. 97) . Instead, the rise of the Internet, has enabled consumption of news on demand from a range of sources from journalists "… to unfiltered news items delivered by search engines, and unvarnished rumour and speculation in blogs…" (Diddi and LaRose, 2006, p. 194). The pattern of the consumption of online news resulted in Ahlers (2006, p. 48) warning of a 'media generational gap' that had emerged with online news being adopted predominately by young adults between 18 and 29 years of age. Information processing research has shown that effective engagement with climate change requires users see the personal relevance of the information (Spence and Pidgeon, 2010, p. 658). Framing (sometimes referred to in literature as schemas) is argued by Lakoff (2010, p. 71) to be unconscious structures containing all our knowledge. Frames are used to process all information we receive. Essentially frames are "…mentally stored clusters of ideas that guide individuals' processing of information" (Entman, 1993, p. 53). These enable people to make decisions or opinions based upon limited information. In the context of elections Houghton (2009, p. 124) highlights that frames enable voters to make a decision on a candidate with the knowledge of their party allegiance alone.

Finally, the fourth key contribution that I seek to make is apply the experimental method to Internet studies on climate change information on the Internet. Previous studies have sometimes used inappropriate methodology for answering their research questions when examining Internet content. Instead, my research uses a mixed method approach to provide a robust approach to Internet studies (See chapter 4). The focus groups examine the use of the Internet by young people and whether they engage with climate change information. Focus

groups have been conducted to remove my personalised experience of Internet use from biasing my experimental design and in particular to inform the experimental treatments and make them as valid as possible. The experimental design allows for direct examination of the consequences of information overload and junk information, and establishes direct causation of media stimuli upon participants' reactions to climate science.

1.3: Research questions

This thesis examines the impact of the Internet in an information society upon young peoples' understanding of climate science, perception of risk, and attitudes to climate change mitigation. This research will seek to answer the following overarching research questions:

How do Internet users engage with climate science and policy debates surrounding anthropogenic climate change?

To what extent does online communication of climate change impact young peoples' understanding, perception of risk, and support for mitigation of climate change?

Subsidiary are introduced in chapter 4 (See table 4.1) that explore the wider context of Internet use and the specific impact aspects of the information society have had to climate change communication.

1.4: Thesis structure

This thesis is structured into seven further chapters. The second chapter explores the academic debates surrounding the concept of the information society and the changes to society that the information technology revolution has had. In particular, this chapter focuses on the rise of the Internet and the opportunities that it has brought for communicating climate change. However, this chapter also examines the consequences that the Internet has had for reactions to climate change with the risk of junk information being harder to distinguish from accurate sources and the impact that information overload has had upon user's

reaction to climate change information. To successfully explore the literature of the information society and the impact of the Internet upon users, this chapter applies the analytical framework of the information society for explaining public understanding of climate change.

The third chapter explores public understanding, risk perception, and support for climate action. This focuses on the debates surrounding how we define public 'understanding' and what level of understanding is necessary for the public to engage effectively in policy debates surrounding science issues in society. This includes an examination of the concept of scientific literacy and a critical examination of the methods used to measure scientific literacy. Along with the debates surrounding how to measure public understanding of science it also focuses on debates surround risk perception and support for action. Finally, this chapter explores the impact of the media in the reaction to climate change information and the processing of information received from the Internet. In particular, this will explore the effect of media exposure and factors that limit exposure to climate change information.

The fourth chapter will set out the research questions and the hypotheses this research will seek to test. It will justify the mixed methodological approach combining focus groups to explore online engagement with climate change information and experimental methodology to explore the impact of the Internet on young peoples' reactions to climate science. The experimental methodological approach has been designed to examine the impact upon participants of reactions to junk information (climate sceptic material) and the consequences of information overload. Chapter four also explains how the experiment has been designed and how the control and dependent variables have been developed to examine the causal link between climate change information and reactions to climate science.

The following chapters explore the results from the mixed methodological approach with the fifth chapter critically examining the results from the focus groups. The focus groups explore the use of the Internet and social media for general use for finding and sharing information, and whether there is active engagement with climate change information. The sixth chapter statistically analyses the results from the experimental groups and critically evaluates the

impact of junk information and information overload upon young peoples' reactions to climate science. This chapter will examine the impact of differing media stimuli on three treatment groups that seeks to examine the impact of junk information and information overload in contrast to the results from the control group.

The seventh chapter of this thesis will provide an overall discussion of the results in relation to previous literature, which will critically address the research questions and hypotheses. This chapter will reflect back to the findings of this study to previous research and the difficulty that the Internet poses to climate change communication on the Internet. The final chapter is a conclusion will appraise the overall research design and address the limitations in the study. Additionally, this will set out a potential future research agenda.

Through this structure, the thesis seeks to understand the impact the Internet has had on young people's reactions to climate change. It does this by building on previous research into public understanding, perception of risk, and attitudes to climate action to be applied to the Internet. It also exploring how the Internet has changed how young people engage with information and the difficulties this produces for climate change communication. In so doing, it makes a key contribution to four areas of study. Firstly, developing the information society into an analytical framework to examine online communication of climate change. Secondly, exploring the consequences the Internet to climate change reactions. Thirdly, applying previous research into media effects and communication literature on the case study of online climate change communication. Finally, applying the experimental method to Internet studies into climate change.

Chapter 2 – An analytical framework for the Information Society

This chapter explores and examines the information society literature and uses this to develop an analytical framework. This framework structures my assessment of the impact that a societal transition, brought about by the rapid changes in communication due to the Internet, has had upon public reactions to climate change. The information society is a highly contested concept, which focuses upon the influence of the information technology revolution upon multiple arenas of human society to varying degrees (Martin, 1995, Masuda, 2004, Britz, 2008). This chapter will explore the debates surrounding the information society and use it to develop an analytical framework to address my research question. The analytical framework gives a structure to examine the consequences of the information society and communicate the core ideas of this research (See Sartori, 1970, and Gerring, 1999). This chapter is divided into two sections. The first section examines the debates on defining the information society and seeks a workable definition for the purposes of my examination of its impact upon the consequences to public reactions to climate change information. The second section explores the sharing of information through social media, and the potential consequences with the risk of junk information[4] (i.e. climate sceptic discourse) and information overload. The information society literature is important to this thesis because it helps understand the context of contemporary climate change material. The analytic framework, along with the focus groups, provides an appropriate set of treatments used as independent variables for predicting understanding, risk perception, and support for mitigation.

2.1: Defining the information society

The information society is a contested and complex concept that has been used by a range of academics since the 1970s. I reduce this contestation and complexity in two stages. First, I will define the concept of the information society

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[4] This is referred to as junk information in this thesis and is discussed in detail later in this chapter with its impact on climate change communication.

that this research is using. Secondly, I will explore the emergence of information society theory and debates surrounding the impact to society.

My thesis uses a broad definition of the information society which was proposed by Martin (1988, p. 179) to be:

"… a society in which the quality of life, as well as prospects for social change and economic development, depend increasingly upon information and its exploitation. In such a society, living standards, patterns of work and leisure, the education system and the market place are all influenced markedly by advances in information and knowledge. This is evidenced by the increasing array of information-intensive products and services, communicated through a wide range of media, many electronic in nature." (Martin, 1995, p. 3)

The application of this definition has been chosen as it redefines the information society away from technological determinism and also focuses on the social impact compared to previous theorists[5], which I explore later in this chapter. Technological determinism is a belief that technology is a solution to complex issues impacting society such as climate change (Pepper, 1993).

My research builds upon the information society theory which originally emerged in the 1970s with the concept differing among academics in both application and development. However there are some common features with a shared belief that the information society represents a shift in the economic mode of production from industrial production to information production and a social transformation with information capital becoming increasingly important along with the spread of information technology and availability of information (Bell, 1973, Bell, 2004, Martin, 1995, Masuda, 1980). There are key areas of dispute amongst scholars, particularly surrounding the consequences of the economic and social shifts in society.

There are three aspects of the information society focused on in this research and each will be examined in turn. However, these are contentious with optimistic predictions, that I refer to as the light side of the information society, and the actual consequences, which I refer to as the dark side of the information

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[5] See below for more detail on the development of the information society theory.

society[6]. To examine the social predictions and the impact has these have been approached in three key themes (See Figures 2.1). The light side of the information society believed that increased information would be shared and available in society with greater number of people contributing to knowledge and collective intelligence. Meanwhile there have been consequences that were not predicted by the light side of the information society which will be discussed later in this chapter.

Figure 2-1: The light side of the information society

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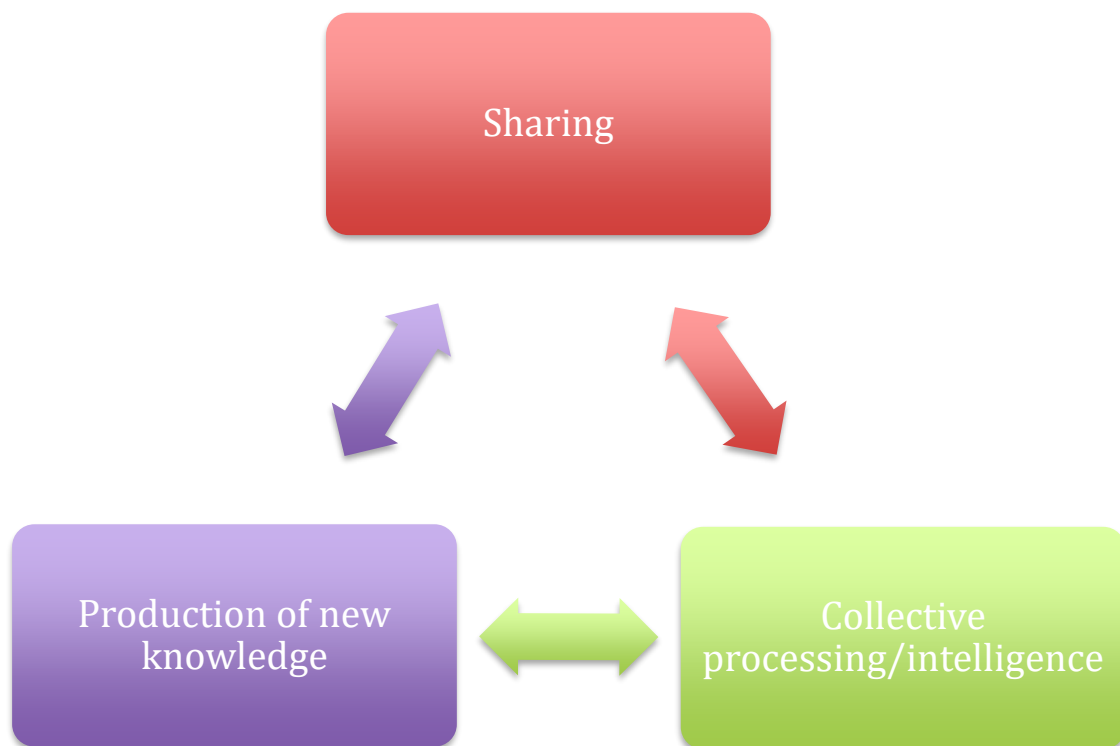
[6] The dark side is discussed the following section of this chapter.

Firstly, there was the prediction of the sharing of information, including an increasing availability of information. The sharing of information is seen as a key aspect of the information society by Masuda (1980) who predicts citizens will have a key role with 'autonomous information networks'. These networks of individuals were believed as essential in the Information Society for sharing information. Through the sharing of information Masuda (1985) argues that citizens will organise campaigns to resolve issues in society if awareness is created. Not all predictions of this rise of information were entirely positive with the emergence of groups working for common problems being seen as potentially problematic by Bell (1973) as socially networked groups of individuals can be in competition and potentially marginalise other groups in society potentially resulting in conflict (Bell, 2004). The sharing of information is seen as important and this prediction has come to pass with the emergence of social media and the ability to easily mass communicate information and organise with other users (See Mossberger et al., 2008). This is a key feature of both the light and dark side of the information society. However, consequences of online communication and communities do not match the idealised beliefs held by Bell (1973) and Masuda (1980)[7].

In contrast, the consequences of increased sharing and access to knowledge differ between the light and dark sides of the information society. The second aspect of the light side of the information society is the mass production of new knowledge with knowledge creation being open to everyone within society (Masuda, 1985). The shift towards intense information production and consumption in an information society was argued by Masuda (1980, p. 3) to result in "… highly intellectual creativity where people may draw future designs on an invisible canvas…" instead of society being based upon mass consumption of consumer goods. While this differs from the predictions in the post-industrial society approach argued by Bell (1973), which also claims the shift to an information economy and greater public participation in the political system, it does not make the same radical claims of societal change (Bell, 2004).

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[7] The consequences of information sharing and online communities are explored later in this chapter.

The rise of knowledge creation has been claimed to be a shift in the mode of production akin to the industrial revolution with authors such as Masuda (1980) who predicted that the mode of production will shift from mass production of material goods to mass production of knowledge and information. This new economic mode of production is argued by Masuda (1980, p. 29) to be defined by an economic model where "… the production of information values and not material values will be the driving force behind the formation and development of society". The impact from the economic shift is proposed to cause transformation across society with participatory democracy and citizen movements tackling social issues while economically moving to environmentally sustainable production (Masuda, 1980). This belief in the shift to the information society are idealised by Masuda (1980, p. 33) as:

> "The spirit of the information society will be the spirit of globalism, a symbiosis in which man and nature can live together in harmony, consisting of strict self-discipline and social contribution."

The predictions are very utopian with a central belief that technological advancement will provide a solution to global environmental problems, economic issues, and social issues. The belief that information technology will solve global issues revolves around the idea that the technology will interconnect people to raise a collective intelligence to transcend the limitations of individual intelligence[8] (Fleissner and Hofkirchner, 1998).

There are other advocates of the information society that shift focus onto the 'post-industrial' economy. Advocates include authors like Bell (2004), (1973), who focus upon the shift to an information driven economy and its impact on social life (Kumar, 1978, Kumar, 1995, Martin, 1995, Bell, 2004). In particular, the shift is characterised from material goods production to a service based economy with a social impact of producing "… a 'communal' society…" but he warns there will be societal conflict caused by this transformation between professionalism and the general population (Bell, 2004, p. 88). This predicted conflict is argued by Bell (2004, p. 88) to be caused by information becoming core to the economy with professionals gaining more power to make decisions which are in conflict

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[8] These claims of collective intelligence are discussed in detail later in this chapter.

with the role of the general population in "… greater participation in the society". However, despite the potential conflict caused by the shift to the post-industrial economy, this shift is argued by Bell (2004, p. 87) to produce high quality of life as "… health, education, recreation, and the arts…" will become "… desirable and possible for everyone".

Although society may not be developing in the manner that some authors imply, the predictions of Masuda (1980) and Bell (1973), that information technology will result in a shift in the mode of production can be evidenced in the changing distribution of the working population in industries within England and Wales (Figure 2.2) (Bell, 2004). The number of people in England and Wales working within the service industry has rapidly grown from 60.5% in 1981 to 81.1% by 2011. The number of working people within the manufacturing industry has declined from 36.3% in 1961 to only 8.9% in 2011. The decline of the manufacturing sector and the rise of the service industry within England and Wales supports the argument made by Bell (1973) of a post-industrial society as the service industry becomes dominant within the economy with growth of service sectors such as finance having an increased demand for an educated workforce (Bell, 2004).

Figure 2-2: Employment by industry in England and Wales
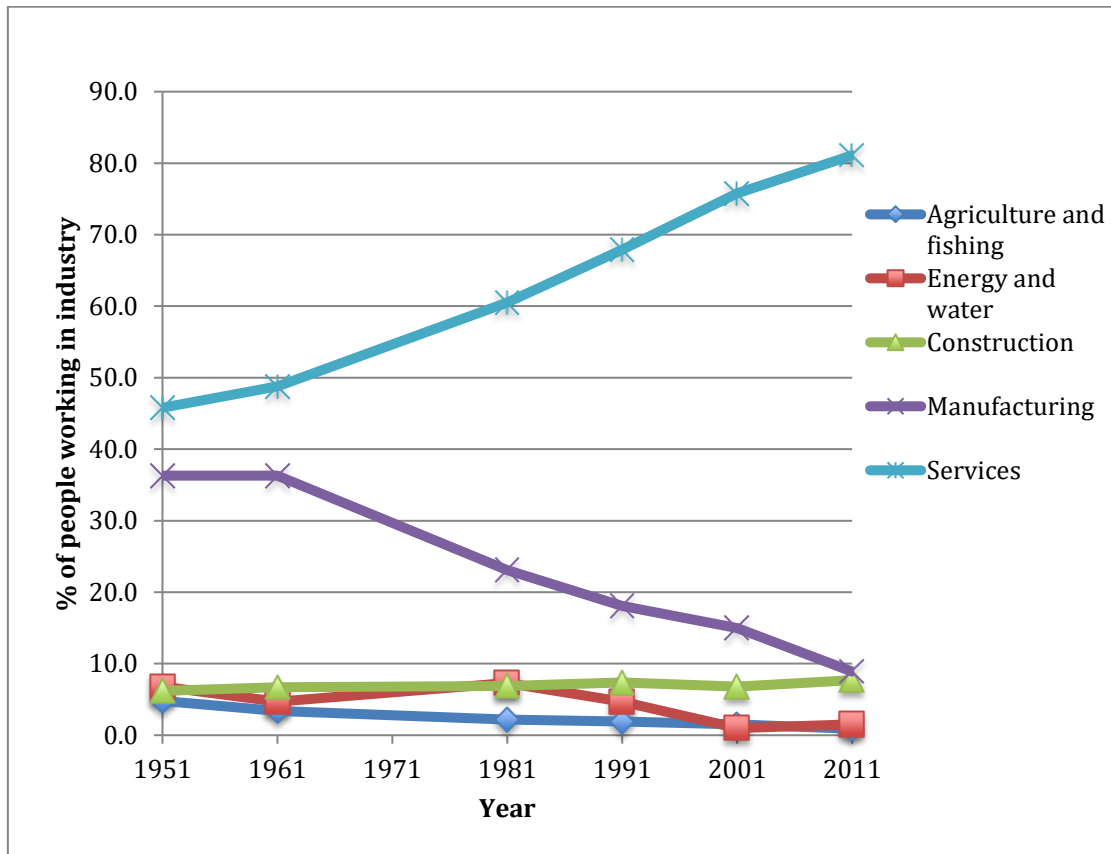
Note: This graph was produced with data from Office for National Statistics (2013). Important to note that Data for the year 1971 is not available so a trend line has been used.

These approaches by Bell (1973) and Masuda (1980) to the concept of the information society point to technology as force equally significant to the Industrial Revolution in terms of organising society and as the dominant mode of production in society. This mass participation in knowledge creation is argued by Masuda (1985) to be a late stage of information society development to be comparable to consumerism in an industrial society. While their work was visionary with industry shifts in England and Wales supporting their predictions of economic reform and the increasingly networked society, their predictions might be accused of being economically determinist and utopian. There are three key issues with the creation of new knowledge being akin to the industrial revolution in the light side of the information society concept.

Firstly, the claims of significance of an information revolution to the mode of production equal to the Industrial Revolution in the West is flawed as the

industrial mode of production continues with globalisation, which has rapidly sped up industrialisation in the developing countries, to move industrial production geographically (Stiglitz, 2002, Youngs, 2007). The movement of global production has occurred with the increasing pace of globalisation since the 1980s which has allowed for the "… networked global economy where production and consumption chains can be flexibly and speedily disaggregated and extended across physical space" (Youngs, 2007, p. 10, See also Giddens, 2002). The new mode of production and the ending of "… the struggle between capitalist and worker…" argued by Bell (2004, p. 88) has instead been a continuation of the capitalist mode of production with "… new avenues of exploitation and new technological means by which to pursue them" (Martin, 1995, p. 5).

The second key issue with the approach to vision of the information society is a core belief that technology will solve significant problems in society (Bell, 1973, Bell, 2004, Masuda, 1980). This approach to defining the information society is technologically deterministic, particularly the approach by Masuda (1980) which went so far as to argue that technological advancement would solve economic, social, and global environmental problems. Technological determinism holds a belief that technological development will provide us with solutions to complex issues such as climate change (Pepper, 1993). This belief is criticised by Bookchin (1982), Pepper (1993), and Porritt (1984) as technological determinism holds the concept of progress itself as inherently linked to technological development and asserts that effective technological solutions will be produced by the market as pressure from an issue grows.

The belief in technology as the solution to pressing issues such as climate change is particularly worrying as the technological deterministic approach distracts from the necessary societal and behavioural changes required to solve issues in society (Bookchin, 1982, Pepper, 1993). Essentially, this belief in technology allows for the continuation of the status quo with no change in the mode of production, which holds onto the belief of unlimited growth, or significant changes in the organisation in society (Dobson, 1995, Pepper, 1993, Schumacher, 1974). The technologically deterministic discourse of the information society is criticised by Tokar (1994, p. 81) as failing to be an environmental solution as information technology has a high environmental cost but "… it better hides the consequences of their production" (Dobson, 1995, p.

99). For example data centres are quickly increasing their carbon emissions, as cloud storage[9] grows in use, with an estimated 2% of global carbon emissions 2008 and growing to 3% by 2020 (Cubitt, 2017, p. 16). The discourse of technological determinism protects the hegemony of the globalised capitalist mode of production and those in society who benefit (Pepper, 1993). It is argued by Pepper (1993) that technology is not fundamentally negative and can potentially be an aspect in solving environmental issues, however, the belief that technology is the singular solution undermines pressure for alternative solutions (See also Fleissner and Hofkirchner, 1998).

The final key issue with this prediction of the light side of the information is that the creation of new knowledge is seen as a positive aspect. There was a presumption that new knowledge is beneficial, but there is the problem of fake/false information being created and shared through information networks in society. This fake information can be any misleading information including news articles, edited videos and images, and users using other people's identities (Blokhin and Ilchenko, 2015). The consequences of junk information can mislead and influence people. For example fake media reports have been shown to be able to convince people to believe events that never happened took place but this was dependent on pre-existing world views with events accepted that strengthen them (Frenda et al., 2013). There have even been examples where fake information has resulted in real world harm with a ridiculous online conspiracy theory called 'Pizzagate'. This claimed high ranking US democrat party officials were involved in paedophile ring operating at a pizza restaurant that resulted in a gunman attacking the restaurant motivated by the online conspiracy (The Guardian, 2016b). There are other examples where advice/instructions are shared online with the aim to harm the person using the information. For example instructions for growing crystals involved the mixing of house hold chemicals into a jar and telling the person to blow using a straw into

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[9] Cloud storage is the off site server storage of information and software that can be remotely accessed by clients enabling for the reduced requirement of hard drives and CD drives as the content can be accessed through the Internet when needed.

the mixture. Instead of creating crystals the product created by the reaction was chlorine gas (McMillan, 2014).

While we have seen the increasing role the everyday person in the production of online content due to the development of Web 2.0. There are the negative consequences of the production and sharing of junk information created and shared online. This was warned by Bell (1973) to have the consequence of conflict between experts and the public. Junk information poses a potentially significant risk to undermining climate change communication to the public with the potential for climate sceptics to produce content and share them through networks of users.

The final aspect to the light side of the information society was the sharing and creation of knowledge would result in collective intelligence as the expectation that there would be significant changes to society and even humanity itself with the increased quantity of information. An extreme example of this idea can be seen with society being envisioned by Masuda (1980, pp. 58-59) to change due to computer networks causing society to become "… resembling an organism" with both long distance communication and ease of access resulting in a "… multicentered complex society…". The idea of an increasingly connected society due to information technological developments was also argued by Bell (1973) with the view that society will become increasingly communal rather than individually driven.

The consequences of this change caused by information technologies have been suggested to have even wider impacts on human genetics with the increased quantity of information. This increased quantity of information upon humans and the emergence of collective processing has even been argued by Masuda (1985, p. 479) to result in the next stage of human evolution with the emergence of "… Homo intelligens…". The belief held by Masuda (1985) is based upon 'gene-culture coevolution' which suggests that there is a link between culture that is generated from mental processes and genes, but changing culture can also change our genes. For example gene-culture coevolution is argued by Gintis (2011, p. 878) to attempt to explore whether genetics:

> "… is responsible for the salience of such other-regarding values as a taste for cooperation, fairness and retribution, the capacity to empathize, and

the ability to value such character virtues such as honesty, hard work, piety and loyalty."

Instead Masuda (1985) goes much further than social traits to suggest that significant changes of culture resulting from information technology will apparently have significant impact with evolution of our genes. This evolution is driven by the use of computers and the increased ability of processing information and the emergence of collective networks to cause significant environmental changes to cause a new species of humans to develop. While these ideas are once again technologically deterministic and significantly questionable there is the underlying belief that the increasing amount of information is beneficial to people.

We have experienced the huge increase in the amounts of information but the beneficial impact is questionable. Instead, the dark side of this aspect of the information society is the consequence of information overload. Information overload is the personal feeling that there is too much information and has consequences on decision making (Liu and Kuo, 2016, p. 2). The long term impact of information overload can result in "…stress, anxiety, sleep disorders, unhappiness, physical fatigue and depression…" (Liu and Kuo, 2016, p. 2). Information overload results in behaviour change with Walgrave and Dejaeghere (2017) finding politicians were outsourcing the processing of information and became selective in what they engaged with. This poses the risk polarisation of public opinion as selective exposure results in the reinforcement of world views and in addition the potential for people to opt out from receiving topics that do not interest them (Schumann, 2004, Mutz and Martin, 2001, Mutz and Young, 2011)[10]. The following section will explore the consequences of the dark side of the information society on climate change communication and will begin by examining the developments of the Internet.

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[10] The consequences to climate change communication are discussed later in this chapter

2.2: The dark side of the information society and the emergence of the Internet

It is important to note that Bell (1973) and Masuda (1980) were visionaries predicting the spread of access to information and growth of the information technology impacting our lives, but generally optimistic that there were positive outcomes for the most part. They pointed to many of the consequences of the Internet age through their concept of information society that emerged before the Internet was even invented. Rather than producing the optimistic consequences predicted, the ability to widely share and access information has instead actually had serious ramifications for communicating climate change and other political issues. In addition, this has the potential to undermine perceptions of risk, understanding, and support for climate action (see chapter 3). While the public understanding literature has not been conjoined with the information society before, this shift in information consumption relates closely with information processing and perceptions of risk literature[11]. In this section, I focus primarily on aspects of information society that have materialised with the advent and widespread adoption of the World Wide Web / Internet and its social impact[12].

The Internet is defined by Ryan (2010, p. 31) as "… a loose arrangement of connected but autonomous networks of devices" which are managed by protocols that bind networks together and "… govern communication between all computers on the Internet". The World Wide Web is a service that runs on the Internet allowing access to information in all formats through web pages accessed by web browser applications (Burners-Lee and Fischetti, 2000, Ryan, 2010, Swiss and Herman, 2000). To explore the development of the Internet and its social impact I turn attention firstly to the significant developments and the growth of the Internet. Secondly, as predicted by visionary information society theorists, I explore how the Internet has led to intense sharing of information through social media. Thirdly, I examine the consequences of the information rich

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[11] Introduced in the contribution to the literature section of chapter 1. This literature is discussed in chapter 3 and links are made between both bodies of literature throughout both chapter 2 and chapter 3.
[12] The World Wide Web is commonly referred to as the Internet in general usage. This research will also refer to the common use of the Internet when discussing websites.

environment upon users' understanding of issues. Finally, I critically evaluate the consequences of junk information upon public reactions to climate change. Overall, this section establishes the development and changes that have taken place with the Internet by exploring each of the key themes of the information society analytical framework used in my thesis.

2.2.1: Early Development of the Internet

The development of the Internet originates from the Cold War when the US military funded computer scientists to develop a decentralised communication system, which could not be eliminated by a direct nuclear strike and continue to function even if sections of the network were destroyed (Curran, 2010, Ryan, 2010). The decentralised communication network required by the US military is argued by Curran (2010, p. 20) to have been compatible with the scientists' own goals to produce the Internet as a research tool and allow the ideological design for "… the open disclosure of information and, in principle, to intellectual cooperation in order to further the shared goal of scientific advance[ment]". The development of the Internet meant that the primary users in the 1980s were academics, as universities were the first adopters of the technology with a priority on the research and communication potential (Curran, 2010).

The original intended design principle of free access to information fell into conflict with commercial interests. The pressure from commercial interests is argued by Curran (2010, p. 22) to be at first progressive by making Internet access more user friendly with "… a commercial web browser (Netscape)...".. However, this pressure from commercialisation is highlighted by Curran (2010) to have potentially seen the enclosure of the 'electronic commons' through pay walls limiting users to access websites unless paying fees. Instead, the drive of commercial interests led to advertising revenue becoming the primary profit focus (Curran, 2010). Advertising revenue became a key focus for commercial interests because a larger user base was seen as more profitable than subscription access for websites, while at the same time a second revenue source was user data which could be collected and sold (Curran, 2010).

Despite the commercial pressures, the users of the Internet were primarily academics in the early 1990s. By 1994 commercial users "… outnumbered academics on the internet by a two-to-one ratio" (Everard, 2000, p. 19). The non-commercial use of the Internet was protected with commercial use being against the Acceptable Use Policy of the National Science Foundation [NSF] which provided the backbone of the Internet (Ryan, 2010). However, the privatisation of the Internet began in 1993 with plans for Internet Service Providers [ISPs] to "operate their own networks and gateways would interconnect them" (Ryan, 2010, p. 121). The NSF Acceptable Use Policy was reformed in January of 1995 allowing for commercial use which was soon followed by the NSF backbone being closed in April 1995 with the NSF reverting to a research network (Ryan, 2010, Everard, 2000).

The continued pressure of commercial interests resulted in a financial speculation bubble with prediction of massive profit returns for investing in the information technology industry (Howcroft, 2001). This was fuelled by a belief in the information society with the idea that the Internet was resulting in the "… reshaping of almost all industries…" (Howcroft, 2001, p. 195). Investors had heavily invested in the technology market and provided funding for the establishment of new online businesses (Howcroft, 2001). The investment in online shopping websites was triggered by the success of eBay with the belief that online shopping was the future (Ryan, 2010, Curran, 2010). This was the case despite products being easily available in physical shops. An example was the company Pets.com selling pet food. In addition to having a higher cost due to shipping charges, such enterprises were challenged by a lack of public interest to shop online due to concerns with transaction security (Ryan, 2010, Curran, 2010).

This speculation bubble burst at the beginning of the year 2000 and was "… referred to as the dot.com implosion…" (Howcroft, 2001, p. 195). The consequence of the bursting of the speculation bubble caused the collapse of many of these new companies and made gaining funding from investors for new electronic commercial websites extremely difficult (Howcroft, 2001). For example, Pets.com collapsed at the end of the year 2000 despite having previously "… raised $82.5 million in its IPO [Initial Public Offering] in February, 2000…" from investors (Ryan, 2010, p. 129). Businesses such as Pets.com are argued by

Ryan (2010) to have spent large quantities of money on advertising to develop public brand awareness without developing the infrastructure of servers to cope with website traffic or the delivery services required. The consequences of the dot.com implosion were wider than just the new electronic commercial websites with impacts that affected "… major conglomerates like AOL Time Warner and Vivendi…" which had to undergo restructuring due to "… failed Net investments…" (Curran, 2010, p. 32).

The driving belief that resulted in the dot.com implosion was the concept of a new economic mode of production with the information society, as previously examined in this chapter with the work of Bell (2004) and Masuda (1980), with the technological determinist belief in an electronic commercial boom (Howcroft, 2001). The technological determinist beliefs that resulted in the consequences of the dot.com implosion are summarised by Howcroft (2001, p. 202) to be common with new technology developments:

> "Just as the telegraph would eliminate wars, the telephone would bring democracy and television would educate the masses, the Internet and with it the new dot.coms are heralded as the technology that has the potential to profoundly affect many industries and the entire retail experience"

The result of the dot.com implosion was the temporary failure of commercialisation to completely take hold of the Internet with commercialisation only partially taking place (Curran, 2010).

In the aftermath of the dot.com implosion there has been a recovery of online retailing with electronic shopping growing and becoming more widespread, particularly with younger people, with prediction of continued growth (Ha and Stoel, 2012, Naseri and Elliott, 2011). Despite the bursting of the speculation bubble, there was a major shift which occurred with the Internet entering a new phase of website design during the early 2000s, which became popularly known as Web 2.0 (Barassi and Trere, 2012, Ryan, 2010). The Web 2.0 is significant as the user experience became increasingly interactional with user-generated content and websites being designed for user participation (Barassi and Trere, 2012, Kata, 2012, Ryan, 2010). Alongside the development of Web 2.0, Internet use increased, particularly in the Western democracies. In the UK, Internet Users

(per 100 people) rapidly increased from 26.82 in the year 2000 to 64.82 by the year 2003, which can be seen in Figure 2.3 (The World Bank, n.d.)

Figure 2-3: Internet users (Per 100 people)
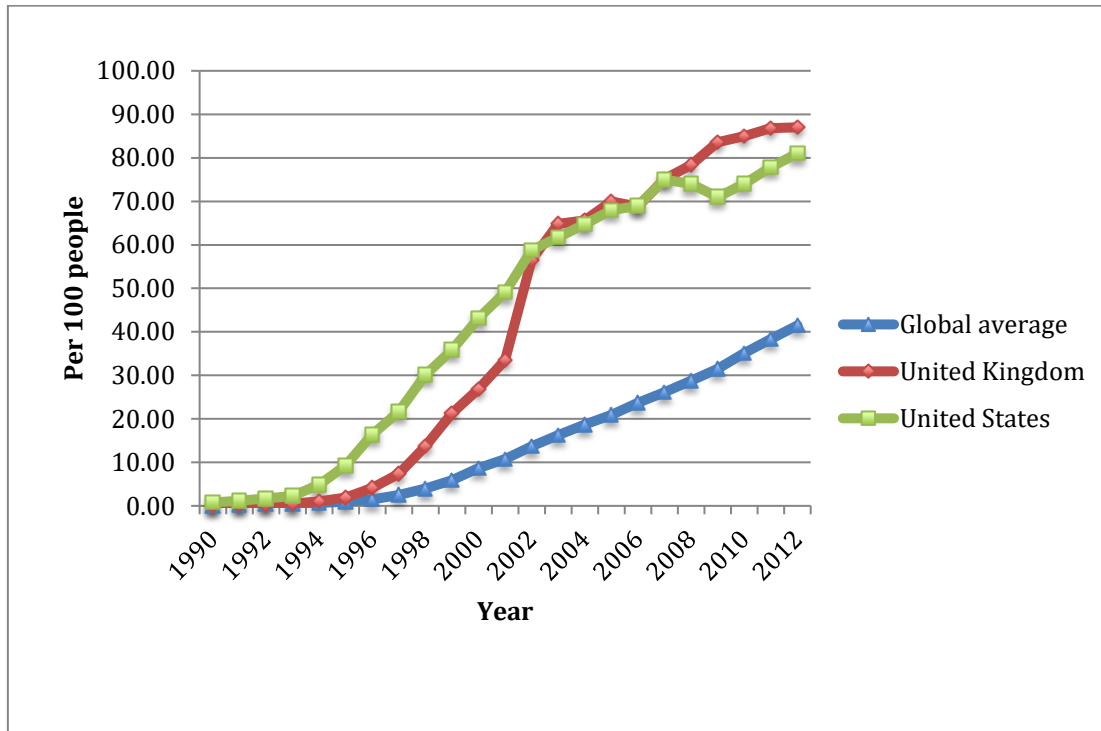
Note: This graph was produced from the internet users (per 100) data set from The World Bank (n.d.) . The global average is calculated by averaging the 214 countries within the data set.

2.2.2: Sharing in the era of Web 2.0

Web 2.0 resulted in the emergence of social networking and online communities with distance no longer being a limiting factor in the sharing of knowledge and values (Gruzd et al., 2011, Kata, 2012). Social media is defined by Kaplan and Haenlein (2010, p. 61) as "… a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content." The new participatory nature of the Internet has had a range of consequences. In particular, these include the rise of social media with user driven content, organisational opportunities for political movements, and opportunities to increase public awareness.

Early adopters of social media were primarily the young, who have been early adopters of new technology and frequent Internet users (Eynon and Malmberg, 2011). However social media has grown in use across a wider demographic (See Figure 1.2) with 77% of those aged between 16 to 24 using social media in 2009 compared to 30% only of 45-54. This has rapidly shifted with both demographics growing in use with 93% of 16 to 24 in 2014 and 68% of 45-54 (Ofcom, 2015, p. 32). Social networking has become increasingly normalised in society with popular websites such as Facebook, which emerged in 2004, and Twitter, which emerged in 2006, rapidly growing in popularity and user bases (Gruzd et al., 2011, Kaplan and Haenlein, 2010).

There are frequent claims that social media results in a decline of face-to-face social interaction (Hampton et al., 2011b). The decline of social interaction is considered to be a problem by Sigman (2009), who claims that new information technology is causing a breakdown of social relations as people instead interact in virtual communities. The use of social media is argued by Amichai-Hamburger and Hayat (2011) to be much more complex than the popular discourse of social isolation that the Internet caused. The assumption of isolation is challenged by Hampton et al. (2011b, p. 133) who argue that current research shows that close social relations do not break down through Internet usage and the research instead suggests that users "… had contact with a higher number of friends and relatives than did nonusers".

Instead the Internet has allowed for the creation of new social relations not bound by geographic location that exist and remain online (Hampton et al., 2011b). There is debate surrounding what these new electronic relationships are and whether these new social relationships are 'friendships' or not (Amichai-Hamburger et al., 2013). In particular, the anonymity the Internet provides highlights the difficulty in defining these new electronic relationships as building trust is seen as difficult (Henderson and Gilding, 2004). However, activity in online communities under user name pseudonyms is argued by Henderson and Gilding (2004) lead to the creation of online identities separate from their offline identities which become the basis of forming online interpersonal relationships with other users.

The growth of online communities was a significant development since Web 2.0 users are able to organise around common interests, share knowledge and values, and there is the potential to organise political activism (Faraj et al., 2011, Kata, 2012, Van Aelst and Walgrave, 2004). The formation of online communities is argued by Kata (2012) to have empowered people with access to a diverse range of information traditionally inaccessible to the average person. For example, the online communities for issues surrounding healthcare are argued by Kata (2012, p. 3779) to have allowed for "… patient empowerment, consumer reviews and advice, supportive communities…".

Alongside the empowerment of the public through online communities the Internet has also allowed for the sharing of information from a wide range of sources. This has been claimed to have democratised information and to have benefitted political activists (Grignou and Patou, 2004). The cost and time required to organise political demonstrations and protests, particularly transnational demonstrations, have been significantly reduced by the use of Internet (Van Aelst and Walgrave, 2004). The online communities that have arisen have created new social networks for activists that allowed for new opportunities to mobilise people onto the streets (Fisher and Boekkooi, 2010). The impact of these social networks on whether people choose to attend demonstrations is argued by Fisher and Boekkooi (2010) to be due to the social networks of activists encouraging participation as potential participants are more likely to attend if they know that others in their personal networks are also attending.

The Internet is also argued by Bennett (2004) to have benefitted political organisation as global activism now has perpetual awareness campaigns for political issues compared to before online activism emerged. The long-term awareness campaigns are due to the decentralised organisation that the Internet has allowed which prevents campaigns being silenced, as there is no central organisation that could be potentially shut down (Bennett, 2004). The potential of impact is also greater with the possibility that an awareness campaign can go viral on social media through the sharing of information and Internet memes (Guadagno et al., 2013, Kien, 2013).

However, while there is the potential for benefiting political engagement and improving awareness of societal issues, there have been consequences with the democratisation of information and social networks. This includes the viral sharing for entertainment, rather than to inform, with serious and complex issues being less likely to shared (Chesterman, 2011)[13]. Even when political or scientific information is virally shared it does not mean it's accurate with wide spread sharing of junk information, including examples such as anti-vaccination information (Kata, 2012). Even then, there is the risk of users filtering out information based upon personal preferences and echo chambers resulting in certain information being ignored with it being possible to opt out of environmental news and messages (Bennett and Segerberg, 2011, Garrett, 2009).

For example, the viral sharing of Internet memes highlight some of these keys issues while providing a method to potentially reach a large number with climate change information. Internet memes are symbols or markers that Internet users share, including images, videos, articles, or websites through social networks (Shifman, 2013). The term meme originates from a contested concept proposed by Dawkins (2006, p. 192) in 1976 who argues memes are culture that is transmitted "… brain to brain via a process which, in a broad sense be called imitation". The concept is argued by Shifman (2013, p. 362) to have been highly contested, even rejected in many academic circles, but the term has been adopted by Internet users for the spread of viral images or videos, which "… often also spawn user-created derivatives". The concept of memes defined by Dawkins (2006) has been rejected not only because they are difficult to define, but also because of the wider issue that the study of culture requires a broader examination as ideas do not exist in isolation (Bloch, 2000, Kuper, 2000, Sperber, 2000). However, the term meme[14] has resurfaced within academia as the word being appropriated for use to describe the viral sharing of information through social networking (Shifman, 2013).

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[13] What makes a successful meme and the difficulty faced by climate change memetics is discussed in depth in the barriers to climate change communication section in chapter 3.

[14] The difficulties facing successful climate change memes are discussed in chapter 3

The significance of Internet memes is argued by Shifman (2013, p. 365) to be the spread of cultural values, norms, and information on a large scale through communication "… person to person, yet gradually scales into a shared social phenomenon". These memes have the potential to spread political messages and concepts or for dominant messages to be subverted and parodied (Cammaerts, 2007, Kien, 2013). There is limited academic research exploring the emergence of individual memes and the spread of a meme. This is due to both the speed of Internet culture and difficulties in measuring the spread of memes.

However, while memes are a significant development from the Internet, this does not mean that the viral sharing of information is inherently positive. For example, there is the potential for the Internet to spread misleading or false information through social networks of users. A key issue with junk information is highlighted by Kien (2013) who argues that once false information has been shared virally, there is no way to delete it from the Internet. A consequence of the immortality of junk information and the speed that it can be shared has the potential for deliberate misinformation campaigns to manipulate the public (Kien, 2013). An example can be seen in the *Kony 2012* video by an NGO called Invisible Children which enjoyed viral success "… in early March of 2012" which "… attracted more than 110 million views…" (Kien, 2013, p. 557). The video (see figure 2.4) was shared by many people who presumed they were sharing "… meaningful information about a demented warlord and his enslavement of child soldiers in Uganda…" (Kien, 2013, p. 557). The video had an emotional impact on the audience and a belief that sharing the information would make a difference, which could easily be accomplished on the social network environments (Bal et al., 2013, Kien, 2013).

Figure 2-4: Kony 2012
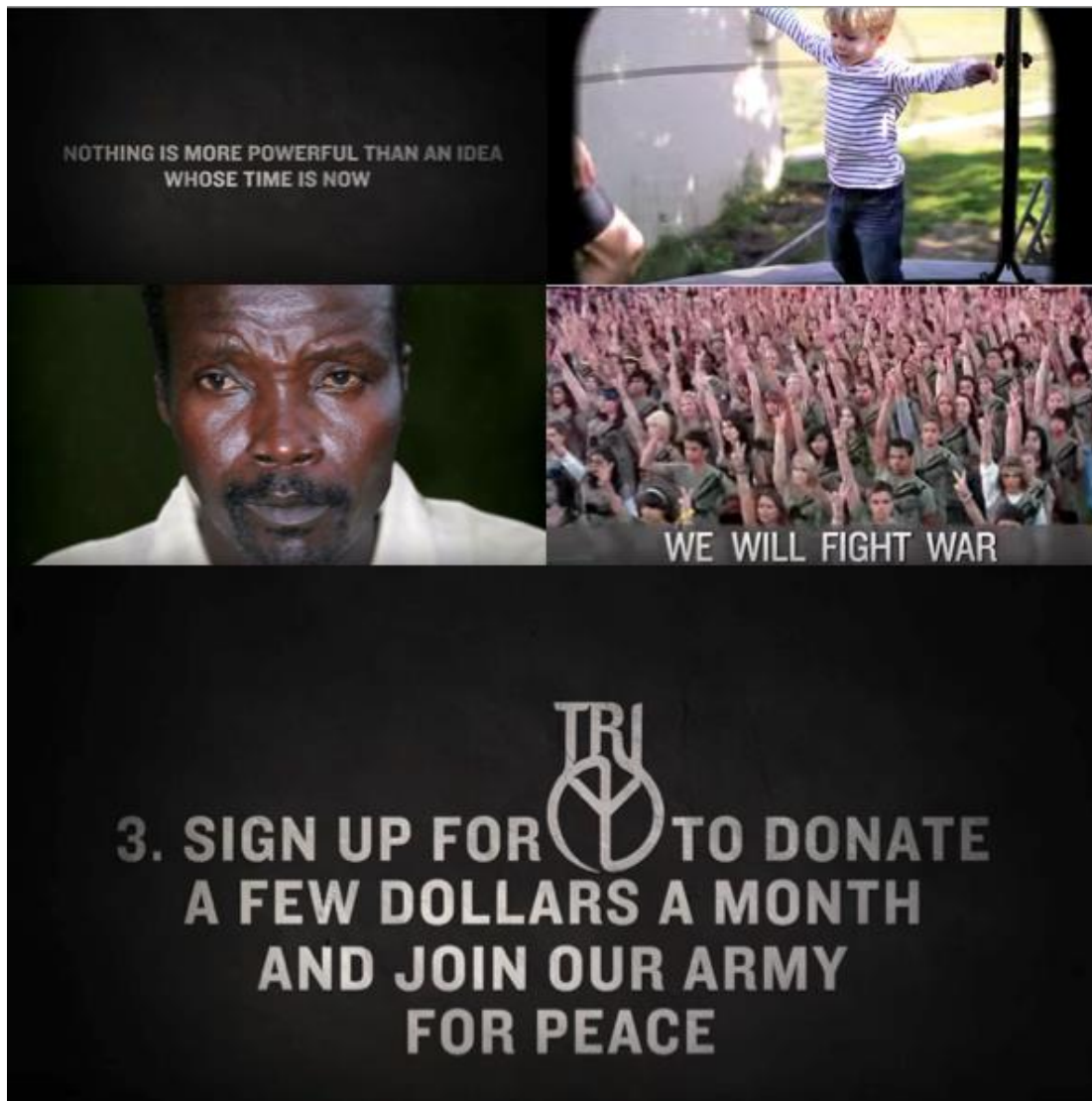
Note: Screenshots taken from Invisible Children (2012). The first image says "nothing is more powerful than an idea whose time is now" and the third image shows a group of young people in military style outfits raising their hands making the 'peace sign'.

However, the information that people were sharing that they believed to be meaningful was factually incorrect such as that "… the warlord in question…" was driven out of "… Uganda years before the video was made" (Kien, 2013, p. 557). While the numerous factual errors are worrying enough in a video designed to produce awareness of the focus and work of Invisible Children as an organisation and to encourage public donations, the spread of the message by Invisible Children is particularly worrying as Kien (2013) highlights that the NGO was found to have been "… spending most of their budget on salaries, travel, and film production" rather than the charitable purposes claimed (Kien, 2013, p. 557).

The example of the *Kony 2012* video highlights two issues that have arisen with the use of social networking. Firstly, users are engaging in 'armchair activism', more negatively called 'slacktivism' (See Morozov, 2011), which is political engagement by sharing of information via social media that the individual, perhaps mistakenly, sees as meaningful involvement in politics or making a difference in the world (Kien, 2013). Online activism is argued by Morozov (2011) to be both easy and have no costs for the user. As a result, these are unlikely to be meaningful groups in comparison to offline activist groups where people have to meet face to face. For example, the success of the viral video Kony 2012 did not translate into political action. Invisible Children's campaign *'Cover the Night'* was a failure with a tiny turnout in Western cities (Carroll, 2012, Paine, 2012). This means that even if there were large amounts of interest in online climate change campaigns this will not necessarily result in people becoming engaged in offline activism.

The other issue that Kony 2012 highlights is both the ease of transmission of junk information and the difficulty in challenging viral content. There was also an attempt to challenge the claims made by the viral video with the Ugandan Prime Minster Amama Mbabazi responding to the false claims, but it "… received less than 100,000 views" (Kien, 2013, p. 557). There is the potential for junk information to be shared virally. The risk of viral sharing of junk information was warned about in the early 1990s by Godwin (1994a) who argued that users have a responsibility to counter harmful information by creating 'counter memes' (See also Kien, 2013). A counter meme is a challenge against a popular meme with the aim to persuade users to stop using the meme (Godwin, 1994a). Counter memes have the potential to reduce the use of offensive memes or the continued reproduction of incorrect information within an online environment (Godwin, 1994a, Godwin, 1994b).

A successful example of a counter meme was produced by Godwin (1994a) who managed to curtail the use of Nazi comparisons in online discussions by managing to get the meme 'Godwin's Law' into popular use. A variation of this meme can be seen below in Figure 2.5, which encapsulated the counter meme in design of a playing card. This was a highly successful counter meme, but Godwin (1994b) does recognise that it is not always possible to

produce a successful counter meme and even then it relies on users themselves taking action to produce and spread a counter meme (see also Kien, 2013).

Figure 2-5: You played the Hitler card!

Note: Image taken from Know Your Meme (n.d.-e)

Climate change counter memes have been used to mock a discourse used by US Republicans 'I'm not a scientist'. This discourse has been used since 2013 to deny anthropogenic climate change by deflecting the question away from climate science, avoiding being perceived as anti-science, to instead focus on the economic costs of acting to reduce carbon emissions (Chait, 2014, Know Your Meme, n.d.-h). This led to a counter meme mocking politicians for their scientific ignorance with one example (see Figure 2.6) being a variation of a Star Trek meme called '*Dammit Jim, I'm a Doctor, Not a X*' (Know Your Meme, n.d.-c). However, these memes did not reach a wide audience or were not particularly reproduced by users. This highlights the difficulty to challenge messages with viral counter memes, as counter memes are not always simple or even necessarily possible without a wide assimilation by a user base (Chesterman, 2011, Kien, 2013).

Figure 2-6: Not a scientist example - 'Dammit Jim'

Note: Image taken from (Memedad, n.d.).

The sharing of information and viral content has the potential to spread environmental messages and the rise of Web 2.0 has enabled users to create and share information over a wide network of users. Memes have emerged allowing for the sharing of messages but also pose a difficulty as they can easily be used for entertainment. The survivability of memes is argued by Chesterman (2011, p. 26) to depend on the users "… immunity to counter memes" and have a longer survival in Internet culture if they are general enough to be used in a variety of ways or mutated to be used with other memes. An important aspect to the successful spread of memes is novelty and entertainment as Internet cultural transmission of memes is an ever changing environment (Chesterman, 2011). This means that serious issues, such as climate change, will struggle, as it's a complex issue, making it difficult to communicate with memes, and also a depressing topic. The ability to share information widely is useful with sharing having the potential for wide spread political campaigns, but also poses the risk that junk information can be easily transmitted to a wider audience or viral content sharing increases pressures on users with information overload and potentially distracts users from significant political issues in society.

2.2.3: Information Overload

Another aspect of the information society has been information overload. This is the result of the Internet allowing users to generate and access greater amounts of information than ever before. The media that people are exposed to has been increasing "… dramatically at an exponential rate" (Schumann, 2004, p. 241). The amount of information available to access is at an unprecedented level in human history (Schumann, 2004). These increases of information stimulation are recent, with major advances in communication technology taking place within the last one hundred years, with developments in communication technology such as commercial television in the late 1940s and more recently the rise of the Internet, greatly increasing media stimulation (Schumann, 2004). The increase in access to information can lead to the presumption that people have access to a wider diversity of information and topics which could potentially lead to an improved public understanding of issues like climate change (Schumann, 2004).

However, increased access to information might result in people selecting information and consequently reducing the diversity of information they receive. The Internet, in particular social media, has allowed for individuals to be selective and filter the information they wish to receive (Bennett and Segerberg, 2011). The selection and resulting reduction in the diversity of information sources is argued by MacGregor (1997) to be necessary, as the amount of information has rapidly increased while our limitations of time and cognitive processing has remained the same[15]. This means that the amount of information on a range of topics available makes it "… impossible to watch it all, let alone analyse it in any detail" (MacGregor, 1997, p. 24). It is important to note that MacGregor (1997) was focusing upon television coverage and since the wide scale adoption of the Internet, the amount of media stimuli that people are subjected to has continued to rapidly increase.

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[15] Information processing is explored in chapter 3

This continued increase of media stimuli and demands on our attention on a range of issues is problematic as there is a cognitive limitation which means that only a finite number of issues can be on our minds at one time (Dunaway et al., 2010). The rising demands on peoples' attention can be seen in the increasing amount of advertising. "… [T]he average American encountered 560 daily advertising messages in 1971 and over 3000 per day by 1997…" (Anderson and de Palma, 2012, p. 2). These increasing demands for our attention and the ever increasing amount of information has been criticised by Shenk (1997) as the pollution of our mental environment that he has called 'data smog'. The information overload caused by the increasing speed and amount of information available is argued by Shenk (1997) to result in people being under increased stress and to result in confusion as increased information undermines understanding.

As a result, the consequences of increasing media stimulation are that people are limiting exposure to "… available messages about the characteristics, culture, values, beliefs, point-of-view including worldviews, preferences, and behaviour of those we believe may be different from us" (Schumann, 2004, p. 234). In particular, this filtering of exposure to information has enabled easy community networking in virtual space between individuals that the Internet has allowed for racist, misogynistic, and homophobic beliefs to be shared and become the dominant discourse in some online communities such as the video gaming community (Shaw, 2014). These spaces do not just allow for the sharing of these values but also the organisation of attacks against individuals who critique the behaviour of the online community or the focus of the communities' shared interest as a way of marginalising criticism (Shaw, 2014).

One likely consequence of selective access of media stimuli is the potential for increasing polarisation of the users' opinion about political topics. Selective media consumption has been an area of increasing academic interest as technological changes have meant that the public has access to a much larger range of media sources for news and can even "… opt out of news consumption entirely" (Smith and Searles, 2014, p. 71). Before the emergence of cable networks and the Internet the range of information to which the public had access to was broadly similar, and limited, with messages that included conflicting points

of views on political issues (Mutz and Martin, 2001, p. 97). In contrast, the selective nature of news consumption is argued by academics such as Mutz and Martin (2001) and Smith and Searles (2014) to be potentially harmful to democracy. As the public becomes fractured and polarised on political issues, they do not engage with other viewpoints. The consequence of selective news consumption to fit pre-existing world views is argued by Stroud (2010, p. 571) to result in the reinforcement of beliefs and individuals will be "unlikely to change their beliefs".

The Internet has provided access to vast amounts of news media, but has risked the polarisation of opinion based upon reinforcement of the pre-existing world view of the user (Schumann, 2004, Mutz and Martin, 2001). Selective exposure due to the wide range of potential media outlets means that communicating climate science to those not interested in climate change is potentially problematic and this is potentially a risk for all political and scientific issues (Mutz and Young, 2011). This potential consequence is argued by Bennett and Lyengar (2008, p. 725) to not necessarily be the case for all subjects as the media still has the role of communicating major news stories, which will be echoed throughout differing media outlets and will therefore be difficult for people to avoid. The impact of misinformation on public reactions to climate science with selective behaviour bias of those holding climate sceptic beliefs would likely have their pre-existing beliefs reinforced and are unlikely to be challenged on their views.

The consequence to climate change communication is a result where users will limit what they engage with based upon pre-existing views. For example, climate sceptic memes, such as those inappropriately conflating weather and climate (Figure 2.7) can be shared amongst those who hold climate sceptic beliefs. The success of climate sceptic memes is difficult to assess. The meme shown in Figure 2.7 has only been shared 452 times on the Quick Meme website (in comparison to other types of viral memes such as this variation of a cat meme (See Quick Meme, n.d.-b) that has been shared 37, 804 times See Figure 2.8). The impact of the meme is questionable upon those undecided about climate change. Attempts at viral content aiming to spread climate consensus is also unlikely to be engaged with by climate sceptics as they filter out information that contradict their worldview.

Figure 2-7: Climate sceptic meme - 'global warming my ass'

Note: Image from Quick Meme (n.d.-a).

Figure 2-8: Some people just need a hug… around the neck… …with a rope.
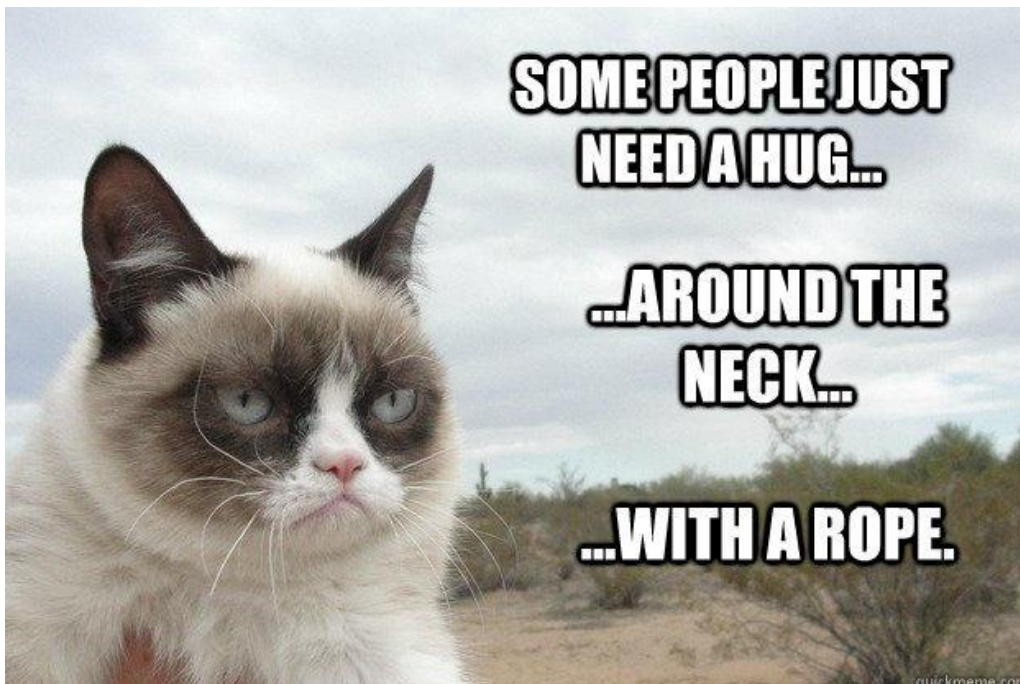
Note: Image taken from Quick Meme (n.d.-b).

Despite the filtering of information, there are examples where viral environmental content can become widely viewed. This is due to shocking material being shared more widely with those less likely to normally engage on

certain topics viewing due to curiosity. A recent example of an environmental shock meme can be seen with a video showing a plastic straw being removed from the nostril of a Sea Turtle (COASTS, 2015). This is an 8 minute long video showing the distressed Sea Turtle (see Figure 2.9) being helped by researchers and has reached nearly 5 million views within a month (COASTS, 2015). The video included a strong message against single use plastic items. While the video description has links to campaigns against single use plastic, such as a campaign by GreenEriePA (n.d.), but the impact on viewers is questionable. The PhD researcher involved in the video set up a donation page for funding which at the time of writing has only achieved $8,625 from 219 people of the $75,000 dollars asked for despite the video reaching nearly 5 million views (COASTS, 2015, Friggener, 2015). Arguably rather than informing users of the dangers of plastic waste this video was a distraction that became an area of focus due to the shocking nature of the video.

Figure 2-9: Sea Turtle with straw up its nostril - "no" to plastic straws
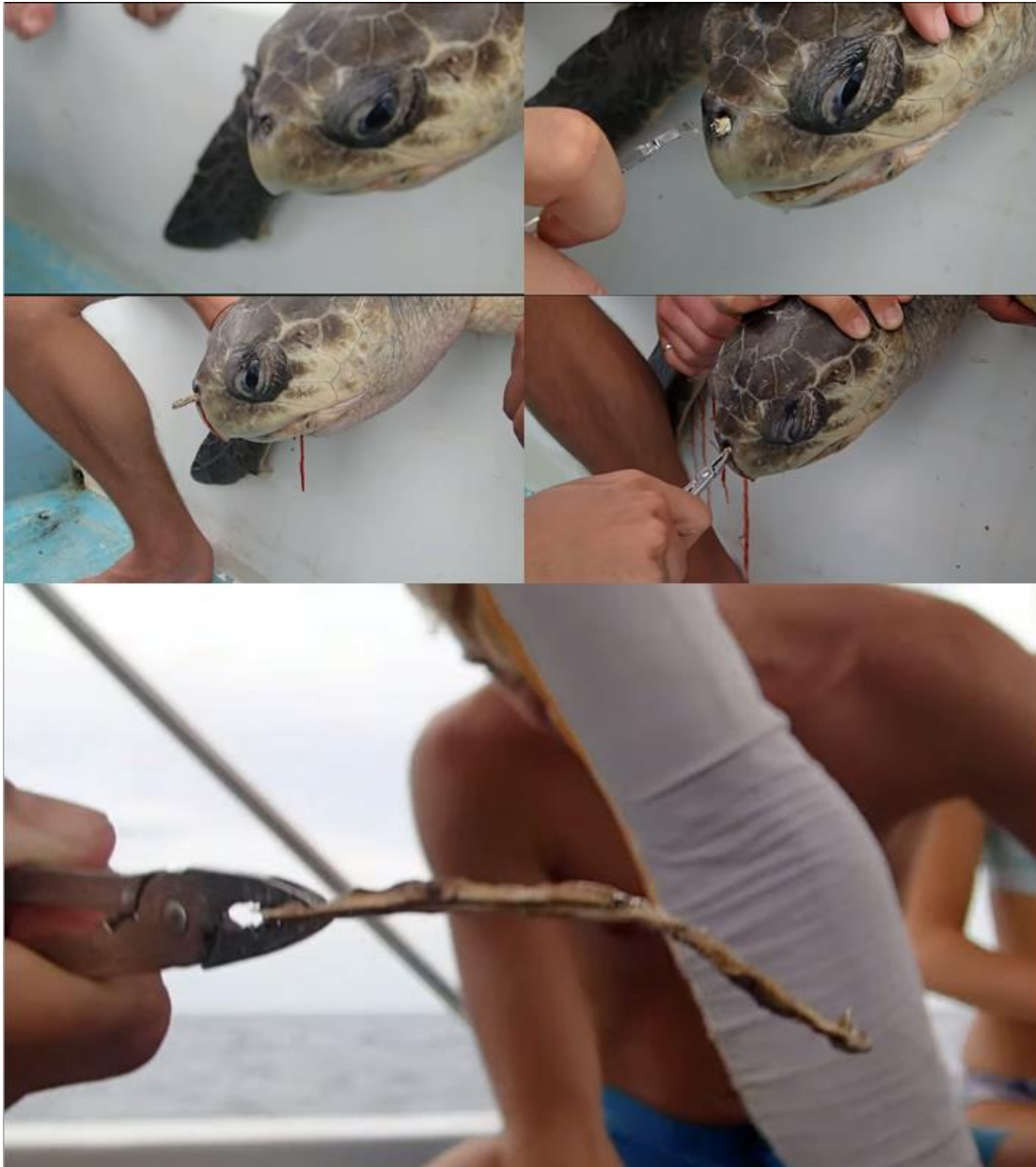
Note: Screen shots take from Youtube video by COASTS (2015).

The Internet has resulted in an extremely information rich environment and a method to cope with the quantities of information is for the user to filter what they want to see. This means that both memes and culture jamming are potentially just more noise in an environment competing for audience attention amongst many stimuli to the point that meaning is lost (Cammaerts, 2007, Shenk, 1997). Culture jamming is the use of parody, particularly of corporate advertising campaigns, to create awareness of the manipulation of marketing in our mental environment and transmit information that challenges hegemonic ideas (Cammaerts, 2007, Rumbo, 2002). This focuses on transforming corporate and

governmental messages to criticise the actions of these institutions (Cammaerts, 2007). This suggests that the Internet has increased the ability for the transmission of ideas, concepts, and criticism of society on a large scale. However, the communication of climate change through viral memes or culture jamming is potentially undermined and simply ignored by users. There have been some examples where environmental messages reach a wide audience, but successful memes are simple and spread for entertainment value (See chapter 3). Rather than reaching large numbers of users, content may only be shared within a limited community of users who share the same views or interests. However, there is the potential for viral content to break through user's inherent filtering of what they see, but these can simply be more distractions rather than real issues or the shocking nature of the material may not have any measurable sense of impact.

2.2.4: Junk information

A key risk with the rise of the Internet is the spread of junk information. One potential driver of junk information is online communities which have the potential to create and spread junk information amongst users. However, there is a more insidious issue with dominant social values within online communities as they re-enforce previously held values and are normalised to the members of these online communities. Re-enforcement of beliefs has serious consequences as it creates an illusion that a larger number of people share these views as they share information amongst themselves (Kata, 2012). The illusion that a community is larger than just the small group of committed active members is argued by Kata (2012, p. 3779) to be an "… easy to fall into trap of self-referencing and mutually reinforcing links that can fool users into believing there are many who share their beliefs…". These communities can damage the communication from experts on topics as the personal stories of members are shared as if they were fact and undermines the messages from experts in the field who are seen as "… just another opinion among many" (Kata, 2012, p. 3779).

An example of a small group of climate sceptics can be seen in the Global Warming Skeptics (n.d.-a) forum which only has 150 registered members. A

screenshot of a climate discussion board on the Global Warming Skeptics (n.d.-b) forum is below (Figure 2.10) with topics attacking climate models and confusing weather with climate in the 'failed predictions' discussion thread. While the forum only has 150 registered members, the view counts on some of the discussion threads are much higher than would be expected as non registered users are accessing the information. For example the thread criticising the claims that warming is causing Arctic Ice to melt, which links to climate sceptic blogs, has been viewed over 4000 times. This suggests that this post has been shared to a wider audience with people looking at the information without registering an account or a small group of users are regularly engaging with the thread.

Figure 2-10: Climate sceptic forum discussion board example

Normal Threads				
⇒ On the futility of climate models: 'simplistic nonsense' Sunsettommy	0	143	☆☆☆☆☆	01-06-2015 04:29 PM Last Post: Sunsettommy
⇒ The Dirty Little Secret About Arctic Ice Sunsettommy	13	4,219	☆☆☆☆☆	12-25-2014 05:13 PM Last Post: Sunsettommy
⇒ Failed Predictions Sunsettommy	0	201	☆☆☆☆☆	12-25-2014 09:22 AM Last Post: Sunsettommy
⇒ Effect of Biogenic Material on Glacial Albedo Questioning_Climate	1	1,092	☆☆☆☆☆	09-26-2014 02:40 PM Last Post: Questioning_Climate

Note: Screenshot taken of the Global Warming Skeptics (n.d.-b) forum in a section discussing climate science

The potential of junk information being shared by the general public is also argued by Kata (2012) to be problematic with the public mistrust of experts. This is coupled with the significant problem that anyone can produce content on the Internet, which means junk information can easily be created and potentially spread (Keen, 2007). An example of the confusion these communities can cause to the general public can be seen in the anti-vaccine movement (Kata, 2012). The anti-vaccination movement has been effective at sharing junk information about the 'potential risk' of vaccines as the general public do not have the scientific understanding to distinguish legitimate sources of information (Kata, 2012). The

claims made by the anti-vaccination movement have been successful in creating doubt in the public of the safety of vaccinating their children as the presence of anti-vaccination material in top search results for health information creates the appearance of contention in the science (Kata, 2012). Making an aspect of science appear more controversial than mainstream science purports was found by Corbett and Durfee (2004, p. 140) to cause doubt and reduce certainty in climate science. This consequence was also found when individuals viewed material that questioned the safety of vaccinations with research showing exposure to "… an anti-vaccine website for merely 5-10 min increased perceptions of vaccination risks and decreased perceptions of the risks of vaccination omission…" (Kata, 2012, p. 3780).

The creation of doubt has serious consequences. In the case of vaccinations, there is a reduced chance that parents will have their children vaccinated and certain diseases could become prominent again, but in issues such as climate change, doubt undermines public pressure for political action (Kata, 2012, Oreskes and Conway, 2010). The Internet has allowed for climate sceptics to organise through blogs to promote climate change denial and create public doubt in the climate change consensus (Lewandowsky et al., 2013). "…[R]eliance on the Internet" is argued by Lewandowsky et al. (2013, p. 624) to be a common factor in "… people who reject science…". The rejection of the scientific consensus on climate change is argued by Lewandowsky et al. (2013, p. 630) to be driven by personal ideological beliefs with the rejection of science on Internet blogs to be "… consistently associated with free market ideology and conspiracist ideation".

The creation of junk information alone is not inherently problematic, but junk information can be shared to a wide audience or just remain within a small community of like-minded users. There is even the possibility for junk information to overcome the self-selection of information caused by information overload and become widely shared across the Internet. The speed at which information is conveyed means that the discourse surrounding climate change events can potentially be initially defined by blogs and Internet users (Nerlich, 2010). An example of junk information that was widely shared and became a significant climate change story by overcoming information overload can be seen in the

'Climategate' incident in November 2009. 'Climategate' was when hackers illegally took over a thousand personal emails from the climate scientists at the University of East Anglia Climate Research Unit and released them on the Internet (Boykoff, 2011, Nerlich, 2010). The term 'Climategate' was a climate sceptic discourse which attacked public trust in climate scientists by portraying climate scientists as dishonest and accusing the researchers of manipulating data (Boykoff, 2011, Nerlich, 2010).

The coverage of 'Climategate' began with online blogs and discussion as traditional media was slow to pick up the story (Nerlich, 2010). The online discussion surrounding 'Climategate' is argued by Nerlich (2010) to have been dominated by conservative right wing bloggers with this small community of climate sceptics shaping the discourse before being picked up by mainstream media. These bloggers focused upon a small handful of emails to attack public trust in climate science and attempt to portray climate change as a 'hoax' or a conspiracy between politicians and scientists (Nerlich, 2010). An example can be seen below in Figure 2.11 with a blog post by Watts (2009) attacking Professor Phil Jones over the colloquial use of the term 'trick' and accusing him of manipulating climate data. These claims of dishonesty and data manipulation were investigated with the scientists involved being exonerated of any wrong doing in the investigations that followed in the wake of 'Climategate' (Boykoff, 2011, Nerlich, 2010). The House of Commons Science and Technology Committee (2010, p. 3) found no evidence of wrong doing, but highlighted a resistance to Freedom of Information requests, as they knew requests from climate sceptics were an attempt to undermine or attack their work. However, the consequences of 'Climategate' coverage on the Internet is argued by Nerlich (2010) to have potentially undermined public reactions to climate change and strengthen climate sceptic views within the general public.

Figure 2-11: Climate sceptic blog coverage of 'Climategate'
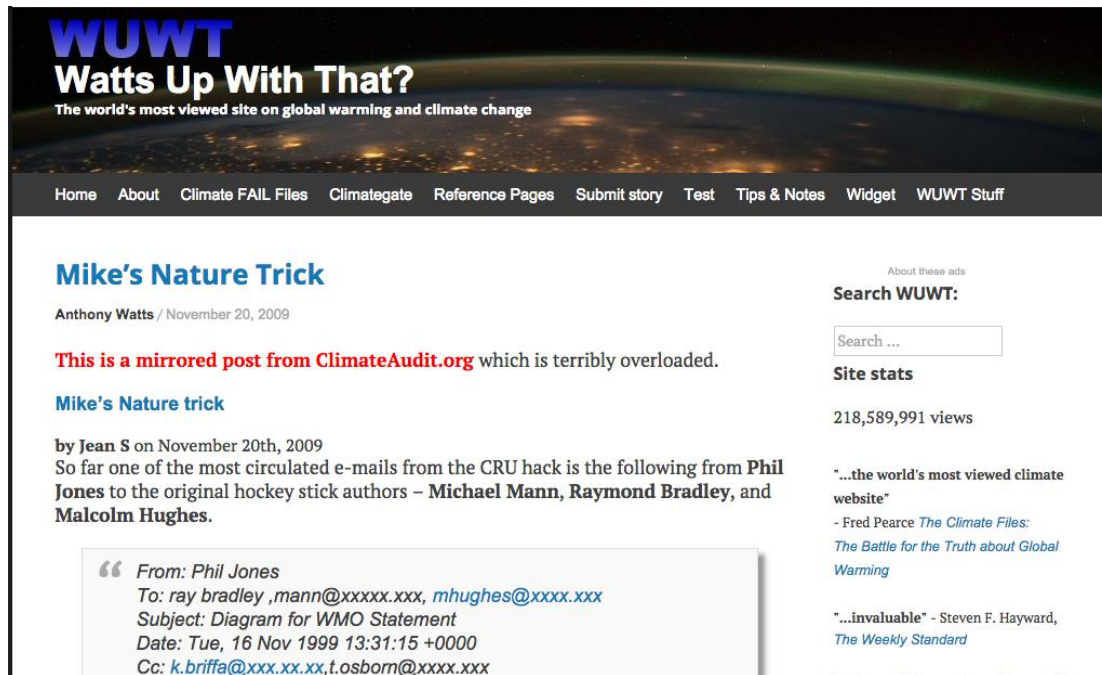
Note: Screenshot of the Watts Up With That climate sceptic blog (Watts, 2009).

The research carried out by Nerlich (2010) explored the impact of 'Climategate' on the metaphors in climate change discourses in climate sceptic blogs. The result of 'Climategate' on the climate sceptic discourse was a significant shift from a sceptic discourse attacking uncertainty in climate science, to justifying inaction, to a climate sceptic discourse attacking the strengthening of the scientific consensus as religious belief and therefore, further undermining climate action (Nerlich, 2010). Another study by Koteyko et al. (2013) explored the impact of 'Climategate' in comments on climate change articles in the online version of 'The Daily Mail' which also found that the climate sceptic denial of climate change had been strengthened. The main reason for this is suggested to have potentially "… allowed the commentators to become more assured in their assertions…" (Koteyko et al., 2013). However, there is limited research on the impact of the climate sceptic discourses on understanding, risk perception, and attitudes to climate action in online communication.

The Internet has created new opportunities for climate sceptics to create doubt, and undermine pressure for action to be taken to tackle climate change (Lewandowsky et al., 2013, Nerlich, 2010). There is difficulty in distinguishing junk information from real information on a range of topics from health advice to

climate change which is further problematic when users are reducing the range of diversity they access due to the quantity of information (Kata, 2012, Schumann, 2004). Simultaneously, there is the problem of communicating climate change which Lakoff (2010) argues is problematic as the public lack the conceptual frames of understanding needed for complex issues such as climate change. However, junk information is problematic but it can become a greater risk at undermining public reactions of climate science if it becomes widely shared, which can be seen in the example of 'Climategate', where small online climate sceptic communities were able to frame the discourse of the event and eventually to have that discourse reported in traditional media.

2.3: Summary

In summary, the overall impact of the Internet upon our lives is summarised by Miller and Bartlett (2012, p. 36) to be "… central to forming our world-views, our attitudes, and our beliefs." The Internet has allowed for the removal of the barrier of distance in communicating ideas, concepts and beliefs, as well as allowing for the organisation of transnational protests and political movements. The consequences of the Internet are becoming more important to critically examine, as there is a wider adoption of social media in society. For example, the adoption of social media has increased with Kaplan and Haenlein (2010, p. 59) highlighting that "As of January 2009, the online social networking application Facebook registered more than 175 million active users". The growth of active users on Facebook has reached 1.35 billion monthly active users by September, 2014 (Facebook Newsroom, n.d). The significance of the Internet in our everyday lives cannot be understated as Kien (2013, p. 555) argues that:

> "Our civilization's current global/social/digitally networked media provides a virtual, simulacra-based environment that is uniquely different from the earth's physical environment, and yet is profoundly part of our everyday experiences."

Therefore, the information society concept is important in explaining a fundamental shift in the role of information within society. While the visions of the light side of the information society by Bell (1973) and Masuda (1980) were

technologically determinist and economically focused, they are in other ways ahead of their times.

However, I reject the vision of the light side of the information society proposed by Bell (1973) and Masuda (1980) (Bell, 2004).This research has rejected their limited economic focus of their definitions for the information society. Instead it focuses on the dark side of the information society as it is important to focus on a broader definition that includes the social and political changes that have taken place with the rise of information technology. Despite the significant flaws in the predictions made, the three aspects of the information society are still relevant to contemporary society with aspects of their work being visionary. There has been both the sharing and increased production of knowledge, but this was incorrectly to have presumed a positive impact. There has, indeed been the growth of information in society but this has had negative consequences. As a result, the dark side of the information society has been used to develop my analytical framework to examine climate change communication online (See figure 2.12).

Figure 2-12: The dark side of the information society
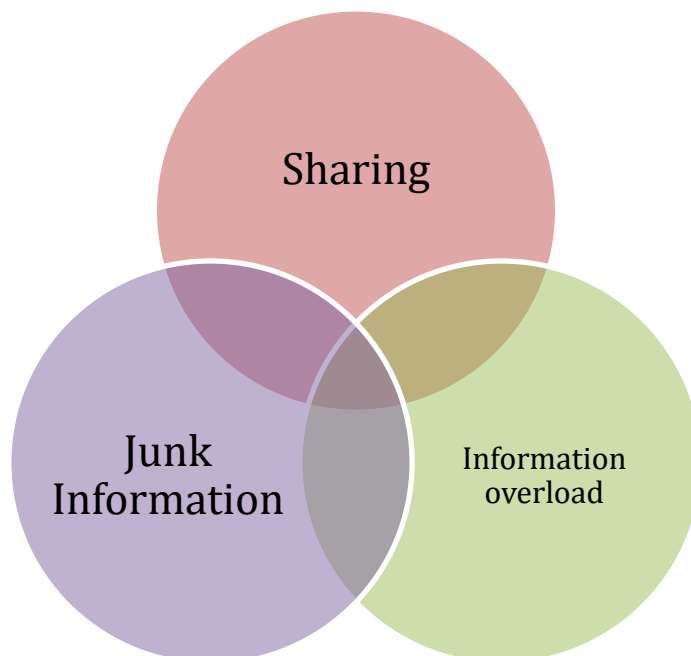
The Internet has allowed for the ability of the public to share information and spread viral messages through social networks. However, there has also been the consequence of information overload with people potentially reducing access to a range of information on a variety of topics due to competition for the user's attention. Rather than result in people becoming increasingly aware of political and social issues, there is the chance that users simply filter out information that is not already an interest to them. At the same time of increased availability and access to information, there has been the risk of the spread of junk information, which is potentially difficult for users to distinguish from real information on a topic, particularly complex issues such as climate change. Junk information can easily be spread through social media in the same way as any other information and can be created by anyone with the example of climate sceptic memes (See Figure 2.7).

The impact of junk information (climate sceptic material) has had limited research into its impact on climate sceptic discourse. This has been extended by my thesis. Previous research that has examined climate sceptic material online by Nerlich (2010) and Koteyko et al. (2013) are interesting as they highlight the shifts in the discourses used by climate sceptics, but they are unable to show a direct impact on reactions to climate science. Other studies on the prominence of climate sceptic information, such as the study done by Gavin and Marshall (2011), do not adequately take into account the personalisation of the Internet and the ability for the user to filter what information they see (Bennett and Segerberg, 2011). Therefore, the consequences of the dark side of the information society are important to examine its impact upon reactions to climate change communication. The following chapter will explore the previous literature on media effects and information process and explore what consequences this has upon Internet communication of climate change.

Chapter 3 - Public understanding and perception of climate change

This chapter examines the debates surround public understanding of science, the perception of risk and barriers to communication, of climate change. This includes a focus on the debates surrounding what we classify as the level of understanding required to be scientific literacy with a focus on the comprehension of climate change information. It is important to define 'understanding' as the term is contested with a broad meaning and as a result can potentially mean anything from a basic understanding of how something works to a complex "… understanding of a concept or construct in the full context of its field" (Miller, 2004, p. 274). In my research I have taken the former approach to measuring public understanding. Scientific literacy is broadly defined as the level of understanding required to engage with societal issues focusing on environmental issues and social issues surrounding technology and science (Holdbrook and Rannikmae, 2007, Millar, 2006, United Nations Educational Scientific and Cultural Organization, n.d., Sturgis and Allum, 2004, Miller, 1983, Miller, 1998, Miller, 2004). There are more specific definitions, for example scientific literacy is argued by Miller (2004) to be the level of understanding required to comprehend science coverage in a broadsheet newspaper. In other words understanding key concepts, such as the experimental methods, and a basic knowledge of physical and biological science This approach to scientific literacy will be operationalized in this research to be developed as control variables for the experimental analysis so that the participants' scientific literacy is not a confounding variable when examining reactions to climate change information.

Public perception of anthropogenic climate change will also be explored in this chapter as it is important to examine as it both impacts how risk is perceived and support for climate action (See Lujala et al., 2015). Climate change is a major political issue and therefore, climate change has received a large amount of media coverage. Previous research has highlighted a very strong public awareness of the issue in the UK with an Department for Environment, Food and Rural Affairs [DEFRA] survey from 2002 that showed "… only 1% of the English public have not heard of either 'climate change', 'global warming', or the

'greenhouse effect'…" (Lorenzoni et al., 2007, p. 446). Despite there being public awareness of climate change in the UK Lorenzoni et al. (2007, p. 447) argue that there is a "… disparity between the public awareness between climate change and concern about climate change…".

Concern about climate change has been shown to be on the decline with a survey by Capstick et al. (2015) with 82% being very concerned or fairly concerned in 2005 to only 67% in 2014. Climate change poses a significant threat to humanity yet the perception of risk is influenced by a number of factors with the delayed and abstract nature of the threat undermining public pressure for action (Lee et al., 2015, Lujala et al., 2015). There is also the additional issue that climate change is difficult to communicate to the public as it "… is a complex phenomenon, with multiple interdependent social and environmental causes…" (Pidgeon, 2012, p. S87). Alongside this some areas of climate science are contested with some uncertainty concerning the impact of climate change in the future (Pidgeon, 2012, p. S87).

To explore the debates surrounding scientific literacy I will examine public understanding, perceptions and climate change communication in three key sections. The first section is focused on the debate surrounding how we define public 'understanding', scientific literacy, and issues with communicating science to the public. Secondly, I will examine the perceptions of climate change and the impact of media framing. Finally, this section will critically examine barriers to online communication of climate change with limitations of the amount of information we can process and the difficulties in producing climate change messages with impact. Ultimately, this chapter examines the current level of public understanding of climate science and stresses the importance of both public understanding for participation in policy debates and the barriers we face in communicating climate change information to the public.

3.1: Public understanding science and measuring scientific literacy

This section explores the debates surrounding public understanding of science and scientific literacy. The debate surrounding the definition of public understanding of science are wide ranging from Miller (2004) who argues that

understanding is the ability to comprehend science coverage in broadsheet newspapers instead proposing a scientific literacy approach, to Shamos (1995) who argues that understanding requires deep knowledge of scientific concepts. However, to explore scientific literacy this section will also focus on developments in science education, but also the impact of popular culture and the rejection of science. This section finally evaluates previous research on the understanding of climate change.

The defining of public understanding is highly contested. Public understanding of science has been a subject of debate among academics with definitions varying considerably (Miller, 2004). Due to the importance of the communication of science and the engagement of scientists with the public it is argued by Miller (2004) that public understanding of science should be measured by scientific literacy. Scientific literacy is defined as being able to comprehend scientific debates in media coverage and the understanding of the potential impacts of scientific research and technology upon society (Sturgis and Allum, 2004, Miller, 1983, Miller, 1998, Miller, 2004). The approach to defining ' public understanding of science ' with measuring public 'scientific literacy' which Miller (2004) has argued while contested is more of an appropriate standard considering that public interaction with scientific research is primarily through media reporting. In addition, the term public is highly contested as 'Public' refers to non-experts as a homogenous group in society when Gauchat (2012) instead argues that the public are diverse groups driven by differing ideological views.

By contrast, Shamos (1995) argues that understanding requires an in-depth knowledge of scientific concepts which the public does not have. For example the development of science education is relatively new with an initial public interest during the industrial revolution, but Shamos (1995, p. 41) argues that science did not become an educational focus "… until well into the twentieth century…". The introduction of science on to school curricula has been problematic and was developed significantly since the late 1980s when school science education was thematically split in England and Wales into biology, chemistry, and physics (Fensham, 2002).

However, the science curriculum that was developed has been significantly criticised in the *Beyond 2000* report as a failure to produce public

understanding of science that "… does not equip them [students] to deal effectively and confidently with scientific information in everyday contexts" (Millar and Osborne, 1998, p. 9). Science has been taught without wider context with assessments focusing "… on memorisation and recall…" that do not provide the necessary understanding to process media science reports (Millar and Osborne, 1998, p. 9). The report highlights that there is no teaching of the formation of scientific understanding with the justification of knowledge or the language of scientific evidence of risk and probability not included within the curriculum (Millar and Osborne, 1998, Fensham, 2002).

This has remained an issue across science education across Europe with a report by Osborne and Dillon (2008) highlighting that the curriculum still narrowly focuses on the three sciences of biology, chemistry, and physics. The curriculum is argued by Ryder (2001, p. 39) to be important to support lifelong learning and engagement with science into their adult life. A key aspect for lifelong learning is "… knowledge about the practices of science". Producing an understanding of how science works is key to producing confidence in the public to encourage active engagement with scientific and technological debates that have social consequences (Ryder, 2001, p. 39). The fragmented approach in the science curriculum is criticised as completely failing to produce a coherent understanding of science which Osborne and Dillon (2008, p. 8) compares "… to being on a train with blacked-windows – you know you are going somewhere but only the train driver knows where".

The wider context of how science produces knowledge, as argued by Fensham (2002), was never included in the finalised curriculum. General understanding of how science builds knowledge overtime and "… that we cannot claim absolute truths in science…" is argued by Shamos (1995, p. 51) to be central to communicating scientific research and policy debates focusing on technology or scientific development with the public. The lack of understanding of what science itself is and the complexity of the term 'science' is encapsulated by Shamos (1995, p. 47):

> "Is science simply what scientists do, as some circular definitions would have it? Or is it a body of useful and practical knowledge about the universe? Or is it a method of inquiry? Or is it the search for order in

nature? Or is it a search for "first principles" Or is its objective to understand, explain, and make predictions about natural phenomena? Yes science is all these things, yet more…"

The complexity of science is argued by Shamos (1995) to make communication of science to the general populace not only difficult but modern science is portrayed as impossible to communicate in 'common language'.

Despite the attempts to increase public understanding of science and improve scientific literacy through education, Shamos (1995) argues that science education has failed to produce a scientifically literate population in developed nations. This is supported by Hazen and Trefil (2009) who argue there has been no real improvement. The drive to develop the publics' scientific literacy is significant as a basic level of scientific understanding is required to participate in policy debate related to scientific developments or issues caused by technology (Miller, 2004). As such the scientific literacy required is argued by Miller (2004, p. 274) "… to be sufficient to read and comprehend the Tuesday science section of 'The New York Times'". However, there has been a failure to produce scientific literacy with research that has shown that the state of scientific literacy in the US and Europe is low where only "… one-quarter of the European and US publics qualify as scientifically literate" (Sturgis and Allum, 2004, p. 56).

Previous research has highlighted that the public have low levels of scientific literacy in relation to basic scientific methodology. For example the 1995 Science and Engineering Indicators Study that examined public understanding of the experimental method asked a question to US adults to select the best if two experimental designs for testing a drug for treating high blood pressure (Miller, 2004). The question gave the choice between testing the drug on one thousand patients with high blood pressure or five hundred with high blood pressure and five hundred with normal blood pressure (Miller, 2004). The result was promising as 69 per cent selected the experiment using the control group, but there was a follow up open question that asked why they selected the experimental design they did. Rather than showing understanding of the experimental method "… 40 percent of the total population…" selected the control group design due to a belief if the drug were fatal "… it would claim fewer victims because it would have been administered to fewer subjects" (Miller, 2004, p. 277). This research highlighted

that there is a lack of public understanding of the experimental method with "approximately 12 percent of US adults selected the two-group design and were able to explain the logic of control groups" (Miller, 2004, p. 277). In particular, the lack of public understanding of the experimental method is worrying as media coverage of developments or discoveries in science are communicated "… in terms of an experiment…" (Miller, 2004, p. 277).

The lack of public understanding of basic scientific concepts that Miller (2004) highlights is important as there is also an additional issue in communicating of scientific facts and on-going scientific research (Field and Powell, 2001). An issue with communicating on going scientific research on topics such as climate change is argued by Field and Powell (2001, p. 422) to have an additional problem due to it being "… impossible to provide accurate and complete information in a single presentation". Due to the requirements of multiple communications of on-going research there is the issue that journalists do not consider science necessarily news worthy, particularly as the news they seek to report is immediate with a short term focus (Field and Powell, 2001, Gregory and Miller, 1998). Even then Besley and Nisbet (2013) have shown that scientists mistrust the media due to the perception that they misrepresentation their field of research (Landstrom et al., 2015, p. 281).

The state of public scientific literacy means that it is difficult to get the public to engage with scientific and technological issues in society. One of the problems faced in science communication is the disconnect between how the average person views the importance of daily life and information they are seen as needing to know (Turney, 1996, p. 1088). For example a survey conducted by Durant et al. (1992) found that the public viewed medical science to both be the most scientific branch of science while also the most interesting (Turney, 1996, p. 1088). This interest from the public in medical science is due to the public viewing medical advancement as more relevant to their lives (Turney, 1996). Instead Turney (1996, p. 1090) argues that the public need to be engaged with in a way that interest them rather than "… insisting the public must understand the same facts in the same way…".

In addition, communicating current research has been argued by Irwin and Micheal (2003) to also be impacted by public trust in science is an important

factor. Especially with controversial topics such as genetically modified foods and climate change. The idea of science itself as a coherent whole is criticised as Wynne (2006) highlights science itself is institutionalised in a variety of ways that the term 'science' is basically meaningless making measuring trust difficult. Attempts to measure trust in science are highlighted by Sturgis and Allum (2004) to be flawed as the context of issues with science and technology need to be considered. There are also flaws with how science is conducted with Haerlin and Parr (1999) highlighting that the lack of transparency and funding from corporations is causing mistrust in the science of genetically modified organisms.

However, Shamos (1995) does not even consider it worthwhile to attempt to produce scientific literacy. The benefit that a scientifically literate population has is questioned by Shamos (1995, p. 74) suggesting a scientific literate population would not benefit society or the public on an individual level. The entire endeavour of educating the youth to produce scientific literacy is attacked by Shamos (1995) to be a waste of time as "… most students lapse back into scientific illiteracy soon after they graduate…". Rather than trying to educate the public to enable their incorporation into discussion making on the issues from scientific and technological development Shamos (1995) believes in an undemocratic decision making process where experts make the decisions rather than the scientifically illiterate public.

Instead he argues there are negative consequences of trying to produce scientific literacy. For example Shamos (1995) argues that scientific literacy has the unintended consequence of producing the belief in the majority of adults that they hold 'very good or adequate' knowledge of science and technology. While the public scientific literacy is low there is a confidence held by the public that their understanding is good which "… means that most adults know all they need or want to know about science" (Shamos, 1995, p. 75). The production of scientific literacy in the public through education is considered to be simply impossible and the idea of the public being informed in the decision making process undermines "… the opinions of credible experts" that the public should rely on for scientific or technological issues (Shamos, 1995, p. 77).

The approach taken to public understanding of Shamos (1995) is critiqued by Miller (2004, p. 274) to "… reflect his expectations for his undergraduate

physics students…". The overall conclusion that Shamos (1995) attempts to produce public understanding of science are unnecessary is an technocratic elitist approach (Miller, 2004, Fischer, 2000). The failure to see an increase in scientific literacy in the population could be attributed to the flawed science curriculum that did not produce an understanding of how science worked or an understanding of scientific language of risk and probability (Millar and Osborne, 1998, Fensham, 2002). Popular culture has also been blamed by Nisbet et al. (2002) for negatively and inaccurately portraying science to the public. Popular television shows such as the X-files have portrayed science negatively in popular culture. The example of the X-files is used by Nisbet et al. (2002) as the show was based around science being unable to explain events or supernatural beliefs being superior to the scientific method. Entertainment undermining the understanding of science is potentially damaging. For example the American TV series 'CSI' has been heavily criticised for undermining public understanding of forensic science to the point that it has altered the expectations of juries of the science presented in court (Schweitzer and Saks, 2007). The consequences of showing forensic science as technological magic has been shown by Schweitzer and Saks (2007) to result in increasing demands for high tech forensic science as evidence and increased scepticism of low tech forensic evidence. Popular culture has potentially made developing public understanding more difficult due to strengthening misconceptions held by the public about the scientific method.

However, decisions that affect the public are important to empower the public to engage with issues relating to scientific developments or consequences of technology (Irwin, 2001, Gregory and Miller, 1998). The ability for the public to engage with science is argued by Ryder (2001, p. 36) to be "… a central aim of functional scientific literacy". The ability for the public to engage with the findings of studies in local decision-making, in particular an understanding of computer modelling, scientific tests, and sample size, to allow for the public to effectively engage in decision making (Ryder, 2001, p. 36). Engagement with the public through incorporating them into science with 'citizen science' has been shown as an effective method to get the public interested and encourage engagement with science while also benefiting scientists (Garbarino and Mason, 2016). Citizen science is a debated concept in social science, which is essentially the inclusion of the public into science enabling large scale data collection (See Ellwood et al.,

2016). There is also the potential use of citizen science there is an opportunity to improve public understanding of science (See Trumbull et al., 2000) and improve attitudes to science (See Price and Lee, 2013)

The risk of isolating the public from engaging with scientific development or societal problems has the potential of developing an 'anti-science' movement (Gregory and Miller, 1998). The term 'anti-science' refers to any groups that criticise science (Gregory and Miller, 1998). The popular view of science is argued by Sturgis and Allum (2004, p. 56) has received increasing public mistrust along with a "backdrop of widespread scientific "ignorance" amongst the lay public". The 'ignorance' that Sturgis and Allum (2004, p. 56) refer to is a lack of public knowledge of basic scientific facts with reference to a survey by Durant et al. (1989, p. 14) that found only 62.8% knew the Earth went around the sun and of that only 34.1% knew that it takes is a year for the Earth to orbit the sun. Despite public 'ignorance' and mistrust of science the concept of a coherent 'anti-science' movement is criticised by Gregory and Miller (1998) as the term refers to anything viewed as anti-science such as astrology to sensational media coverage of science. While the 'anti-science' movement is questionable as a coherent construct there is an argument made by Holton (1992) that to effectively challenge anti-science views held by the public there is a requirement for scientists to actively engaged with the public (Gregory and Miller, 1998). However, simply engaging with science may not be enough to improve attitudes and trust as science is complex (See Brossard et al., 2005).

In the case of climate change previous research has worryingly shown there is a range of flaws and misconceptions the public understanding of climate science. In the first UK scientific literacy test in 1988 it was highlighted by Durant et al. (1989, p. 11) that they found that "… a mere 23% recognised a link between the burning of fossil fuels in coal-fired power stations and the problem of global warming". This survey had 2,009 participants from the UK with participants being over the age of 18. A more recent survey by Poortinga et al. (2006, p. 12) which was conducted in 2005 found that participants were aware of the main human causes with "… 29% mentioning the burning of fossil fuels…". The question used by Poortinga et al. (2006) was an open question design so cannot be easily compared to the survey by Durant et al. (1989). In the US a survey by Bord et al.

(2000, p. 208) found that 89% of participants knew that the "use of coal and oil by utilities or electric companies" was a cause of global warming. However, only 46% of respondents thought it was a major cause (See Figure 3.1).

Figure 3-1: Coal and oil use by utilities or electrical companies a cause of climate change?

Use of coal and oil by utilities or electric companies
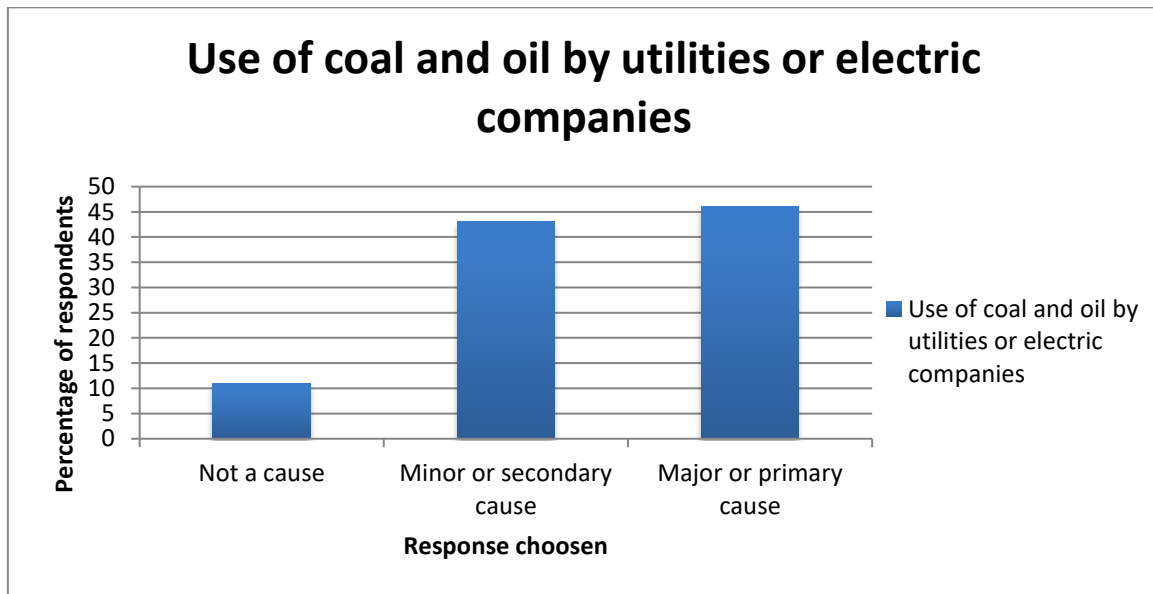
Note: Data from Bord et al. (2000, p. 208).

This example highlights an issue with the public's understanding of climate change. These can be significant flaws in understanding of basic concepts with the confusion highlighted by Pidgeon (2012, p. S87) with climate being confused with weather. Another problem highlighted in the survey of US university students by Bord et al. (2000, p. 208) found that they "…tend to underestimate the role of automobiles, utilities, and home heating and cooling in emitting large quantities of CO_2". However, there was a range of other factors found that the US students believed caused climate change which included "… aerosols, insecticides, nuclear power generation, and depletion of ozone in the upper atmosphere…" (Bord et al., 2000. p. 208). The cause of climate change being a result of the depletion of the Ozone is an interesting example of flawed knowledge which Ungar (2000, p. 303) highlights was found both in the US population and in New Zealand. New Zealand significantly differs from the US with the population having greater environmental consciousness and awareness of the consequences of climate change. This confusion was also found in focus groups carried out in high

schools in Australia which found that students were aware of the issues surrounding the hole in the Ozone but not sure how it was different from climate change (Harriet, 2000, p. 318).

The issue of Ozone depletion differs from climate change, as the issue of the ozone hole was easier to understand as the consequences were simpler, in contrast to climate change, which has a wide array of consequences. The solution to Ozone deletion are simpler than those to address climate change, and the public understood that using certain products contributed to ozone depletion (Ungar, 2000, p. 303). This resulted in the American public avoiding goods that harmed the ozone layer before regulation was passed. However, ozone depletion had entered the public consciousness before climate change and a result Kempton et al. (1995, p. 68) argues that climate change information has been processed by the public and related to ozone depletion due to both being atmospheric issues (Ungar, 2000, p. 304). This was also found in research by Bostrom et al. (1994, p. 969) which found in interviews that "…few people mentioned any greenhouse gases apart from CFCs…".

Flaws in knowledge are significant as they shape the environmental behaviour taken by the public. For example if there is confusion between ozone depletion and climate change then people may waste effort on behaviour changes that do not help solve the problem, "… such as conscientiously refusing to use spray cans, while neglecting such critical strategies as energy conservation" (Bostrom et al., 1994, p. 969). The adoption of pro-environment behavioural changes as a response to climate change is slow and weak. Lorenzoni et al. (2007, p. 447) for example, note that it is more likely that recycling is adopted rather than reducing energy usage. This behaviour change stems from both a lack of understanding of the causes of climate change but also from resistance to changing behaviour from an energy intensive life style. Therefore, increasing public understanding of climate science is an important first step in encouraging people adopt effective behaviour change and produce political support for reducing the emissions of greenhouse gases.

3.2: Perception of risk and the framing of climate science

People's perceptions of risk are highly related to the ways in which climate change is framed in the media (including the Internet) and by individuals. This section focuses on individual and media framing. This is important as pro-environmental behaviour change is difficult to encourage even if we were to overcome the hurdle of public understanding of climate science. Despite wide scale awareness of climate change there is little action being taken to deal with it (See Naustdalslid, 2011). In particular, there is previous research that the majority of the UK public hold the view that climate change does not have a direct personal consequence to them and are resistant to changing their behaviour, such as travel habits, to reduce carbon emissions (Lorenzoni et al., 2007). Other research by Gelcich et al. (2014) found in response to the anthropogenic impacts on marine environments that survey responses were not changing behaviour due to feeling overwhelmed by the scope of the problem and or unsure how they could make a difference at the individual level. There has been research on the perceptions of young people with a study in Australia by Tucci et al. (2007) which "... found that among a group of 10-14 year-olds about 27% believed that the world may end during their lifetime due to climate change..." (Ojala, 2011, p, 625).

While there is widespread awareness of climate change the attitudes towards climate change is split with a UK survey by the Department for Environment Food and Rural Affairs (2010) finding that while a majority support governmental action on climate change. There were 38 per cent of respondents who viewed climate change as too far in the distance to be a concern (See figures 3.2 and 3.3). This divide between attitude towards engagement and awareness is interesting. Lorenzoni et al. (2007, p. 451) found "… a lack of basic knowledge about causes, impacts and solutions to climate change." Examples of poor knowledge are demonstrated by Capstick and Pidgeon (2014) where people experience cold weather and therefore, question the validity of climate change due to them believe climate change equals warmer weather. Therefore, the personal experience of cold weather results in doubt in climate science as the poor level of understanding that the climate is warming is equated to warmer weather. However, other research by Marquart-Pyatt et al. (2014) suggests that ideological processing is more significant than changes to the climate in public perception. Alongside this they found that there were barriers to engagement due

to the lack of desire to engage with climate change information and confusion where to find reliable information on climate science. Therefore, it is important to explore the reasons for poor public understanding of climate science and the difficulties faced in the communicating climate change.

Figure 3-2: UK attitudes to government action on combating climate change

It's not worth Britain trying to combat climate change, because other countries will just cancel out what we do
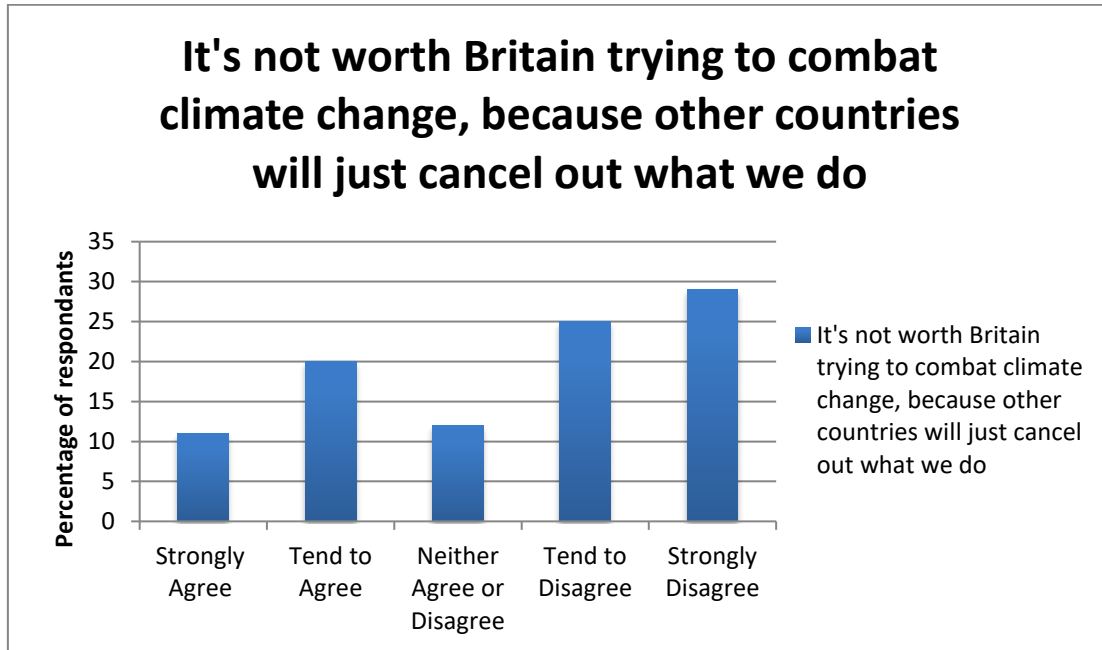
Note: Data from the Department for Environment Food and Rural Affairs (2010, p. 16).

Figure 3-3: UK concern about future impact of climate change

The effects of climate change are too far in the future to really worry me
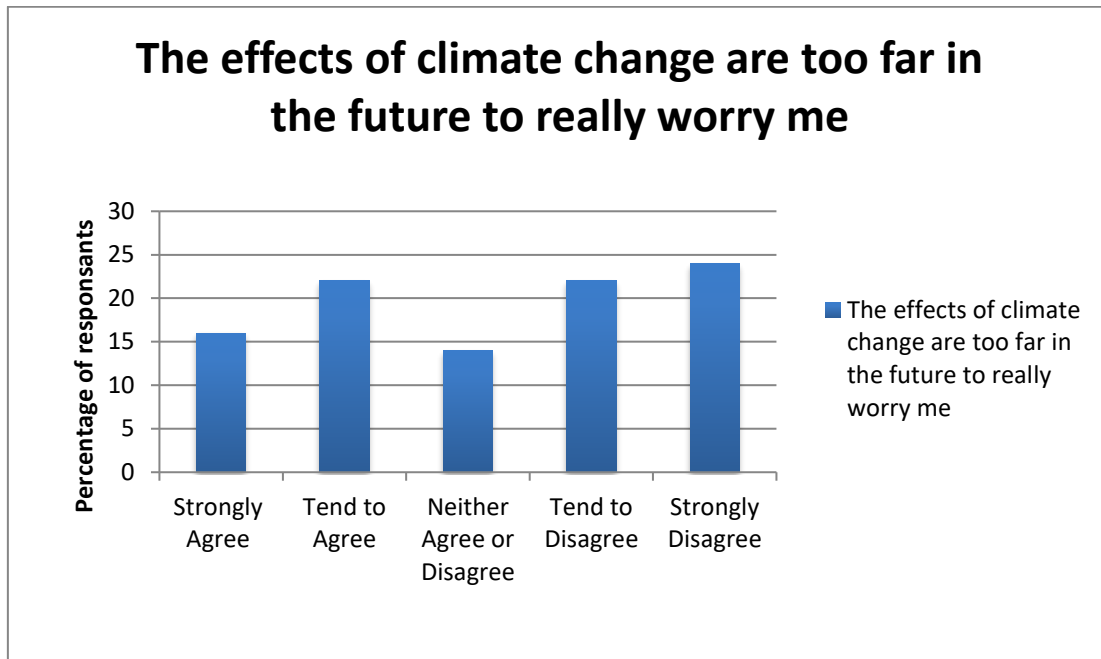
Note: Data from the Department for Environment Food and Rural Affairs (2010, p. 1).

There is range of barriers to effective citizen engagement with the issue of climate change. Two fundamental issues with climate change communication is argued by Moser (2010, p. 33) to not being visible and no direct impact on health. In this regard climate change contrast to other forms of visually environmental issues, such as smog, which are visible to the naked eye with a clear impact on health. There have been campaigns to attempt to increase awareness to the issue of carbon emissions with Moser (2010, p. 33) highlighting a campaigns to save energy with one in Australia called '*You Have The Power*'. This campaign visualised the impact of energy usage producing greenhouse gas as black balloons coming from electrical appliances and filtering out of homes. There have been similar attempts to increase awareness of the consequences in UK based campaigns with the government advert '*Act on CO_2*', which showed a child being read a story about the consequences of climate change (see Figure 3.4). This advert attracted a negative backlash with complaints made about the content (Sweney, 2009).

Figure 3-4: Act on CO$_2$ TV advert

Note: Screenshots from video uploaded by Joe the Electrician (2009).

Both of these campaigns highlight an issue that people are disconnected with the impacts of energy use on climate change along with the issue that emissions from the individual is relatively small (Moser, 2010, p. 33). This was shown in a study by Semenza et al. (2008, p. 483) to be the second most common barrier, after a lack of understanding of how to reduce their impact on climate change, that their own behaviour was not seen as significant enough to make a difference. This is also exacerbated by climate change being seen as an international issue. As a result it is viewed by the public as disconnected from

them with domestic issues viewed as holding greater importance (Gavin, 2009, Sampei and Aoyagi-Usui, 2009).

While the public may see climate change as an international issue there is also the argument by Moser (2010, p. 34) that due to our disconnection with nature in developed countries we do not "… notice subtle, incremental environmental changes…". This is compounded from the large time scales under which climate change takes place compared to other forms of environmental pollution with much more immediate impacts (Hansen et al., 2012, p. E2422). As a result the risks posed by climate change are often viewed as greater for society rather than a risk at the individual level (Pidgeon, 2012, p. S88). An aspect of this can be due to people being unfamiliar with the impact that climate change will have on their lives with examples such as extreme weather events.

Effective risk communication to the public is argued by Pidgeon and Fischhoff (2011, p. 38) requires both a better public understanding of climate science and effectively framed messages about the risks climate change poses. Framing is a process where information is selected and discourses are used to portray an issue in a particular way (Muschert, 2009, Nisbet, 2009, Scheufele, 1999). This process is an inherent part of media coverage due to the constraints of space and time as a result Nisbet (2009, p. 15) argues that there is simply "… no such thing as unframed information…". Frames form the storylines that communicate an event or issue to the public of "… why an issue might be a problem, who or what might be responsible for it, and what should be done about it" (Nisbet, 2009, p. 15). Through the framing of coverage the media also sets the agenda for public debate by focusing and excluding aspects of a topic (Scheufele, 2000).

Frames are argued Lakoff (2010) to be important to study as humans are not rational and filter information through pre-existing mental frames with ideological bias and irrational beliefs. Frames (or sometimes referred to in literature as schemas) are the unconscious neural structures in the brain that process all information we receive (Lakoff, 2010). These frames are used for "all thinking and talking…" which develop, change and strengthen over time (Lakoff, 2010, p. 71). These developed frames process issues thematically which links to a direct frame and also "… closely related concepts such as categories, scripts,

or stereotypes connote mentally stored clusters of ideas that guide individuals' processing of information" (Dunaway et al., 2010, Entman, 1993, p. 53). For example, a study by Hoffman et al. (2016) found that decision making of pain management treatments were effected by racial biases in American medical students. The study found "… many white medical students and residents hold beliefs about the biological difference between blacks and whites, many of which are false or fantastical in nature…" (Hoffman et al., 2016, p. 4). This bias in processing information from the patient's condition resulted in reduced accuracy of pain treatments when treating black patients due to these irrational beliefs in racial differences. Difficulties posed in the processing of climate change information along with problems in making the public aware of their own greenhouse gas emissions have made climate change communication problematic. Even if awareness of the public actions is produced there is the risk they will simply see their own emissions as insignificant to the global problem.

Media framing is significant as the frames used to cover an issue shapes the public discussion (Scheufele, 1999). As a result the media is particularly powerful in setting the agenda of public discussions with the shaping of what the public view as issues but also how they are interpreted by the public (Mercado, 2012, Nelson et al., 1997). The literature on agenda setting focuses particularly on two areas with the influence of the media on public opinion or the effect of the media on the policy agenda (Dalen and Aelst, 2013). This section will focus on the former as Dalen and Aelst (2013) highlight the difficulties in establishing the direct influence of the media on the policy agenda. The media influences public opinion and their perception of society (Wolfe et al., 2013).

The framing of an issue has been shown that it greatly impacts public's perception of issues in society just by how the information is framed. An experiment was conducted by Kahneman and Tversky (1984) which gave subjects two choices between programs A and B followed by choices between programs C and D (Entman, 1993, p.53). The statement given to participants was "Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people" (Kahneman and Tversky, 1984, p. 343, Entman, 1993, p. 53). Participants were offered two potential solutions:

"If Program A is adopted, 200 people will be saved. If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved. Which of the two programs would you favour?" (Kahneman and Tversky, 1984, p. 343, Entman, 1993, p. 53).

The majority of participants selected option A (72%). This was followed with the choice between two other solutions that are the same with the focus being deaths rather than the number that could be 'saved':

"If Program C is adopted, 400 people will die. If Program D is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die" (Kahneman and Tversky, 1984, p. 343, Entman, 1993, p. 54).

Despite these being the same options as before program C only received 22 per cent of the vote with program D receiving 78 per cent (Entman, 1993, p. 54). The simple changes to the phrasing of the programs were enough to alter the decisions made by participants with a greater emotional weight with death being the focus of Programs C and D.

Therefore, the way an issue is framed to the public can result in greatly influence public opinion and concern (Dunaway et al., 2010). An example highlighted by Dunaway et al. (2010, p. 362) is coverage of immigration is often framed in a negative way with crime being a focus of most coverage about immigration at a much higher amount that the "… actual occurrence in society…". In the US crime was used to frame "… 36 per cent of all network news stories covering Latinos" (Dunaway et al., 2010, p. 362). These negative frames potentially influence the public to view immigration as a negative thing in society and potentially distract from significant issues in society.

The selective framing of issues in society can be a distraction as there are only a limited number of issues that we can focus on at any one time (See information overload in chapter 2) (Dunaway et al., 2010). So the media can put prominence other issues or produce moral panics directing the public's attention away from issues such as climate change. Moral panics are produced when something, this can be new technology or group of people, emerges in society and is treated as a threat to the values in society (See Goode and Ben-Yehuda, 2009). For example a recent moral panic has been focused on the sexual risk to children the Internet apparently poses (Quayle, 2015). Instead, Quayle (2015, p. 41) highlights that the Internet is a factor in a small number "… of sexual offences

against children in the US…" and "… the rates of child sexual abuse show a decline". The framing of Internet risk creates the image to the public that the Internet itself is a risk to the safety of children.

Therefore, the media can draw attention to issues, but also skew the public's perception of an issue. Despite the potential to skew or distract the public the media is vital to draw focus on issues in society as we are only able to focus on a finite number of issues at a time due to cognitive limitations (Dunaway et al., 2010). A consequence of these cognitive limitations is that the media is extremely important to get the public engaged with an issue and its relevance to the wider public, (Gavin, 2010). However, coverage itself does not necessarily create public support for effective measures to deal with an issue as framing can significantly influence how an issue is perceived (Scheufele and Tewksbury, 2007). For example, the framing of climate change information has a significant influence on the public's perception of climate science and support for effective policy making. Previous research into the framing of climate change has particularly focused on climate sceptic coverage (See Boykoff, 2007, Boykoff, 2011, Boykoff and Boykoff, 2004, Oreskes and Conway, 2010). This research seeks to examine whether climate sceptic material is a risk to online communication of climate change and whether there is a causal link between sceptic material and reactions to climate science.

Climate sceptic material makes climate science appear still debated and undermine public support for emission reduction has been argued by Oreskes and Conway (2010) as the manufacture of doubt. Essentially by creating the public perception that climate science is still debated then it undermines public pressure to regulate polluting industries. This is a tactic Oreskes and Conway (2010) highlight to have been used by the tobacco industry to try to discredit the link between cancer and the smoking of tobacco. By keeping the public perception that the science was still debated it meant it "… would be safe from litigation and regulation" (Oreskes and Conway, 2010). The same approach has been taken by fossil fuel companies with the funding of climate sceptics to attempt to maintain the public perception that climate science is still debated.

There is evidence that fossil fuel companies have spent hundreds of millions of dollars to fund climate change counter-movement [CCCM]

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organisations to delay effective climate change policies (Brulle, 2014). The funding of these organisations are not always clear with Brulle (2014, p. 691) highlighting that companies such as "… the ExxonMobil Foundation were heavily involved in funding CCCM organizations" but have publicly stopped funding these groups and instead "… shifted to pass through untraceable sources". Through the manufacture of doubt fossil fuel intensive industry protects itself from public pressure to regulate emissions (Oreskes and Conway, 2010).

While the framing of climate change information can impact the public's perception and understanding of climate science there not necessary a direct effect on the public for example whether they engage with information. In particular, selective media exposure to climate change information is important to explore as the selective exposure to information can influence a individuals' understanding of climate change and potentially limit the impact of climate change communication. Selective media exposure is caused by individuals making decisions on what media to engage with which is based upon previously held political beliefs and world views (See Garrett, 2009). This is important to examine, as the decisions made by people to engage with climate science could potentially limit the potential effectiveness of climate change communication if users choose not to engage with it. This section will begin by exploring the debates surrounding selective media exposure and the potential consequences of polarising of the public.

The Internet provides an environment where users can directly select what they wish to engage with and therefore potentially opt out of receiving information from differing points of views. The Internet is argued by Garrett (2009) to allow for users to have much greater control over what information and sources they are exposed to with the potential for users to simply not see information that contradicts their world view. This selective exposure is argued by Schumann (2004, p. 234) as a consequence of the increasing media exposure which means that people are limiting exposure to "… available messages about the characteristics, culture, values, beliefs, point-of-view including worldviews, preferences, and behaviour of those we believe may be different from us". The effect of the media on an individual attitudes, values, and understanding of a topic is influenced by the exposure to media sources.

Selective media exposure can shape how we perceive reality with our values and beliefs being influenced and strengthened. For example, Malamuth (1985, p. 313) ran an experiment exploring the portrayal of rape in pornography and found that exposure to aggressive pornography "… may contribute to males' acceptance of rape myths and/or violence against women". However, the effect of media exposure depends if individuals decide to engage with the media content and this section will look at how the Internet has given greater control to users with what media content they engage with. The selectivity of media sources is influenced by a range of factors with "… a person's ages, gender, disposition, prior experience, mood, ideology, social influences, and social identity" (Slater, 2007, p. 282).

For example research by Nisbet and Goidel (2007) into the impact of the framing of coverage of the embryonic stem cell research focused on two main discourse frames. The coverage was framed as either an issue related to 'Christian morality' or 'social and economic progress'. The result from Nisbet and Goidel (2007) research showed that individuals who viewed media outlets which took the discourse frame of an issue to 'Christian morality' were more likely to have a negative view of stem cell research, while those viewing media outlets which used the frame that stem cell research was social and economic progress were more likely to be supportive. Through this selective use of media there is the effect of the media spiral reinforcing pre-existing beliefs and attitudes (Slater, 2007).

The consequence of the reinforcement of pre-existing beliefs through selective exposure is the polarisation of the public (Stroud, 2010). Essentially there is a fear in the literature surrounding the Internet that users will simply produce 'echo chambers' for their own beliefs and as a consequence the public become increasingly polarised with less tolerance for those who hold differing views (Stroud, 2010, p. 557). Experiments by Keating et al. (2016) found that group discussions with likeminded people resulted in participants becoming increasingly polarised and seeing the other side as more extreme without being aware that their own views had become significantly polarised. This is problematic if users filter out differing worldviews as they simply reinforce their views and become increasingly polarised without being aware of the impact. It is

argued by Sunstein (2007) a consequence of this polarised society is social fragmentation (Kim, 2015).

In contrast, a study by Valentino et al. (2009) found that people did engage with differing points of view in particular to be able to counter arguments from the other side of a debate. This finding is supported by the research of Kim (2015) which found that the effects of polarisation was reduced in social networks where individuals engaged with those with differing world-views. Therefore, suggesting that just engaging with like-minded media sources does not necessarily produce polarisation, but if an individual's social interactions are also made up of like-minded individuals then there is a strong process of polarisation and rejection of other worldviews. This poses a problem for climate science communication, as those who choose to engage with media that rejects the scientific consensus will not develop an adequate understanding, but instead have their climate sceptic beliefs reinforced.

3.3: Barriers to climate change communication online

A key problem in applying this literature to climate change communication online is that the Internet has the potential that people can opt out of news coverage and simply never engage with climate change information. The Internet has enabled the general public to filter out information on topics they are not interest in through the use of social media (as discussed in chapter 2). The lack of engagement goes back to the previously discussed barriers to climate change communication where with a key barrier to engagement is argued by Scannell and Gifford (2013, p. 77) to be the lack of attachment "… to one's local area…". Therefore, it is important to increase engagement with climate change information, but there is the risk that engagement with climate sceptic material might result in the rejection of climate science and increase polarisation if users do not engage with the climate consensus.

This lack of interest can be seen in the opportunities to spread climate change information through meme (see chapter 2). Memes hold the potential to widely share information or critique corporate and political institutions. However, the success of viral success of memes has been suggested by Weng et al. (2012)

to be random with limited attention from audiences and the sheer quantity of information being shared. This was shown in the research by Weng et al. (2012) that used a computer model to model Twitter which modelled user behaviour with meme sharing. They found that the success of a meme were based on the structure of a social network and finite user attention so some memes gained zero traction while others survived long term with a large audience suggesting that the success of virally shared content.is entirely random. In contrast Chesterman (2011) argues that memes spread on a range of aspects for example including perceived emotional impact and entertainment values, to be simple and easily understood, and able to spread in a variety of formats (images, video, audio etc). In particular, memes require two key features to survive in Internet culture. Firstly, the meme requires enough variety to remain interesting to an audience, and secondly, it needs to be mutable which means it can be used with other memes. This means that the meme continues to be shared.

An example of a successful reproducing meme within Internet culture can be seen in the My Little Pony [MLP] memes that emerged in 2010 (Know your Meme, n.d.-k, Robertson, 2014). Achieving the key step of viral success (see Figure 3.5), but instead of declining in the sharing of content it achieved long term success due to the mutability and variety of the meme. Even if a meme was to decline there is always the potential for re-emergence in Internet culture. At times this is due to memes being event specific examples including '2Spooky' meme that emerges every year around Halloween (Know Your Meme, n.d.-a). The production of the MLP memes has continued to grow with the Know your Meme (n.d.-k) MLP page has, in January, 2015, has 9,203,076 page views and 210,779 images on the MLP meme image gallery. An example can be seen in Figure 3.6. The MLP memes are an example of successful meme with high survivability for the key reasons argued by Chesterman (2011): variety and mutability (the ability to be merged with other memes).

Figure 3-5: Model of successful viral content
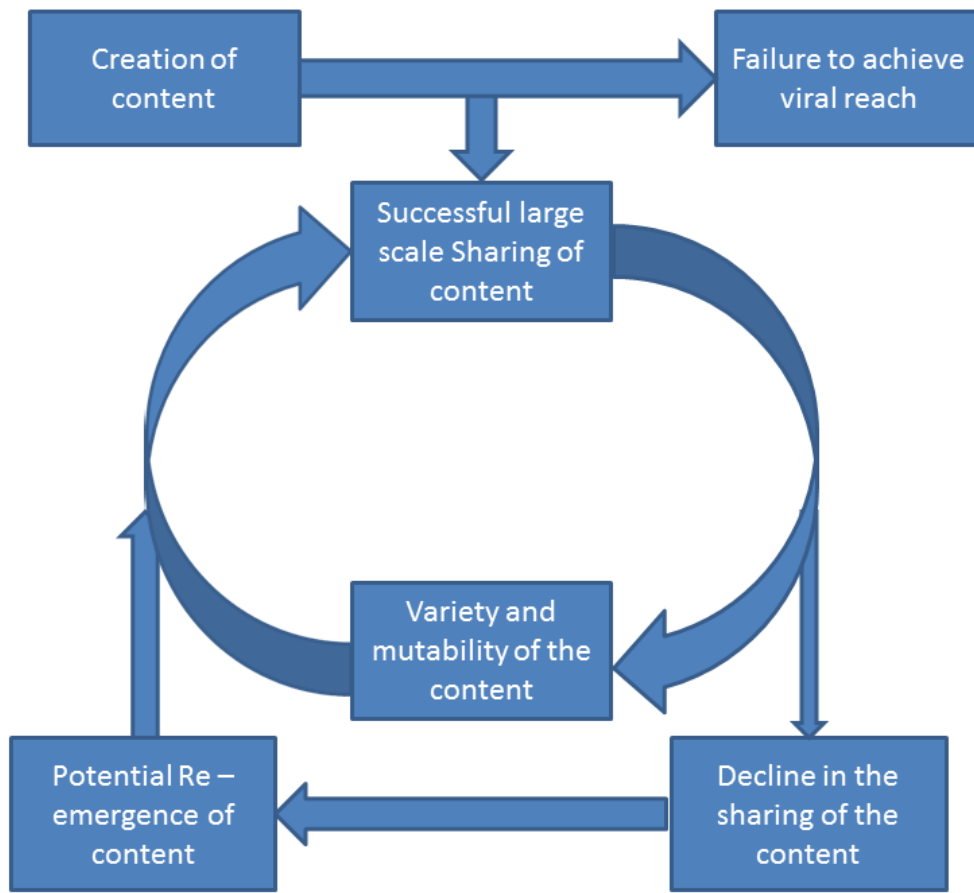
Figure 3-6: Confound these ponies they drive me to drink

CONFOUND THESE PONIES

THEY DRIVE ME TO DRINK

Note: Image taken from RainbowFuckinDash117 (n.d.)

In particular the success of MLP memes is due to them being highly mutable. The merging of MLP with other memes and wider popular culture is known in Internet jargon as 'ponifying' (Know Your Meme, n.d.-l). An example is the mutation of popular image memes to create 'ponified' versions. This can be seen in a meme called *'It's dangerous to go alone! Take this'* (See Figure 3.7), that originally emerged in 2006 and uses a quote from the 1986 videogame '*The Legend of Zelda*' which is superimposed on an image of an animal or item being offered (Know Your Meme, n.d.-i). Alongside image memes there are many examples of videos that have had viral success with one example being an ponified animation by Jacob Kitts (2012) called '*Lord of the Rings Re-enacted by Ponies*' (one video in a series of videos that ponifies popular TV shows and Films) that parodies key scenes from the '*The Lord of the Rings*' film trilogy and has received over six million views (See figure 3,8).

Figure 3-7: Variations of the 'It's dangerous to go alone! Take this'

Note: The kitten example of 'It's dangerous to go alone! Take this' meme is taken from Know Your Meme (n.d.-i) and the MLP variation is taken from the Know Your Meme (n.d.-j) image gallery.

Figure 3-8: Lord of the Rings Re-enacted by ponies

Note: Screenshots taken from Jacob Kitts (2012).

These MLP memes meet both of the requirements for successful memes with mutability and variety to maintain user interest as the ponifying of other memes and popular culture has resulted in long term survival within Internet culture. However, in contrast climate change has struggled to produce viral success with a search for 'climate change' on Know Your Meme website, in December, 2015, produces a result of only 15 images and 17 videos (Know Your Meme, n.d.-m). For example an attempt at spreading viral climate consensus information in an entertaining format (See Figure 3.9) was a video by Hungry

Beast (2011). Through the song the video seeks to impart information about climate consensus while highlighting the influence of the fossil fuel lobby on politicians and criticising climate sceptics with the lyrics including:

> "Feedback is like climate change on crack
> The permafrost subtracts: feedback
> Methane release wack: feedback.
> Write a letter then burn it: feedback
> Denialists deny this in your dreams
> Coz climate change means greater extremes,
> Shit won't be the norm
> Heat waves bigger badder storms
> The Greenhouse effect is just a theory sucker (Alan Jones)
> Yeah so is gravity float away muther f**cker" (Hungry Beast, 2011).

The images used in the video along with the lyrics are designed to be entertaining yet informative. Despite this the video, in September, 2015, has only been viewed 232,209 times since it was uploaded in 2011, compared to 'Lord of the Rings Re-enacted by Ponies' which received over 6 million views (Figure 3.8). This shows a failure to achieve the key step of viral success (see Figure 3.5) even if the video had been virally successful it does not offer mutability or variety so would most likely have declined in viral sharing rapidly. The impact of the song on viewers is also difficult to attain with comments disabled, but has received a majority of up votes (positive feedback), which suggests climate sceptics have not engaged with it as personalisation of the Internet experience means that its unlikely to see climate consensus material (See chapter 2). However, the video highlights a key barrier for climate change of being a complex subject when Chesterman (2011) suggests entertaining content is more likely to be successful.

Figure 3-9: Climate consensus video - I'm a climate scientist (HUNGRY BEAST)'
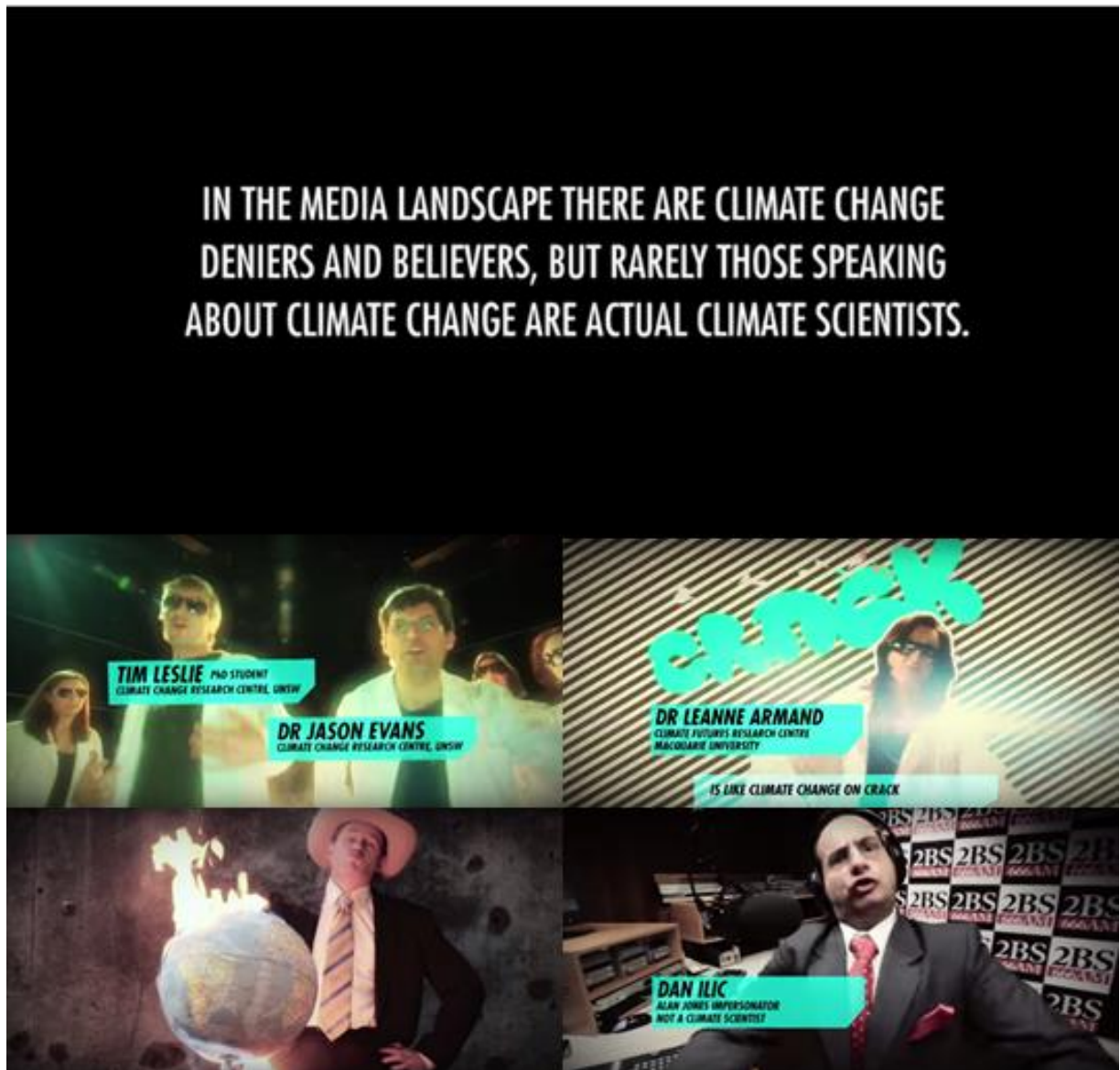
Note: Screenshots taken from 'I'm a climate scientist' video by Hungry Beast (2011). Middle left image text says "Tim Leslie PhD Student – Climate Change Research Centre , UNSW" and Dr Jason Evans – Climate change Research Centre, UNSW". The middle right image "Dr Leanne Armand – Climate Futures Research Centre – Macquarie University" and "Is like climate change on crack". Bottom right image says "Dan Ilic – Alan Jones impersonator – Not a climate scientist".

These memes highlight the potential difficulty of communicating climate change via memes, which may provide difficulty to produce in great variety or be mutated with other types of memes to transmit climate change information. The success of MLP memes, and the failure of climate change memes, highlights that users generally engage in the transmission of memes for entertainment as well

the representation of their personal beliefs or values they identify with (Kien, 2013, Sreekumar and Vadrevu, 2013). Attempts to communicate climate change with memes would require environmental networks to engage in the creative process of meme production and ability to be shared widely through social media as well as being able to successfully adapt popular memes to send an environmental message. Even then simply mutating and mimicking other successful viral content does not necessarily result in an environmental message reaching a wider audience.

This suggests that memes are not necessarily an effective method of political critique, but the Internet has enabled the sharing of critique with culture jamming (see chapter 2) being used to potentially reach wider audiences (Cammaerts, 2007). There have been an example of successful environmental memes. One can be seen in the mimicking of video adverts with 'A Cheesy Love Story' that raises awareness of Doritos use of palm oil and their contribution to the destruction of the rainforest and consequently contributing to climate change (See Figure 3.10) (SumOfUs, 2015a). The video is humorous depicting the relationship of a couple from their first meeting to wedding and showing that they revolve their lives round Doritos (SumOfUs, 2015a) The video then hits the viewer with a twist ending when they honeymoon to the 'Doritos forest' and the video shifts tone to a shocking image of deforestation for palm oil plantations (SumOfUs, 2015a) This example achieved some viral success with over 2 million views. Nevertheless, the effectiveness of culture jamming as another way to engage people with political values and concept is argued by Cammaerts (2007) to have no real macro level impact with some evidence of minor impacts, but as a facet of other methods in a campaign. The example of culture jamming by the SumOfUs (2015a) may have been viewed 2 million times, but the direct impact upon users is questionable as it may simply be shared for entertainment between users rather than for the political message. Youtube comments potentially highlight little impact on some users (See Figure 3.11), but many cases could simply be attempting to annoy, intent is difficult to tell with comments. Another key issue that limits the impact of culture jamming, which is a similar factor with memes, is that anyone can create content. As a result, culture jamming is not limited to communicating criticism to counter hegemonic ideology with jamming

techniques being used by corporations in marketing and by governments in political campaigns (Cammaerts, 2007).

Figure 3-10: A cheesy love story - the Ad Doritos don't want you to see
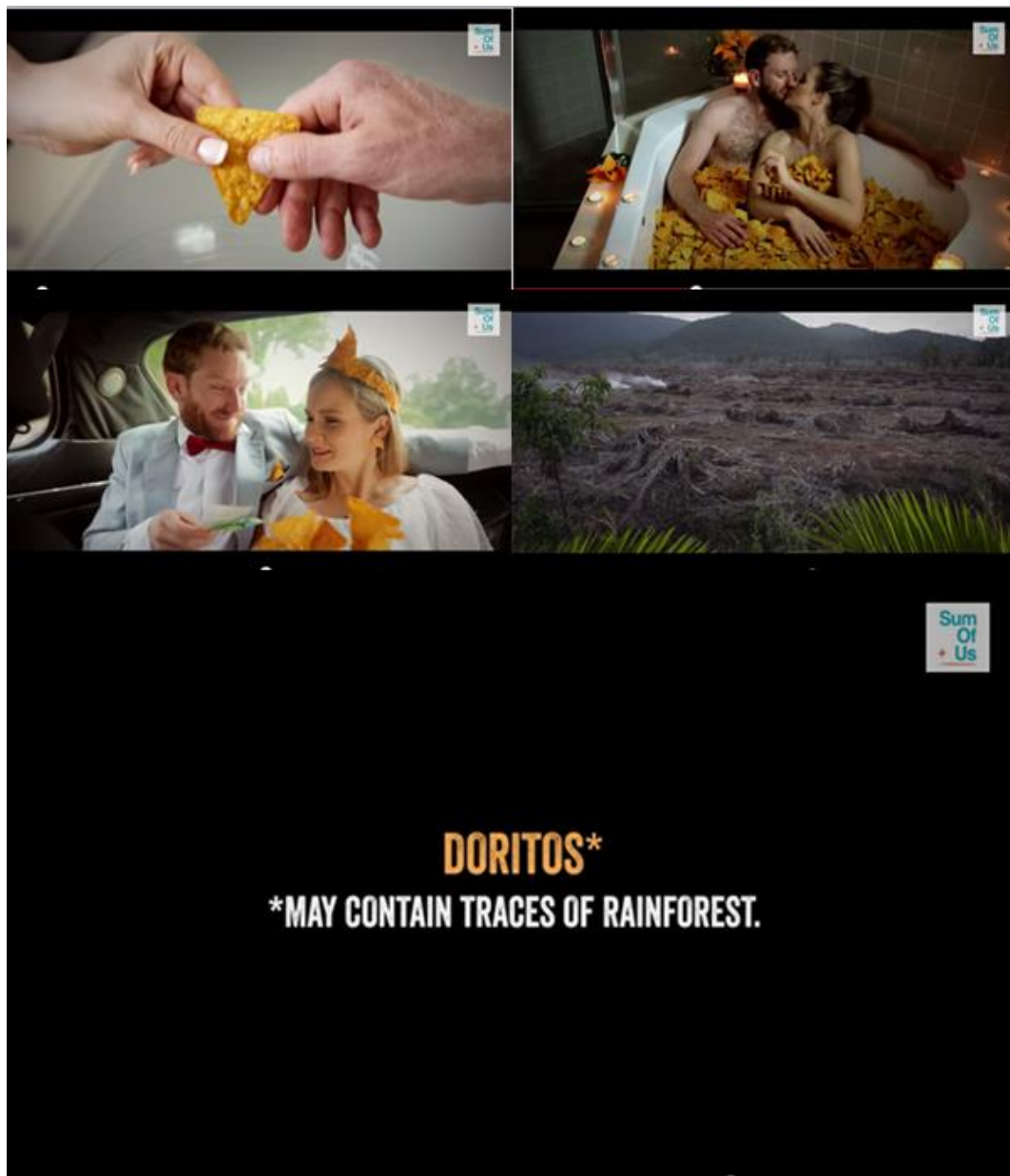
Note: Screen shots taken from the video 'A Cheesy Love Story' by the SumOfUs (2015a).

Figure 3-11: Youtube comment example

Raul Alfonso Tejada 1 month ago
opens Doritos bag
Reply
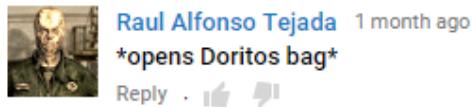
Note: Screenshot taken from comment section taken from the video 'A Cheesy Love Story' by the SumOfUs (2015a).

Additional attempts at creating viral success that the SumOfUs (2015a) had with '*A cheesy love story – the ad Doritos don't want you to see*' has not been replicated in the following videos they have produced. While memes have the potential to spread political messages (See chapter 2) the creation of viral material is difficult. In attempting to increase public awareness of the harm to the Antarctic ecosystem caused by Krill oil health supplements there were two videos produced. The first video was an animated music video which only received 23,602 views (SumofUs, 2015b). The second video instead mimicked Internet prank videos which was attempting to increase awareness that Sainsbury's were selling Krill oil health supplements and create public pressure on the supermarket to stop them stocking the product (SumOfUs, 2015c). Prank videos are popular viral videos where people play pranks on others and film the reactions. For example, TheCHAIZYchannel (2015) prank video '*Shampooing strangers prank*' has received over 4 million views. However, in using this popular style of viral video the SumOfUs (2015c) released a video called '*Sainsbury's, how does it feel*', which had people dressed in crab and Killer Whale costumes stealing food from people, only received 13,086 views. Either these are simply not gaining enough attention to go viral or the mutation of other popular memes to spread environmental messages is not well received.

However, lessons can be learned from the Brony subculture that have mass-produced and shared viral MLP content online. Apart from having a committed online community it also meets the criteria of variety and mutability argued by Chesterman (2011) that is required by online viral content with high survivability in Internet culture. This behaviour is seen in 'ponification' of other popular memes and popular culture and could be potentially mimicked with the alteration of popular online memes to spread climate change awareness and information. An example of merging a climate change message with popular

culture can be seen with 'Everything is NOT awesome' video (See figure 3.12) by GreenpeaceVideo (2014) which used the song '*Everything is awesome*' from the popular '*The Lego Movie*' (Lord and Miller, 2014). This was a successful viral video which received over 7 million views and drew attention to a campaign to pressure Lego to end a partnership with Shell, which itself was successful with Lego not renewing the contract with Shell. This was the most viral video in Greenpeace history (Greenpeace, 2014).

Figure 3-12: Everything is not awesome video

Note: Screenshots taken from GreenpeaceVideo (2014).

Successful viral communication requires engagement with an audience online to share the content to a wider audience and without this engagement climate change (See Figure 3.5). This has also been shown with the difficulties SumofUs (n.d.) as an issue for wider environmental content which is going to struggle to reach an audience large enough to achieve viral success. Even if content manages to reach a wide enough audience to achieve a viral reach, such as the '*Advert Doritos Don't want you to See*' by SumOfUs (2015a), there is still the problem that the content will not survive long within Internet culture. This is due to viral content needing to have variety or mutability to survive in Internet culture (See Chesterman, 2011). This is why MLP memes have been so successful. In the case of the SumOfUs (2015a) there is the initial viral success, but declines relatively quickly as it's a single video so lacks variety and is also not easily mutable.

However, this highlights a barrier of the viral spread of climate change information. The speed of transmission and the frequent changing landscape of Internet culture has a consequence of the memes being shared are both short term and the information they share does not necessarily produce understanding of a concept or an issue (Chesterman, 2011, Kien, 2013). Instead users generally engage in the transmission of memes for entertainment and representation of their personal beliefs or values they identify with (Kien, 2013, Sreekumar and Vadrevu, 2013). The sharing of memes for entertainment can be seen in the success of MLP memes, which providing no practical communication purpose apart from entertainment. The sharing of viral content for entertainment can distract users from more significant issues in society such as climate change. Due to the sharing of memes for entertainment, there is the risk that memes which focus on societal issues are often intended to be read in an ironic or sarcastic way (Kien, 2013). Rather than challenge those who hold onto the values or belief that are intended to be confronted with the meme are instead argued by Kien (2013) to receive little to no impact as the message is taken at face value by those it is aimed at confronting.

In addition to the serious barrier to climate change information not being seen due to the information competition with Internet There also significant challenges with climate change being a complex topic. This requires the public to

develop the necessary frames to adequately process this information with ideological barriers and appealing to emotions.

A key problem with climate change communication when the public can easily opt out of coverage is the difficulty of developing the public's frames for understanding climate science. The communication of climate change is argued by Lakoff (2010, p. 73) to struggle to effectively impact the public as the frames required are "… built up over a long period of time…" as it is a complex topic. This is why pre-existing ideological frames prove to be a significant barrier as they can result in the public rejecting climate change information. In addition these frames are triggered by emotions that the information is passed through. A potential issue with this is the public can reject climate science if a scandal takes place or is manufactured.

Political scandals have been shown by Kepplinger et al. (2012) to have significant impacts on media audiences motivating a public response for harsh punishments on those who committed the act. This suggests that Climategate, which was discussed in the previous chapter, that was a manufactured scandal with the misrepresentation of climate scientists emails (See Nerlich, 2010). The reporting of this scandal by right wing blogs shaped the coverage before the story reached the mainstream media (Nerlich, 2010). This potentially means that the effects of Climategate was far stronger than just returning the climate sceptic discourse to UK newspapers (See Passmore, 2016). In particularly, the scandal potentially reinforced the ideological beliefs of those who already reject climate science.

The second key barrier to communicating climate change is the difficulty overcoming ideological hurdles as facts can be dismissed based upon ideological belief (Lakoff, 2010). Effective communication of climate change is argued as important by Lakoff (2010) to develop the publics' ability to adequately process information about climate change. However, this is not a simple process as the ideological frames are strengthened over time through the use of everyday language and require this language to be challenged or climate change to be communicated in a way to use these pre existing frames (Lakoff, 2010). While language activates frames Lakoff (2010, p. 73) argues that "words themselves are not frames". This means that just repeating slogans to get the public the

language of climate science in the everyday language of the public is flawed as they require pre-existing frames to comprehend the topic (Lakoff, 2010).

Ideological beliefs have been shown to influence how an individual views climate change and environmental issues. An example can be seen in research by McCright and Dunlap (2011) into the US public's belief in climate change which has shown that individual's ideological views shape whether they believe the scientific consensus or deny the existence of climate change. In the US this ideological split is between the two US political parties with the supporters of the Democrats being much more likely to support the scientific consensus while Republicans are more likely to deny climate change (Dunlap and McCright, 2008, McCright and Dunlap, 2011). This party split is evident in attitudes towards general environmental issues and the environmental movement in general with Democrats much more likely to support (Dunlap et al., 2001). This is due to the Republicans greater interest in protecting "… the industrial capitalistic system" rather than environmental considerations (McCright and Dunlap, 2011, p. 180). Due to the self-selection of the information caused by information overload means that Republican supporters will more likely engage with junk information and makes effective communication of climate change difficult.

In addition, an appeal to emotions is also important. Emotions are argued by Roeser (2012) to be a significant factor in climate change communication to explain the gap between awareness of the seriousness of the issue and a lack of action to deal with it. For example creating public fear about the consequences of climate change is argued by Meijnders et al. (2001) to potentially get the public to focus and think about the issue critically. However, the use of fear has been criticised by O'Neill and Nicholson-Cole (2009) as an effective communication strategy of climate change. The use of fear has been shown to be highly effective in getting the public's attention to focus on climate change but O'Neill and Nicholson-Cole (2009) argue that it instead acts as a barrier to producing public understanding and behaviour change. The reason for this barrier is the impact that coverage designed to cause a fear response may cause the public to feel "… helpless and overwhelmed…" and even potentially result in them taking a position of denial (O'Neill and Nicholson-Cole, 2009, p. 375).

Fear alone does not create public behaviour change and has been shown by Semenza et al. (2008) to be a key barrier as the public view their own behaviour as insignificant and a hopeless attempt to mitigate their own emissions. Instead the public need to have a message of hope that climate change is a serious challenge but one that can be overcome (Roeser, 2012, p. 1038). In addition to the message of hope O'Neill and Nicholson-Cole (2009) argues that the public need to be engaged with climate change in a broader connection to their everyday lives. This would potentially overcome one of the key barriers to effective climate change communication as its simply seen as an international issue (Gavin, 2009, Sampei and Aoyagi-Usui, 2009).

3.4: Summary

In summary, the debate surrounding understanding of science and scientific literacy is a contested area of study, but there is a general consensus that scientific literacy in the general public is low. In my research the approach to understanding that I am taking is scientific literacy rather than presuming in-depth understanding of science is required for the public to effectively engage with technological and scientific issues. However, the approaches to measuring scientific literacy are varied. The approach of using basic understanding provides an interesting insight in previous knowledge held by participants, but this cannot be generalised to effectively scientific literacy.

Instead, I will be focusing upon the ability to understand the scientific process. The ability to understand the scientific process empowers the public to effectively engage with scientists and scientific studies about issues that directly affect them. Understanding of the scientific process has been shown to be low in the US public, but this is also expected in the UK as science education has focused on biology, chemistry, and physics rather than focus on how science is carried out and why. Despite the issues with scientific literacy including the problem that due to these range of aspects you cannot label someone scientifically literate compared to literacy and numeracy tests. Instead they provide an interesting insight into the understanding of differing areas of science. Therefore, this research is using the approach of scientific literacy as the control variables for the experimental approach (see chapter 4).

However, the poor state of scientific literacy poses a problem for climate change communication. The vast majority of the UK population is aware of climate change but there is also very poor understanding. Climate change does have many challenges in developing understanding. In particular, the public feel disconnected to the issue and at the same time the issue is also highly complicated with the public getting confused over the causes.

While the Internet offers new opportunities to communicate climate change with viral communication there is competition with a large array of topics and distractions from serious issues. The fast-paced communication the Internet offers means that virally shared material is often for entertainment and be easily mutable which is why MLP memes have proven to be so successful. Even if information is received it can fail to have an impact on support for action if it rejected on ideological grounds or makes the public feel helpless, such as a message of fear may cause disconnection from future climate change communication.

Overall, there are issues with climate change communication with the public having a poor scientific literacy with significant misunderstandings of climate science. The communication of climate change has been problematic in the past as framing can undermine the message of the climate consensus, but also there is risk that the public will not engage with climate change information. Instead information overload means that the public are likely to filter out climate change information and instead are more likely to get distracted content shared for entertainment. The following chapter will examine the methodology used to explore engagement with climate science online and examine the impact of climate change information on young people's understanding of climate change.

The literature reviews have informed this research design (See figure 3.13). Information overload (see chapter 2) and information processing are explored in the focus groups to better design the information overload treatment of the experiments. The literature on climate change reactions is used to create the dependent and control variables of the experiment, and frame the discussion in chapter 7.

Figure 3-13: Research design
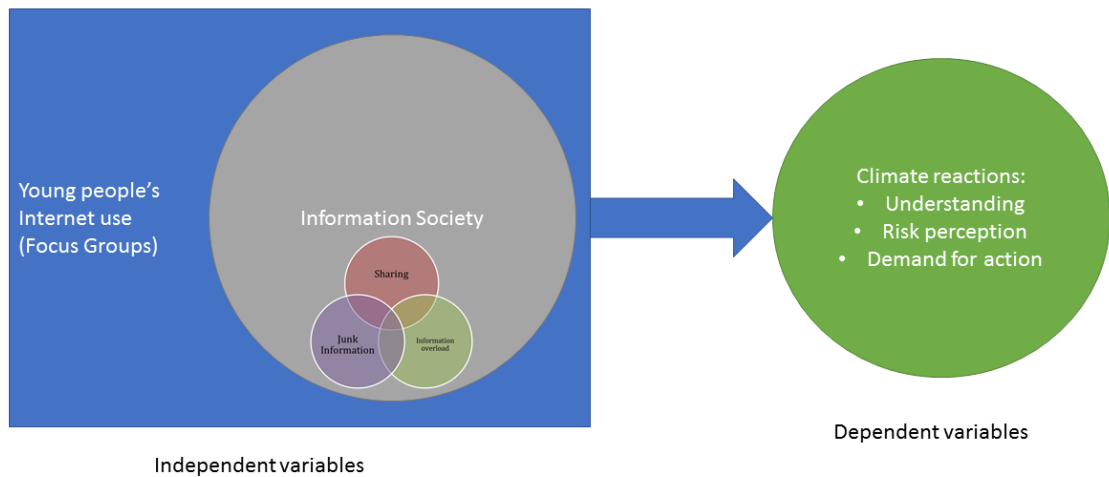
The literature review on the information has been key to defining the independent variables used in this experimental design. While this chapter has been key in the defining of the dependent variables and the control variables for the experimental design (See chapter 4). Overall, by bridging these two bodies of literature I can explore how the Internet has effected young people's reactions to climate change.

Chapter 4 - Methodology

This research seeks to examine the impact of Internet use on young peoples' engagement with climate change and their understanding, perception of risk, and support for mitigation. I have carried out this research using a mixed methodological approach. Firstly, I use the qualitative approach of focus groups to explore how young people use the Internet and their lack of engagement with climate change information online. The focus groups examine the sharing of climate change information and how that relates to information overload and junk information. Secondly, I use a quantitative experimental design to critically examine the causal relationship between differing types of Internet media stimuli on the participants reactions to climate change. The experimental design critically examines the impact of information overload and junk information upon participants' reactions to climate science. This research design has been developed using the information society analytical framework (see chapter 2) with questions.

This approach of mixed methods may appear that the research ontology and epistemology are in conflict. My research uses a constructivist ontology with focus groups being used to explore how young people view the Internet and whether they engage with climate change online, while using experiments to examine causation of differing information treatments which is a post-positive epistemology approach (See Crotty, 1998). Through the use of the information society there is an analytical framework that this research is seeking to examine with subsidiary themes for the focus group being deduced through the research findings. This provides greater context and also allows for the production of a strong ecologically valid experimental design (de Vaus, 2001). The causal focus of the experiments is a post-positive approach, as it seeks to understand the consequences of different climate change environments on young people (See de Vaus, 2001). However, these are not in conflict. This pragmatic approach allows for an in depth exploration of the consequences of the information society on young people with a qualitative approach building a wider understanding of the context and daily impact of the Internet while the quantitative approach allows

for examination of direct consequences of information overload and junk information.

This chapter is structured in three parts. Firstly, this section begins by briefly introducing the methods this research is using, along with why other approaches have been rejected, and the decision to use a mixed methodological approach. This is followed by a second section, which explains the rationale for the use of focus groups to explore how young people engage with and share climate change information, as well as the sampling approach used, and how the focus groups were conducted. Finally, this chapter justifies the selection of the experimental methodological approach while also explaining the research design used for the experiments. This section will also include how these experiments have been conducted and the sampling methodology employed.

4.1: Mixed methodological approach

The mixed methodological design enables a wider research scope (See Figures 4.1 and 4.2) and a more complete examination than simply using either a qualitative or quantitative method (Read and Marsh, 2002, Teddlie and Tashakkori, 2009, p. 7). The use of a qualitative methodological approach allows for the collection of rich data and enables an in-depth view on how participants view a topic within their social constructs (Bryman and Teevan, 2005, Have, 2004, Marvasti, 2004, Vanderstoep and Johnston, 2009). There are two possible interpretations of information overload. It could refer to two potential consequences with Shenk (1997) arguing that increased information increases stress and creates confusion, so potentially there is too much climate change information available, or the increased amount of information results in users becoming selective (See chapter 3) and filtering the topics and information they wish to receive (Bennett and Segerberg, 2011). The focus groups made it possible to select the most ecologically valid interpretation. The reveals that the latter with information competition resulting in selective behaviour (See chapter 5). The quantitative methodological approach of experiments have been selected as it has the benefit of being able to draw a causal link between exposure to climate change Internet media stimuli and reactions to climate science (See Bryman and Teevan, 2005, Vanderstoep and Johnston, 2009). To reduce the risk

of potential ethical issues in the use of both methods there was informed consent (See appendix A and B) with the right to leave the study at any point of the participant's choosing (de Vaus, 2001, Moses and Knutsen, 2012). The use of focus groups compliments the research conducted through the experimental method, as the qualitative research builds context. This qualitative approach, of focus groups informed the research design of the experimental methodological approach in particular by allowing for the exploration of the rapidly increasing media stimuli (information overload) on Internet users and how this has impacted engagement with climate change (Schumann, 2004, p. 241). This information will enable the experimental design to be more valid since it more accurately mimics information overload (see chapter 2) that the participants experience using the Internet. Through this research design I seek to answer the two key research questions (See chapter 1) and in particular, I have used these methods to answer the following subsidiary research questions (see Table 4.1):

Table 4-1: Subsidiary research questions explored by which method

Research Questions [RQ]	Subsidiary research questions [SRQ]	Question	Method
RQ1: How do Internet users engage with climate science and policy debates surrounding anthropogenic climate change?	SRQ1	*Context:* How do Internet users perceive their engagement with the Internet and connectivity?	Focus groups
	SRQ2	*Context:* Do users receive and engage with information about climate change through their Internet and social media usage?	Focus groups
	SRQ3	Sharing: How do Internet users share information with others?	Focus groups
RQ2: To what extent does online communication of climate change impact young peoples' understanding, perception of risk, and support for mitigation of climate change?	SRQ4	Information overload: Does the competition for the user's attention reduce the impact of climate change information on understanding climate science, perception of risk, and support for climate action?	Experiments
	SRQ5	Junk information: To what extent does information on climate change that contradicts the scientific consensus undermine public understanding of climate science or reduce perception of risk and support for action?	Experiments
	SRQ6	Information overload and junk Information: Does information that contradicts the scientific consensus have less of an impact on understanding, perception of risk, and support for action when there is competition for young people's attention?	Experiments

Figure 4-1: Methods address the following questions/hypotheses

Context: How do Internet users perceive their engagement with the Internet and connectivity?

Context: Do users receive and engage with information about climate change through their Internet and social media usage?

Sharing: How do Internet users share information with others?

Focus groups

Junk information: H1. Contradictory information from the scientific consensus reduces young people's understanding of climate science.

Junk information: H2. Climate sceptic material reduces young people's perception of risk that climate change poses to society and undermines their support for climate mitigation.

Information Overload: H3. Even with competition from differing topics in an information competitive environment the impact of climate change information on young peoples' understanding of climate science will improve.

Information Overload H4. Despite the increased amount of information the perception of risk that climate change poses to society and support for climate mitigation will improve.

Junk information and Information overload: H5. This effect is reduced when presented alongside other topics competing for the young people's attention.

Experimental design

Junk information and Information overload: H6, Junk information in an information competition environment does not reduce young people's perception of risk from climate change and does not undermine their support for climate mitigation.

[16] See also Table 4.4 for more information on hypotheses.

Figure 4-2: The literature review and focus groups have been used to develop the experimental treatments
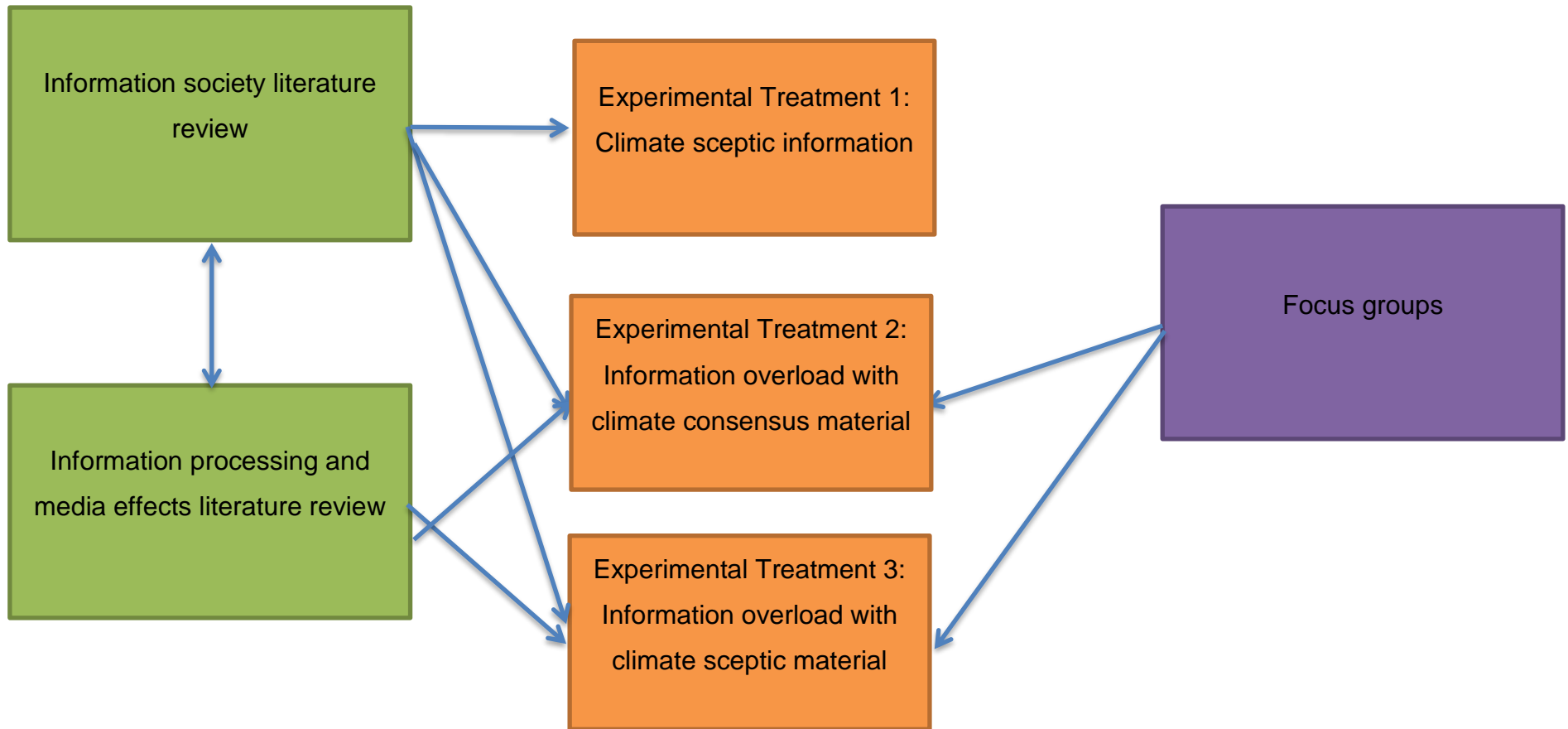
4.1.1: Ethical considerations

This mixed methods approach to my research had a series of ethical considerations. The participants were informed that they could withdraw from the study and given key information so they could give informed consent (See Appendix A and B). The focus groups transcription I made sure to remove any information that could establish the identity of the participants. This makes sure no harm or consequences for taking part in the focus groups as individuals cannot be identified (Bryman and Teevan, 2005). However, I had to be careful with the amount of information given to participants in the experiments, as there had to be clear information so participants could give informed consent but not enough to undermine the data collection. The consent form for the experiments (See appendix B) were clear about the procedure, but did not mention it was interested in climate change, as those in the information overload treatments would likely ignore the other environmental news stories and focus on the climate change ones. Also as the experiments were measuring scientific literacy there was no collection of personal demographic information to make sure the data remained completely anonymous.

4.2: Focus Groups

The focus groups seek to gather contextual data on engagement with and sharing of information about climate science through the use of two phases of focus groups. This approach has been chosen due to key advantages compared to both quantitative and other qualitative approaches. For example, the main advantage that a focus group approach has over face to face interviewing is the challenge of exploring the use of the Internet, which has become normalised in the participants' lives, but has a wide range of potential uses for engaging with information and entertainment (See chapter 1). A group discussion exploring their usage of the Internet and the interactions between themselves produces deeper understanding as they can question each other and build upon ideas mentioned by other participants (Bryman and Teevan, 2005). The qualitative approach of focus groups allows for the gathering of deeper understanding and context on how participants engage with climate change information and how they perceive the significance of the Internet in their lives. The group interaction aspect is argued by Bryman and Teevan (2005, p. 195) to have the benefit that participants

will question each other and produce "… more realistic accounts of what people think…" through discussion.

There is the potential risk with focus groups that quiet participants could have limited participation if there are louder members in the group which can take a greater amount of time (Bryman and Teevan, 2005, Bell, 2010). This requires the facilitator to keep the group well moderated to make sure all participants are able to contribute and to prevent the participants going off topic (Bryman and Teevan, 2005). The approach of focus groups does have the potential that the group can put pressure on participants to conform and can reduce the amount participants will disagree with each other or have an open discussion on socially unacceptable topics which would not be an issue in one to one interviews (Bryman and Teevan, 2005).

A key criticism of focus groups and more widely of qualitative research approaches is a lack of representativeness due to the small sample sizes (Reed and Payton, 1997, p. 766). Rather than produce representative data that can be generalised, the focus groups instead provide in-depth contextual information with interactions between members offering insights about the topic of interest that one would not be able to get through one to one interviews or quantitative approaches (Reed and Payton, 1997). For example, surveys can be used to collect representative data. However, the data on Internet use they gather is shallow with surveys, such as the British Household Panel Survey (n.d.-b, p. 19), which ask Internet related questions:

"Does your household have access to the internet from home?"

While survey questions of this nature provide information on household access to the Internet, they do not provide an insight on how the Internet is being used. The contextual information from focus groups is also greatly beneficial for reducing the inherent bias from my own experience of Internet and social media without the contextual evidence from interviews, my own Internet use might have undermined the internal validity of the experimental design. An important aspect of the Internet experience is personalisation (see chapter 3). Facebook is unclear how exactly it selects what to show its users and Google personalises search results based on browsing history (See Grant, 2009, Lee and Cranage, 2011, Sullivan, 2009).

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The focus groups were carried out using a semi-structured approach, as there is a risk that allowing open discussion would result in a large amount of information not being on topic with important aspects not being covered (Bryman and Teevan, 2005). At the same time, enough structure is required to maintain understanding of the questions being asked, but without intervention undermining the flow of discussions. Therefore, a semi-structured approach was used with the facilitator only interrupting discussion to move on to the next question, to pick up on points of interest that may not have been picked up on by other participants, and to refocus discussion when the participants go off topic (Bryman and Teevan, 2005).

Participants were selected by convenience sampling. Convenience sampling is the selection of participants who are accessible, but in this case selection of participants is also based upon purpose as well as convenience as the research design is interested in young peoples' use of the Internet (Marshall, 1996). Five focus groups took place, with a mixture of undergraduate and postgraduate students from a range of courses (See Table 4.2). These were conducted in two stages, with the first stage groups used to develop the second stage groups (See Appendix C and Appendix D). There was no significant climate related events or coverage in between the two stages of focus groups with no major climate change events causing a spike in media coverage found using a Lexis Nexis search. All focus groups have been used in the analysis. The first two focus groups were run with large groups that provided some key insights and were used to help refine the questions for the final three focus groups. Therefore, the participants that were recruited for the first two focus groups were politics undergraduates as they are accessible and meet the theoretical interests of the study with their use of the Internet being among frequent Internet users (as discussed in chapter 2). The other three focus groups were conducted with smaller groups of young people from a diverse range of university courses. Overall, five focus groups were run with a total of 37 participants.

Table 4-2: Focus group participants

Focus group	Stage	Date	Number of participants	Courses the students were studying
FG1	Stage one	March, 2015	11	Politics
FG2	Stage one	March, 2015	12	Politics
FG3	Stage two	April. 2015	6	Politics, music, film studies, and biology
FG4	Stage two	April, 2015	4	Politics
FG5	Stage two	April, 2015	4	History and biology

The stage two focus groups that followed were also recruited through convenience sampling and snowball sampling. Snowball sampling is common in qualitative research as it allows for participants to be found within the scope of the researcher's interests (Devine, 2002, p. 205). The use of the snowball sampling method meant that the participants selected were still students, but allowed for a wider sample of the young Internet users targeted for this research. While the limited sample means that results cannot be generalised to a wider portion of society, the use of students in the focus groups provides a valuable insight into young people's engagement with climate change information and helps provide a more accurate representation of the Internet in the experimental designs.

The focus groups were conducted in an appropriate room for the number of participants and also a quiet environment for recording the sessions. The recording of the focus groups has been completed through the use of two Dictaphones. The use of two Dictaphones meant there was no need to take notes of what the participants said during the focus groups. Note taking is argued by Bryman and Teevan (2005) to be too disruptive. During the start of each of the focus groups there is a brief introduction to the research and a consent form is

handed out to each participant and completed by every participant. The focus groups included prompts to help focus the discussion.

4.2.1: Transcription and analysis

The focus groups were transcribed using the following transcription conventions:

I – Interviewer

P- Participants are numbered in the transcription.

AP – all or majority of participants

? - Unclear who the speaker is

?? - Unclear who the speaker is but most likely a different speaker from the previous unknown line above.

// - Indicates overlap from previous speaker.

** indicates noises such as general murmuring of agreement or laughter**

[Removed] - used to remove personal details that could compromises anonymity of a participant or participants

The transcription conventions are important as they standardise the style and the level of detail in all focus group transcriptions (Hennink, 2010). This research is not particularly interested in a detailed content analysis on how the information is communicated by the participants, which means that there is not a high level of detail in the transcriptions. I omitted pauses and fillers, like 'ums' from the transcript (Eros, 2014). Overlap and general group reactions have been recorded. These transcriptions were then coded into key themes of both how the Internet is used and engagement with climate change. The four theoretical themes of interest, are also split into subsidiary themes that the focus group transcripts have been coded into (See chapter 5). The subsidiary themes were formed inductively while the main themes reflect the context of the Internet on the lives of the participants and the other three are from the information society framework used in this analysis.

4.3: The experimental method

The experimental method has been selected for this study as it is an ideal methodology for examining causation as it is designed to focus on an independent variable upon a dependant outcome while the other variables are removed (de Vaus, 2001, Stoker and John, 2009, Stoker, 2010, Moses and Knutsen, 2012). A key aspect that this research seeks to examine is the consequences of information overload and also critically examining the impact of junk information upon participants' reaction to climate change. To establish causation the basic experimental design uses a control group and a test group influenced by the independent variable allowing for the two groups to be compared (Lijphart, 1971, Moses and Knutsen, 2012, de Vaus, 2001). There has been a growing popularity of this methodology. In particular, economic research has embraced the experimental method to examine behaviour to test economic theories (Smith, 1994).

This method is central to the hard sciences, such as biology, but is a more recent development in social science research (McDermott, 2002, Stoker, 2010). Lijphart (1971, p. 683) states that:

> "The experimental method, in its simplest form, uses two equivalent groups, one of which (the experimental group) is exposed to a stimulus while the other (the control group) is not. The two groups are then compared, and any difference can be attributed to the stimulus."

Through the control of other factors (e.g. scientific literacy) we can determine whether the stimulus is the causal factor (de Vaus, 2001). This makes the experimental method particularly good for testing theories in practice which has been used in behavioural economic research (Smith, 1994). It is necessary to carefully design the experiment to have strong internal validity (Loewenstein, 1999). Strong internal validity is important to maintain as the interest is in the impact of the stimulus given to the treatment groups and this cannot be presumed if the researcher does not factor in potential external events or even a failure to randomly assign participants to treatment groups (Loewenstein, 1999). Presuming the internal validity is strong then the experimental method is excellent at establishing causal links between variables and enables statistical analysis of

the results that can be compared to examine the impact of a stimuli (Bryman and Teevan, 2005, de Vaus, 2001). The experiment used a controlled environment with computers unable to access the Internet so the participants could only engage with the media stimuli provided.

The experimental method is not often used in social science for practical and ethical reasons (de Vaus, 2001, Moses and Knutsen, 2012). Firstly, the experimental method has practical limitations in certain types of social science research as social scientists do not have access to influence government policies or institutions to examine large variables such as economic development (Green and Gerber, 2003, Stoker, 2010). Instead the experimental method requires a reductionist approach that seeks to reduce the area of interest to a certain variable of interest (de Vaus, 2001). Through this reductionist approach there can be examination of a variable while the control allows for direct causal inference, as long as the experiment has been carried out correctly to prevent loss of internal validity (Loewenstein, 1999). However, a consequence of this reductionist approach is the issue that external validity is lost as the setting of the experiment is artificial so the ability to generalise the findings can be questionable (de Vaus, 2001). This is why focus groups were conducted to make the media stimuli more realistic as it better reflected competition with other topics.

The artificial reality of the laboratory experiment has a key advantage, which means that there is greater internal validity, as there is the removal of external variables that could alter the impact of the treatment on participants (Bryman and Teevan, 2005, p. 31). The laboratory experiment gives control over the allocation of participants and the strength of the experimental method is random allocation of participants to treatment and control groups (de Vaus, 2001, p. 70). Random allocation of participants has the benefit of making "… the groups comparable in all respects with regard to the experimental variable" (de Vaus, 2001, p. 70). The groups need to be carefully run and requires careful measurement of the variables of interest to maintain both the internal and external validity of the experiment (McDermott, 2011, p. 35). Secondly, there are ethical issues with potential harm to participants and with "… intervening in the running of political democratic processes and institutions for the purposes of experimentation…" (Stoker, 2010, p. 303, see also de Vaus, 2001, Moses and Knutsen, 2012). Harm can be reduced with the experimenter making sure all data

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is anonymised and that the participants are never lied to or feel deceived. The experiment participants were informed of anonymous data collection and gave informed consent (see Appendix B).

However, the experimental method has allowed for the collection of empirical data from the treatment groups with results that can establish a causal link to the impact of a media treatment on participants' reactions to climate change information, which can be generalized over a larger population (de Vaus, 2001). Therefore, the focus of this research is not limited by the practical limitations. This is also not limited by ethical issues as this research uses informed consent and does not seek to mislead participants. There is one potential issue with informed consent forms. Disclosing too much information on what the goals of the experiment are to the participants in a study of behaviour can risk the participants conforming to expectations and resulting in the study being invalid (de Vaus, 2001). To avoid the potential of participants conforming and undermining the validity, this research gives the minimum necessary information to participants on the consent forms at the beginning of the experiment for informed consent (de Vaus, 2001). The participants had the opportunity to opt into receiving a debrief of the research findings (de Vaus, 2001).

Participants were university students from a range of undergraduate and postgraduate courses from a variety of university campuses (the University of Exeter and the University of Southampton). They were carefully vetted to be aged 18 to 25. The use of students is common in politics experiments with papers published "… from 1990 through 2006, one fourth of experimental articles in general political science journals relied on student subjects, whereas more than seventy percent did so in more specialized journals" (Druckman and Kam, 2011, p. 42). An example of an experiment exploring the impact of the media on the perception of the certainty of climate science was carried out by Corbett and Durfee (2004) with a 209 students. They were split into three treatment groups with 54 receiving climate change information, 51 receiving controversial material, and another 51 receiving both controversial and consensus with 53 in the control (Corbett and Durfee, 2004, p. 139).They found that controversy focused media articles resulted in a decline of the participants' certainty of climate science, but the researchers highlight that the use of students means they are reluctant to

generalise the results to a wider population (Corbett and Durfee, 2004, p. 142). The use of students as participants is highlighted by McDermott (2011, p. 36) to be seen as a risk to external validity of the experiment as a result of the narrow sample population, in particular the use of students could undermine generalisation of results.

Despite the reluctance by Corbett and Durfee (2004) to generalise their results due to the use of students, it is important to note that the use of students has been defended in political research. For example, Druckman and Kam (2011, p. 51) argue that student and non-student populations do not significantly differ:

> "… when it comes to partisanship (we find this for partisan direction and intensity), ideology, importance of religion, belief in limited government, views about homosexuality as a way of life, contributions of immigrants to society, social trust, degree of following and discussing politics, and overall media use."

Due to the similarity of students and non-students, there is a limited impact that students have on external validity. The similarities particularly in media use and political engagement mean that students are viable for examining the casual impact of media exposure on their perceptions of climate change. University students are also meet also in the target study group of young people.

The decision to study young people is due to previous research that suggests that technological advancements and electronic communication have become normalised in the lives of young people (Eynon and Malmberg, 2011). The spread of technology can be seen in the adoption of social media with the average age shifting "… from 33 in 2008 to 38 in 2010" as a wider range of society adopt the technology (Hampton et al., 2011a, p. 3). Therefore, the impact that information overload and junk information has on the understanding of climate change science upon Internet users can be generalised to a wider portion of society as information technology is more widely normalised and adopted by a wider user base.

The sampling is a convenience approach as undergraduate students are within the theoretical interests of this study and they are accessible. Participants were randomly assigned to one of the treatment groups or the control group. These experiments had 183 participants in total that were split between three

treatment groups and the control (See Table 4.3). The participants were randomly assigned to either one of the treatment groups or the control group. Additional participants for the control were collected using an online survey due to difficulties in recruiting an adequate sample size. So as to not violate the assumption of random selection the control and treatment groups were then weighted using propensity scoring[17] to ensure matching between samples.

Table 4-3: Number of participants

Group	Number of participants
Control	81
Junk information	33
Information overload	34
Information overload and junk information	35
Total	183

These were collected over a series of sessions due to difficulties recruiting participant numbers with Two data collection sessions on Penryn campus on the 27th January and the 16th March 2016, Streatham campus on the 26th February, and the final experiments were run on the 5th May at the University of Southampton. An additional online survey was run shortly following the Southampton data to increase control data. Initially the media stimuli were selected from within the week previously from the first data collection on Penryn campus, but due to the lack of participants the same media stimuli was used for all experiments with no major spike in climate change coverage between January 2016, and May, 2016.

The experiment was run with three treatments and a control. Each of the treatment samples were randomly given one of the three media stimuli. If they were in a treatment group they either received climate sceptic information, climate consensus with competition for user attention, and junk information with competition for user attention. The control received no media stimuli. The design of this experiment meant that sharing could not be examined as to keep strong

[17] Propensity scoring is discussed in a later section on the analysis of the experimental results.

internal validity the experiments were run in a controlled self-contained environment. They could have shared in what was in the self-contained environment among each other, if a different design approach was taken, but that would not have captured how people share in real life as the focus groups illustrated that they share infotainment not climate change information. There was additional control data collected using an online survey. The control group allows for comparison of the impact of the media stimuli upon public understanding and perceptions of climate change.

The media stimulus consists of a range of online newspaper articles and blog posts selected based upon treatment type. Identifying information for each media stimulus was removed so the source and type (blog or newspaper article) was not given to participants so they could only judge based on content rather than where the source originated from. The experiment was computerised using Excel and self-administered by the participants' in a controlled environment with the exception of the additional survey data collected for the control (See Figure 4.3). The participants had a controlled environment in Excel with the use of macros saving the data, moving them on to the next section, and they could not freely move around the Excel document[18]. The participants started at the welcome screen and when they pressed the 'start' button they were moved to the excel sheet with the scientific literacy questions. These scientific literacy questions were used for control variables. Following the completion of the scientific literacy questions, the excel document would move them on to the next section depending which version of excel document they were started on (randomly put in either a treatment or the control). Those in a treatment group were then moved onto the screen with PDF versions of articles hyperlinked to the work book. Those who were in the control were taken straight to the climate change questions and after 10 to 20 minutes those in the treatment groups moved onto them. These questions were asked after the media stimuli due to the interest in exploring information overload. If participants were presented with climate change questions then shown climate change information in competition with other environmental issues it would have changed how the participants engaged

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[18] The use of macros in Excel and the screens seen by the participants are detailed later in this chapter

with the information as the purpose of the study is made clear to them. After completing the climate change questions, all participants were moved onto the final questions with the participant survey and once that was finished a thank you message (the Excel Workbook then saved and closed itself).

Figure 4-3: Computerised experimental design
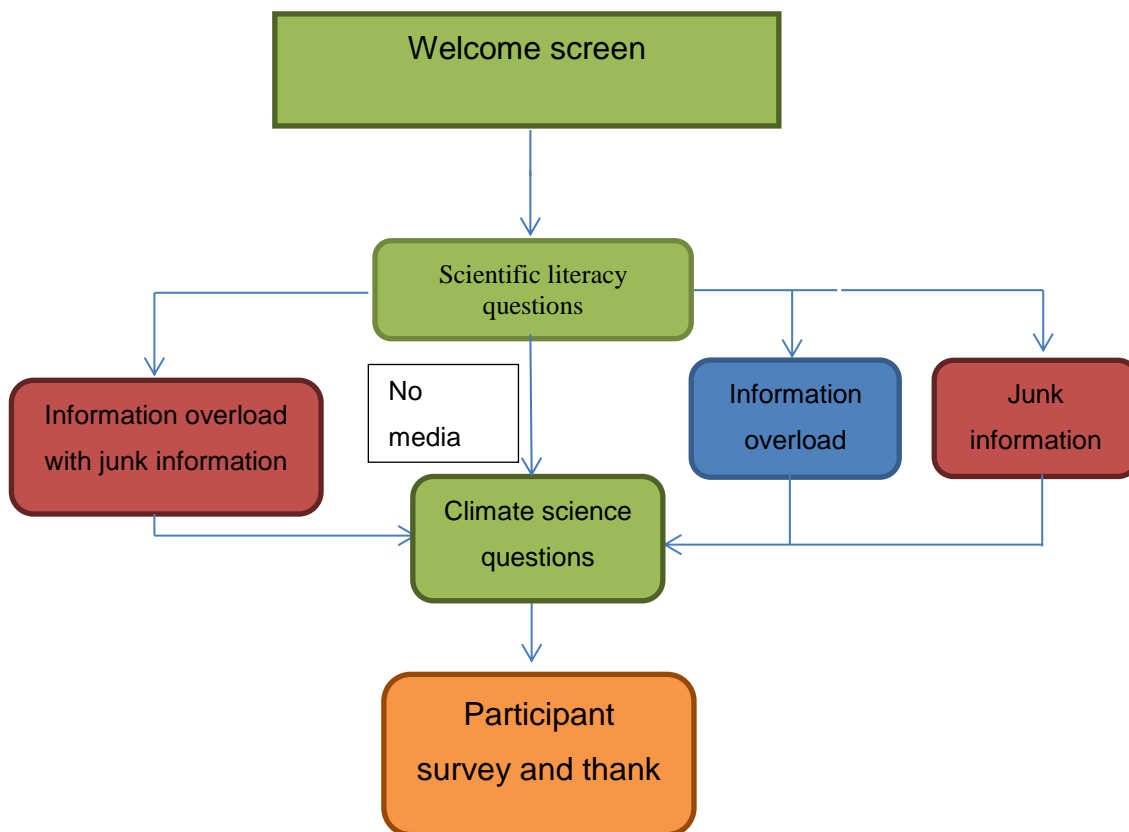
Excel has been chosen for this experiment to produce the controlled environment requirement. I organised a shared IT account that had no Internet access so the data collection for the treatment groups would not require Internet access. Excel was also on all the computers available without having to organise specialist software to be installed on each of the computers used. Additionally I could control what the participants saw with settings within Excel. For example, the use of Macros to hide sheets and move the participants between Excel sheets meant that participants could not freely move around the Excel Workbook (See Figure 4.4). These macros enabled me to check that all questions were answered by participants and automatically saved the Excel Workbook between the sets of questions to make sure there was no risk of losing data from computer or software

crashes (See Figure 4.5). The 'thank you for participating' sheet included a macro that saved and closed the Excel Workbook (See Figure 4.6). As well as the control of the participants' experience in the experiment, the use of Excel allowed for the collection of both multiple choice and open survey questions. It also enabled participants to engage with offline media stimuli (that mimicked online media), which was stored as PDFs and accessed through hyperlinked images (See Figure 4.7).

Figure 4-4: Welcome screen start button macro

```vba
Sub GP1A()
'
' Group 1 (Control) Move from Welcome screen
'
'
    Application.ScreenUpdating = False
    Sheets("Q97").Visible = True
    Sheets("Welcome").Visible = False
    Sheets("Q97").Select
    Range("F2").Select
    Application.ScreenUpdating = True

End Sub
```

Note: This macro simply moves the participant from the welcome screen to the scientific literacy questions while hiding the welcome screen sheet from the participants' view.

Figure 4-5: Macro for the scientific literacy questions continue button

```vb
Sub GP1B()
'
' Group 1 (Control) Validate Pre questions, Save & Move to CC questions
'
Application.ScreenUpdating = False

Sheets("Q97").Select

Dim score As Integer, result As String
score = Range("M1").Value


    Sheets("Q97").Select
        If score >= 0.1 Then
            Sheets("Q97").Select
            Range("F2").Select
            MsgBox "You must answer All the questions before continuing."

        Else:
            Sheets("Q54").Visible = True
            Sheets("Q97").Visible = False
            Sheets("Q54").Select
            Range("F2").Select

        End If

ActiveWorkbook.Save

Application.ScreenUpdating = True
```

Note: This macro checked that all the scientific literacy questions had been answered by the participants. If questions had not been answered it would bring up an error message and if they had it would move them onto the next sheet, in this case the sheet with climate change questions as this was the control group.

Figure 4-6: ' Thank you for participating' sheet exit macro

```vb
Sub GP1Z()
'
' Saves and closes active workbook

Application.ScreenUpdating = False
Sheets("Welcome").Visible = True
Sheets("Leaving").Visible = False
ActiveWorkbook.Save
ActiveWorkbook.Close
'

End Sub
```

Note: This macro simply saves, resets the view to the welcome screen for the next time the workbook is opened, and closes the workbook.

Figure 4-7: Media stimuli from junk information treatment group

Each image is hyperlinked to the PDF article and participants could click through to each. The design was meant to mimic the appearance of social media displays. The order of the articles was randomised for each participant.

At the beginning of the experiment all participants saw a welcoming screen (See Figure 4.8). Participants were then taken to the first set of questions that measured their scientific literacy (See Figure 4.9). The measuring of scientific literacy is important to gauge the level of science understanding the participants have. Allocation to the treatment group is random, but if a group has a high amount of individuals who are scientifically literate then they could potentially skew results as they may simply ignore climate change information that contradicts the scientific consensus. There were some participants in the control not randomly selected. With the need to increase the sample size. They answered the computerised survey matching the treatment groups to the additional research participants meant that these did not skew the results.

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Figure 4-8: Experiment welcome screen
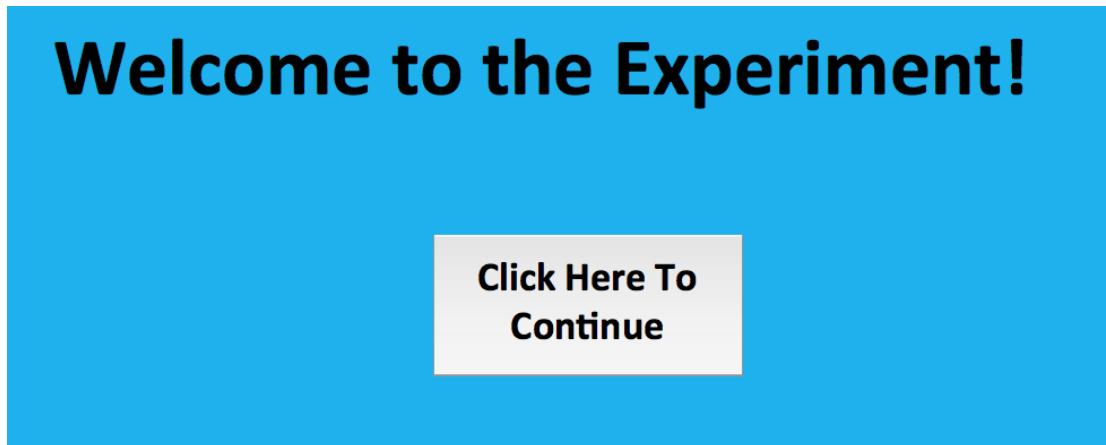
Note: This welcome screen meant that all participants began the experiment at the same time.

Figure 4-9: Scientific literacy questions

Number	Question	Answer
1	The center of the Earth is very hot (True or False).	
2	The continents have been moving their location for millions of years and will continue to move (True or False).	
3	Lasers work by focusing sound waves (True or False).	
4	All radioactivity is man made (True or False)	
5	Electrons are smaller than atoms. (True or False)	
6	Does the Earth go round the sun, or does the sun go around the Earth?	
7	It is the father's gene that decides whether the baby is a boy or a girl. (True or False)	
8	Antibiotics kill viruses as well as bacteria (True or False)	
9	Human beings, as we know them today, developed from earilier species of animal (True or False)	
10	Would you say that astrology is very scientific, sort of scientific, or not at all scientific?	
11	A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness. (1) Does this mean that if their first child has the illness, the next three will not?	
12	(2) Does this mean that each of the couple's children will have the same risk of suffering from the illness?	
13	Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? (Scientist 1 or scientist 2?)	
14	Why is it better to test the drug this way?	
15	When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms. First, some articles refer to the results of a scientific study. When you read or hear the term scientific study, do you have a clear understanding of what it means, a general sense of what it means, or little understanding of what it means?	
16	In your own words, could you tell me what it means to study something scientifically?	

Click Here To Continue

Note: Questions 1 to 12 and question 15 are all multiple choice that participants could select from a drop down menu while questions 14 and 16 were open questions. The coding for these can be found in Appendix F. The open questions were coded as 1 if the participant showed clear understanding with correct use of terminology or a general sense where they correctly described, for example the experimental method, but did not use the correct terminology. If not the open question would be scored as 0.

4.3.1: Control variables

The measurement of scientific literacy is debated by academics. For example, factual knowledge is viewed as important by Durant et al. (1989) in measuring scientific literacy while in contrast Ryder (2001) argues the understanding of the scientific method is more important for efficient public engagement (See chapter 3). The scientific literacy questions provide control variables in my models. They include tests of basic knowledge of both biology and physical sciences, and the participants understanding of probability, the experimental method, and whether they knew what it means to study something scientifically. It also tests to see if they can reject pseudoscience. The participants are given scores on the number of correct answers (See Appendix F).

The concept of scientific literacy (see chapter 3) is an adaption of the basic concept of literacy, the ability to read and write, to be applied to the ability to read and understand science reporting (Miller, 1998). However, to compare scientific literacy to the basic concept of literacy is a simplistic and broad approach as "… scientific literacy might include everything from reading the label on a package of food, to repairing an automobile, to reading about the newest images from the Hubble telescope" (Miller, 1998, p. 204). The Organisation for Economic Co-operation and Development (2003) argue "… that people cannot be classified as either scientifically literate or not literate" (National Science Board, 2014, p. 7-20). Therefore, key aspects of this concept have been operationalised into control variables for the experiment, as these provide a key insight into scientific knowledge of the participants' that could influence the results of the experimental treatments.

These scientific literacy control variables measured three key factors of scientific literacy. The first key factor is basic knowledge of science that includes both biological and physical sciences. The approach of measuring the basic knowledge of scientific concepts has been one of the key aspects of measuring scientific literacy. Basic knowledge of science is measured through a short series of mostly true and false questions. These questions have been used in the US survey by the National Science Board (2014, p. 7-22) which included questions on both the physical sciences, such as "All radioactivity is man-made", and biological sciences "Antibiotics kill viruses as well as bacteria". Through the use

of a limited number of these questions it has enabled the measurement of basic knowledge of both the physical and biological sciences.

This approach of basic knowledge included in scientific literacy tests is argued by Bauer (2009, p. 223) to be a fundamental problem. This problem is argued by Ryder (2001, p. 36) that it does not measure scientific literacy as public critical engagement with science requires understanding of scientific methodology rather than basic 'textbook' scientific knowledge. There are limitations with the measuring of basic knowledge, as it does not inherently give a picture of whether they understand science, but instead shows only if they have basic 'textbook' knowledge. The limited nature of these questions means that National Science Board (2014, p. 7-22) highlight that while the questions are "… keyed to knowledge taught in schools, generalisations about Americans' knowledge of science should be made cautiously". Despite limitations, these questions have been incorporated into my scientific literacy test because they offer an insight into the participants' pre-existing basic knowledge of science. Overall, the inclusion of basic scientific knowledge is included in my scientific literacy tests due to such questions offering an interesting insight of pre-established knowledge of the participants. However, individual questions are not particularly helpful. Instead grouping them into biological and physical science indexes gives an idea of the participants' pre-existing basic knowledge in each field (See National Science Board, 2014)

The second key factor used in measuring scientific literacy examines the participants' understanding of scientific processes. Measuring the understanding of scientific processes focuses upon questions that give a control variables giving the treatments scores for the understanding of probability, understanding the experimental method, and if they know what it means to study something scientifically. Understanding of probability is significant to measuring scientific literacy as probability is presented to the public in science reporting (Miller, 2004, p. 278). Another key aspect to understanding science reporting in the media is the concept of experiments, which is often used to frame scientific research to the public with the presumption that the public understand the nature of experiments (Miller, 2004, p. 277). Alongside these key concepts to understanding the scientific method there is also the additional examination of

whether there is understanding of what it means to do a scientific study (Miller, 2004, p. 275).

The understanding of probability is important for the public to understand as Miller (2004, p. 278) argues that "probability underlies all inferential statistics, and the results of a wide array of scientific research presented to the public… in terms of statistical reliability of the results". The surveys conducted in the US by National Science Board (2014, p. 7-24) used the survey questions:

"A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness. (1) Does this mean that if their first child has the illness, the next three will not have the illness? (No); and (2) Does this mean that each of the couple's children will have the same risk of suffering from the illness? (Yes)"

If these questions were correctly answered then the survey respondent was classified as understanding probability.

The National Science Board (2014, p. 7-24) measures experimental understanding with two questions. The first using the following statement and giving a choice between the two research designs:

"Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug?"

A fundamental problem with relying on this question alone would be the presumption that participants have selected the correct method due to understanding that control groups are a key aspect of the experimental method. Instead, Miller (2004, p. 277) found that this question received an emotive response with most respondents correctly choosing the experimental design due to less people being potentially harmed by the drug test. Therefore, to test whether or not the participant has chosen the correct experimental design due to

understanding the importance of the control group there is a second question. This question is an open question: "Why is it better to test the drug this way?" This second question enables measurement of whether there is understanding of the experimental method or not. This was coded in the experimental design (See Appendix F) as a score of 1 if the response to the open question was correct either using the correct terminology, for example referring correctly to treatment and control groups, or broadly describing the experimental method without the standard terminology, for example with descriptions of comparative study. To be classified as understanding the experimental method the participant was required to correctly select the closed question with scientist 2 running an experiment with a treatment and a control group, and also being judged as having a clear understanding or a general sense of the meaning of the experimental method in the open question.

The understanding of scientific study is measured in the surveys by National Science Board (2014) through the use of two questions. The first question is a multiple choice and asks:

"When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms. First, some articles refer to the results of a scientific study. When you read or hear the term scientific study, do you have a clear understanding of what it means, a general sense of what it means, or little understanding of what it means?"

This question seeks to gauge whether the participants are confident in whether they think they understand the term 'scientific study' with a multiple-choice response with the correct answers being 'a clear understanding' or 'general sense'. These participants were then tested with the following open question: "In your own words, could you tell me what it means to study something scientifically?" This question was used to examine whether the participants knew that scientific studies seek to test hypotheses or show awareness of systematic comparison. A score of 1 (See Appendix F) is given if the participant demonstrates either 'a clear understanding', where they demonstrate a clear understanding of the answer with accurate terminology, or ''a general sense', where they demonstrate understanding of the concept but do not use correct

terminology. To be given a score of 1 for the understanding of scientific study correctly answering this open question or the open question for understanding the experimental method and being judged as understanding statistics. Scientific study is a more complex variable as it requires understanding of aspects of both statistics and the experimental method. Overall, these questions enabled three control variables to measure the understanding of the scientific methods between the experimental groups.

The final aspect of scientific literacy tests have included whether or not participants in surveys reject pseudoscience. Pseudoscience claims attempt to appear scientific when they are not plausible or have evidence to support the claims (Pena and Paco, 2004, p. 1). The rejection of pseudoscience is seen as an important indicator to whether the public can distinguish science from fake claims. This is used in the National Science Board (2014, p. 7-25) surveys which asks whether astrology was 'scientific', 'not very scientific' or 'not scientific at all'. The issue with belief in pseudoscience is highlighted by Pena and Paco (2004, p. 6) to often be viewed as a public expression of "… ignorance about the underlying philosophy and methodology of science…". The rejection of pseudoscience is the final control variable.

Therefore, by using these control variables it enables the removal of the confounding factors of previous scientific knowledge and scientific understanding. This allows for the impact of the experimental treatments to be accurately measured. The experimental treatments will be discussed in the following section.

4.3.2: Experimental treatment groups

Following the scientific literacy test the three treatment groups (See Table 4.4) were provided with a series of online newspaper articles and blog posts. Video and image memes have not been included in the experimental treatments. Videos added an additional practical issue with both having to provide headphones for each user and massively increasing the hard drive space required to be preloaded onto the computers. Image memes would have also required additional space but instead they are normally simplistic messages (See

chapter 3) and the focus groups found them untrustworthy despite being a shared aspect of the Internet experience (Chapter 5). The identifying information of the origin or each of the articles will be removed to reduce self-selection bias based upon the source the article is from. The order of the articles is randomised for each participant. The participants were recommended spending no more than twenty minutes on this section of the experiment. The articles each of the participants received depended on the treatment group they had been assigned. The junk information treatment group received six climate sceptic articles. While junk information and information overload treatment received the same climate sceptic articles they were also mixed with six articles on genetically modified organisms and six articles about the impact of pesticides on bees. The information overload receives six climate change articles from the climate consensus perspective that is also in competition with the additional environmental news stories.

Table 4-4: Treatment groups

	Climate change consensus media	Climate sceptic media (Junk information)
Climate change only (There is no information competition)	This is not tested as this research is interested in the consequences of information overload and junk information. The three treatments are contrasted to the control group to examine the impact of the media stimuli.	This treatment receives only information that contradicts the scientific consensus from climate sceptic sources. The information they receive will be six articles from newspapers and blogs.
Hypotheses	N/A	*H1. Contradictory information from the scientific consensus reduces young people's understanding of climate science.* *H2. Climate sceptic material reduces young people's perception of risk that climate change poses to society and undermines their support for climate mitigation.*
Information competition with other environmental topics (Information overload)	This treatment receives only information that is from the scientific consensus of climate change. The six climate consensus articles are in competition with six articles about genetically modified organisms and six articles about pesticides. This is due to both of these also being environmental issues facing society.	This treatment receives only information that contradicts the scientific consensus from climate sceptic sources. The six climate sceptic articles are in competition with six articles about genetically modified organisms and six articles about pesticides.
Hypotheses	*H3. Even with competition from differing topics in an information competitive environment the impact of climate change information on young peoples' understanding of climate science will improve.* *H4. Despite the increased amount of information the perception of risk that climate change poses to society and support for climate mitigation will improve.*	*H5. This effect is reduced when presented alongside other topics competing for the young people's attention* *H6: Junk information in an information competition environment does not reduce young people's perception of risk from climate change and does not undermine their support for climate mitigation.*

The first treatment group will received six climate sceptic articles from climate sceptic sources (See table 4.5). This treatment is compared to the control and was expected to have a lower understanding of climate science, weaker perception of risk, and worse attitudes to taking action to mitigate climate change. This expected result is tested by hypothesis H1 and H2:

H1. Contradictory information from the scientific consensus reduces young people's understanding of climate science.

H2. Climate sceptic material reduces young people's perception of risk that climate change poses to society and undermines their support for climate mitigation.

Junk information shared online (See chapter 2) can create doubt in climate science, not only potentially undermining public understanding, but also the potential for the perception of risk to be reduced and undermining public pressure for action (See chapter 3).

Table 4-5: Climate sceptic articles

Article name	Type of source	Description of content
'Is global warming a hoax'	Website	Claims global warming is a hoax. Uses a common sceptic claim of global cooling trends and argues that climate change is a conspiracy by the government.
'Horrible new threat from global warming – fewer pearl necklaces (or not)'	Website – blog *'Watts Up With That?'*	This is a short article that criticises researchers as using climate change as "lip service to justify a grant" while also claiming that rising ocean temperatures mean that ocean acidification is not a significant environmental impact on marine animals.
'If the UK were to try and achieve COP21 ideas – hold on to your hats!'	Website – blog *'Watts Up With That?'*	This article attacks COP21 for apparently suggesting the move from gas powered household heating to electric heating. The article claims that the moving from gas household heating would require 250 coal power stations or 1.5 million wind turbines.
'2015 Global Temp, Or How Some Scientists Deliberately Mistook Weather For Climate'	Website – *'Climate Change Dispatch'*	This article claims that global warming is not taking place. Instead the article suggests record breaking temperatures to be due to the El Niño effect and therefore, warming has not occurred as it was an "truly exceptional year for weather, and for misleading press releases."
'Base policies on reality, not deceit'	Website – *'Climate Change Dispatch'*	This is another article claiming that climate change is a conspiracy to benefit the ruling elite and mislead the public with the funding of 'one-sided research' to reject 'reliable' fossil fuels.
'How geological forces are behind the 'Warmest Year Ever''	Website – *'Climate Change Dispatch'*	This article claims that global warming is not taking place and there has been no real temperature increase. Instead this argues that the public are being misinformed by propaganda when the real cause is the El Niño effect rather than greenhouse gas emissions.

Sources: (WhoReallyKnows, 2016, Watts, 2016, Foster, 2016, Whitehouse, 2016, Driessen, 2016, Kamis, 2016)

The second experimental treatment group receives articles (See Table 4.7) that support the scientific consensus of anthropogenic climate change. In addition they also receive articles on pesticides and genetically modified organisms as the Internet has resulted in competition for the users' attention (See chapter 2) while climate change also struggles to get attention due to other environmental issues competing for the publics' attention (see chapter 3). The focus group explored whether they engaged with climate change information and found that information overload was experienced as competition for attention rather than too much information about climate change (see chapter 5). Therefore, to test the impact of climate change information in a high information environment, there has been six consensus articles (See Table 4.6) with twelve other environmental science stories competing for the participants' attention (See Table 4.7).

The results will test the hypotheses H3 and H4:

H3. The competition from differing topics in an information rich environment undermines the impact of climate change information on young people's understanding of climate science.

H4. The competition from other topics reduces the perception of risk that climate change poses to society and reduces support for climate mitigation.

Table 4-6: Climate consensus articles

Article name	Type of source	Description of content
'Record hot years near impossible without manmade climate change – study'	Newspaper – The Guardian	This article focuses on the recent record-breaking temperature and a recent scientific study reinforcing human activity as the driving cause.
'Snow blindness The Republicans and climate change'	Magazine – The Economist	This article discusses the confusion of weather with climate demonstrated by a US Republican Senator and a wider focus on climate denial in the Republican party.
'In Greenland, a climate change mystery with clues written in water and stone	Website	This article discusses the melting of the Greenland ice sheet with a particular focus on the research being conducted in the region and warning of the risk of large sea level rise that climate change is causing
'Lake Poopo: Bolivia's second largest lake dries up due to climate change, displacing thousands of people'	Newspaper – The Independent	The focus of this article is on the disappearance of Lake Poopo in Bolivia and the consequences of climate change to water resources.
'Why are some British newspapers still denying climate change?'	Newspaper – The Guardian	This article is critical of other UK newspapers for failing to adequately communicate the climate consensus to the public.
'How Likely Is The Observed Recent Warmth?'	Website – Realclimate	This is another article discussing the recent warming trends, but focuses on the likelihood that the trend in warming has been caused by humans with a clear message that with high confidence the observed warming is due to human activity.

Sources: (Carrington, 2016, The Economist, 2016, Daniel, 2016, Mortimer, 2016, Ward, 2016, RealClimate, 2016)

Table 4-7: Competing environmental science articles

Article name	Type of source	Environmental issue focused on
'EPA study shows neonicotinoid pesticides really are killing off honeybees'	Website	Impact of pesticides on Bees
'Ontario, Canada admits pesticides are killing mass amounts of bees. here's what they're doing about it'	Website	Impact of pesticides on Bees
'German Supermarket Chain Bans Bee-Killing Neonic Pesticides On Produce'	Website	Impact of pesticides on Bees
'Millions of bees turning up dead around GMO corn fields soaked with neonicotinoid pesticides'	Website	Impact of pesticides on Bees
'EPA's first neonicotinoid assessment finds risk to honey bees'	Website	Impact of pesticides on Bees
'EPA releases phase one neonic testing results'	Website	Impact of pesticides on Bees
'Genetically-modified Fuji apple could be on tables soon'	Newspaper	Genetically Modified Organisms
'Zika Virus Could Stir Demand for GM Mosquitoes'	Website	Genetically Modified Organisms
'Brazil's Zika virus could be tackled with genetically modified mosquitoes'	Newspaper	Genetically Modified Organisms
'EU fires pro-GMO scientific adviser who wanted to deny nations the right to ban GMOs'	Website	Genetically Modified Organisms
'How The TPP Could Lead To More Global Trade Of GMOs'	Website	Genetically Modified Organisms
'CBS Morning Show Runs Heavily Biased Segment on GMOs'	Website	Genetically Modified Organisms

Sources: (Reynolds, 2016, Walia, 2016, Sarich, 2016, Gutierrez, 2016, Thomas, 2016, Davies, 2016, Irwin, 2016, Regalado, 2016, The Guardian, 2016a, Heyes, 2016, Husted, 2016, Meyer, 2016)

This treatment group is sought to determine whether there was an impact of junk information in an environment where there is competition for the attention of the user. Due to this competition on the participants' attention, it is much less likely to engage with junk information climate change in the information overload treatment groups. The information overload group with climate change consensus information is expected to have a higher understanding than the information overload group with sceptic information. Therefore, the impact of junk information in information rich environment will be tested the following hypothesis H5 and H6:

H5. This effect is reduced when presented alongside other topics competing for the young people's attention

H6: Junk information in an information competition environment does not reduce young people's perception of risk from climate change and does not undermine their support for climate mitigation.

The expectation is that the junk information will have a lessened impact due to the participants being able to select which articles they are interested in. This means those who have better understanding of climate science could simply filter out the junk information articles by their titles and images alone. As a result the effect is weaker and participants' should have a better understanding of climate change, a higher sensitivity to risk of climate change, and better more positive attitudes towards climate action than the group that solely received junk information.

The control group was used to provide a comparison to the treatment groups that received the media stimuli. This group received the initial scientific literacy testing. This was followed by the section on climate change questions. No media stimuli were given, enabling a comparison to the significance of the stimuli given to each treatment group. The control group also received the follow up questions. The essential purpose of this group is to provide comparison.

4.3.3: Dependent variables

Following from the media stimuli there were a series of questions that examine the participants' knowledge of and attitudes towards climate change. There were three broad types of questions asked. The first sought to gauge the basic understanding participants have of climate change, such as whether they were able to identify the causes of climate change. The second set of questions examined the impact the media stimuli had upon the participants' perception of the risk climate change poses. The final set of questions directly examined the participants' attitudes towards climate change. These questions were presented together on the same screen and enabled comparison on a key range of factors that could have been influenced by the media stimuli. These three types of questions are discussed in detail in the following sections, but have been selected as they have been used in previous research (See chapter 3) by other academics and allow for the potential comparison with prior results (Bord et al., 2000, Department for Environment Food and Rural Affairs, 2010, British Household Panel Survey, n.d.-b).

The first basic knowledge questions sought to measure the participants' understanding of climate science (See Figure 4.10). These questions sought to measure three factors in the participants understanding. Firstly, participants' understanding of the causes of climate change was measured. To do this, the participants' were given a list of potential causes and were asked to select whether they are a major cause, minor cause, or not a cause at all. This question was used in a survey of US university students by Bord et al. (2000, p. 208) which found that respondents underestimated the impact of cars and confused things that were not a cause such as pesticide use. These scores were combined together giving a total score of 8 to create the 'understanding of the causes of climate change' dependent variable.

Figure 4-10: Basic knowledge questions

Number	Question	Statement	Answer
1	Regardless of whether you know much about Climate change, please indicate whether you think each of the following is a major or primary cause of Climate change, a minor or secondary cause, or not a cause at all.	Pollution/emissions from business and industry	
		Use of aerosol spray cans	
		Use of chemicals to destroy insect pests	
		People driving their cars	
		Use of coal and oil by utilities or electric companies	
		Depletion of ozone in the upper atmosphere	
		Destruction of tropical forests	
		Nuclear power generation	
		People heating and cooling their homes	
2	Are the following statements about climate change true or false?	Human activity is a significant cause of climate change	
		Climate naturally varies over time so we should not worry	
		Climate change is causing the majority of glaciers and sea ice to melt around the world	
		The hole in the ozone layer causes global warming	
		There is nothing we can do about climate change. It's already too late.	
		Scientists disagree about whether humans are causing the Earth's climate to change	
		Global warming is a good thing, because it will rid us of frigid winters and make plants grow more quickly	
3	The following gases are greenhouse gases (True or False)	Argon	
		Water Vapour	
		Methane	
		Nitrogen	
		Carbon Dioxide	
		Chlorofluorocarbons (CFCs)	
		Oxygen	
		Nitrous Oxide	

Note: Question 1 Question from (Bord et al., 2000) with Question 2 being inspired by common misconceptions highlighted by Gore (2006). The final question simply tests whether participants held a basic understanding of which gases were greenhouse gases.

In addition to examining whether the participants understood the causes of climate change there is also a series of true and false statements which tested a range of basic understanding of climate science. These directly test how the participants understand the consequences of climate change, with questions such as "Human activity is a significant cause of climate change", along with statements testing the participants' basic knowledge of climate science that examines their perception of climate science. One of the examples tests whether the participants understand that there is a scientific consensus surrounding human activity causing climate change with a false statement that "Scientists disagree about whether humans are changing the Earth's climate". These scores were combined together to create the dependent variable measuring the understanding of climate science with a total possible score of 6. Finally, to test the basic knowledge of the participants, there is an inclusion of a final question asking if they can identify the greenhouse gases. The score from this was combined to create the dependent variable for the basic knowledge of greenhouse gases with a total score of 8 possible.

These basic knowledge questions are important to examine whether the media stimuli from the treatments has impacted the participants' basic understanding. Flaws in understanding are potentially highly problematic as attempts at adopting pro environmental behaviour results in the public failing to choose methods that would reduce their impact on the climate (See Bostrom et al., 1994, Lorenzoni et al., 2007). Overall, these three questions check basic knowledge of climate change and its effects.

The second set of questions seeks to examine whether the experimental treatments impacted how they perceived the risks from climate change at both an individual level and a societal level (See Figure 4.11). These have been included to examine the impact of media exposure on their perception of risk from climate change. Previous research has found that the public view climate change as a greater risk to society than to themselves (Pidgeon, 2012, p. S88). These questions have been used in previous research by Bord et al. (2000) for examining the risk perception of climate change in the US public.

Figure 4-11: Perception of risk questions

4	In your judgement, how likely are you, sometime during your life to experience serious threats to your health or overall well-being as a result of each of the following	Violent Crime	
		Auto accidents	
		The disease AIDS	
		Cancer	
		Heart disease	
		Hazardous chemicals	
		Air Pollution	
		Climate change	
		Water pollution	
5	In your judgement, how likely is it that each of the following will have extremely harmful, long-term impacts on our society?	Violent Crime	
		Auto accidents	
		The disease AIDS	
		Cancer	
		Heart disease	
		Hazardous chemicals	
		Air Pollution	
		Climate change	
		Water pollution	

Note: Questions taken from Bord et al. (2000)

Finally, the last set of climate change questions seek to measure the attitudes to the problems posed and the importance of tackling carbon emissions (See Figure 4.12). These questions seek to test two key aspects. Firstly, they enable examination of whether the media exposure from the treatments shapes the participants' views of whether climate change is an issue for the UK or whether they see the problem as international issues are more likely to impact developing countries. Secondly, these questions also measure whether the participants are influenced by media exposure on their perception of whether climate change requires action either for it being seen as too far in the future to be a concern or whether the action of the UK alone would make a difference. This has been shown in previous research to be a barrier in the communication of climate change as it is seen as an international issue and is instead in competition with domestic issues, such as the economy, for the public's attention (See Gavin, 2009, Sampei and Aoyagi-Usui, 2009).

Figure 4-12: Climate change attitude questions

6	Do you agree or disagree with the following statements:	"Extensive and long-lasting flooding caused by climate change is likely to take place in low-lying countries like Bangladesh or the Netherlands."	
		"Extensive and long-lasting flooding caused by climate change is likely to take place in the UK."	
		"Climate change is likely to cause severe food shortages in places like Africa and India."	
		"Climate change is likely to cause severe food shortages in the UK."	
		"People in the UK will be affected by climate change in the next 30 years."	
		"People in the UK will be affected by climate change in the next 200 years."	
7	Do you agree or disagree with the following statements:	It's not worth Britain trying to combat climate change, because other countries will just cancel out what we do	
		The effects of climate change are too far in the future to really worry me	
	Click Here To Continue		

Note: Questions from Department for Environment Food and Rural Affairs (2010) and the British Household Panel Survey (n.d.-a)

Overall, by measuring these three key aspects of the participants reactions to climate science and it allows to compare the impact of the differing experimental treatments to the control group. This means that the impact of the media stimuli can be compared between how it has impacted the participants' basic understanding of climate science, whether they perceive climate change as a risk, and what their attitudes on taking action to combat climate change. These three factors provide a larger picture into the impact of junk information and information overload than simply measuring attitudes or basic knowledge.

4.3.4: Follow up questions

The final part of the experiment consisted of a series of follow up questions (See Figure 4.13). This section recorded how the participants felt the experiment went for them. This includes two closed questions where the participants responded to whether they found the instructions clear and if there was confusion. This is followed by an open question which allows them to expand on these points. Those that took part in a treatment also had the additional open questions asking how they chose to engage with the media stimuli and whether they decided to engage with some media examples more than others (See Figure 4.14). Additionally, the follow up questions for all participants also ask closed questions to whether they see science and climate change when they are online. There is also an open question which seeks to find out in their own words if they engage with climate change information when they are online. Finally, the follow up questions sought to find out how they frequently they engage with different types of media.

Figure 4-13: Follow up questions

Number	Question	Answer
1	What course do you study?	
2	The experimental were instructions clear	
3	The experiment was confusing	
4	How did you find taking part in the experiment?	
5	Do you see information about science online?	
6	Do you see information about climate change online?	
7	Do you normally engage with climate change information online?	
8	How frequently do you buy newspapers?	
9	How frequently do you watch television news?	
10	How frequently do you use the Internet to receive news?	

Click Here To Continue

Figure 4-14: Additional questions for the treatment groups

In the experiment how did you decide which media to engage with?
Did you engage with some sources more than others and if so why?

4.3.5: Statistical Analysis

The data collection from the experiment collected participant's scientific literacy (control variables) and their reaction to climate change information after the media stimuli (dependent variables). The research examines the group results through the use of statistical analysis using the software SPSS. It is unfortunate that allocation of participants into the control and treatment groups was not entirely random. This is because of the difficulties of ensuring a large sample size. Data collection was carried out on three university campuses as getting the initial data collection proved to be problematic. Even recruiting from methods and environmental politics units being taught on Penryn campus only gained 101 participants in total compared to the 180 that I had expected to attend. This was reflected in attempts at other campuses with an organised data collection at Southampton University to increase the total numbers, which only resulted in 6 additional participants when I was expecting around 40 students to attend. Running them on the University of Exeter Streatham campus only gained an additional 15 participants when I had expected around 50 participants to attend. In order to increase sample size, an additional 61 participants for the control group data was collected through an online survey (See Appendix E). The online survey was sent out to campus based student groups on Facebook and shared out by people online. This introduces a self-selection bias as non-random samples have been introduced.

In order to balance the non-random samples, I used propensity score matching and stratification. Propensity scoring is a method of weighting results using pre-treatment factors, in this experiment scientific literacy, allowing for the improvement of internal validity of the between group comparisons (Holmes, 2014). Propensity scoring also allows for the avoidance of confounding variables

caused from differences in the application of the experiment and may impact the causal claims. This sample-matching approach is frequently used in quasi-experimental designs (Holmes, 2014). The purpose of this approach is to attempt to adjust and weigh data where randomness cannot be guaranteed to eliminate, or, at worst reduce, differences on confounding variables. The idea was to make the treatment groups match the control data as much as possible. Cochran (1968) and Rosenbaum and Rubin (1983) show that a significant amount of difference between control and treatment groups can be reduced by stratifying in this way.

The stratified sample matching took the following steps:

1. The control data (from both the experimental conditions and survey) was combined with the treatment data.

2. A logistic regression was estimated where R_i=1 if i is in the control group, otherwise R_i=0. The model was used to estimate [19]:

$$PR(CG = 1) = \frac{e^{\beta x}}{1+e^{\beta x}} = P$$

The co-variates were the full set of variables collected as part of the experiment (and the survey version of the experiment). See Appendix E for a full copy of the survey and details of variable construction (see Appendix F). The model was satisfactory, with a Chi_2 test of 71.00*** (significant at the 0.00 level) and a reasonable adjusted $R2$ of 0.260 (Nagelkerke R Square). The model correctly predicts 98.1% of the treatment group cases.

3. Next, I looked at the predicted probabilities of the combined treatment groups and sorted the individual cases' propensity scores into quartiles to determine the cut-off thresholds for the stratification. The thresholds were as follows: quartile 1 = 0.01381 THRU 0.16827; quartile 2 = 0.1682902 THRU 0.326875; quartile 3=0.326875 THRU 0.5201305; quartile 4 =0.5201306 THRU 0.54248.

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[19] Notes for equation:
    CG = Control group
    $e^{\beta x}$ = Regression on co-variates
    P = probability

4. Turning now to the control group data, combined for the experimental and survey settings, I defined 4 stratification groups as per step 3. The same thresholds were used.

5. In the next step, I calculated the weight for the treatment groups in each strata by taking the frequency in that strata for the control group, and dividing it by the frequency for the treatment group as illustrated in Table 4.8.

Table 4-8: Frequencies in each strata and the resultant weights

Quartile (stratum)	Control group frequency	Treatment group frequency	Calculation	New weight for treatment groups by strata
1	20	60	20/60	0.333
2	19	27	19/27	0.704
3	22	13	13/22	0.692
4	20	2	20/2	10.000
Total	81	102		

6. Finally, a weight of 1 was assigned to all of the control group cases.

Linear regressions tests were used to examine whether there was a significant impact in the stimuli on the participants' reactions to climate change. These linear regressions are run comparing each treatment in turn to the control. The results are then analysed as three models each testing each dependent variables. Model 1 does tests the impact of climate consensus stimuli in an information overload has on each dependent variable. Model 2 tests the impact of junk information (climate sceptic material) only on each of the dependent variables. Model 3 tests the impact of climate sceptic media in an information competition environment on each dependent variable. This approach of modelling is similar to experimental research by Margetts et al. (2011) that examined the likelihood of people signing petitions and donating money to the causes of the petition. This research was interested in behaviour shaped by how many people had previously signed a petition and used this model to test each

treatment of high over one million signatures (Model 1), medium being between 100 and one million (Model 2), and low being less than 100 (Model 3). This approach of the models testing the treatments has been used in my experimental analysis.

In particular, linear regressions were run on nine dependent variables used in the experiments. Firstly, three linear regressions have been run on each of the climate science understanding results looking at whether there is any significant impact of the media stimuli on knowledge on greenhouse gases, understanding the causes of climate change, and understanding of climate science. Secondly, linear regression was run on four dependent variables that measured the perception of risk to the participants as an individual, and their perception of risk to society. In addition, linear regressions were run on two dependent variables that examine the participant's perception of risk climate change poses to the UK and also internationally. Finally, linear regression was run on attitudes for the support for climate change mitigation with dependent variables measuring whether the media stimuli have impacted their support for Britain combating climate change and whether they felt that climate change was too far in the future to be a concern.

Through the use of this mixed methodological approach, this enables a detailed exploration of the impact of the internet and its consequences on reactions to climate change information. The following chapters will detail the analysis and findings of these methods. The focus groups (chapter 5), examines the use of the Internet and engagement with climate change information online. This informs the information overload treatments which are statistically analysed in (chapter 6) to examine the direct causal consequences of the experimental treatments on the dependent variables.

Chapter 5 - Focus group analysis

This chapter analyses the results that emerged from the focus group discussions on Internet usage and the sharing of climate change information online. These focus groups sought to answer the following questions, and are also used to create valid experimental treatments for the information overload treatment groups (to test hypotheses H1, H2, H3, H4, H5 and H6):

- *Context:* How do Internet users perceive their engagement with the Internet and connectivity?
- *Context:* Do users receive and engage with information about climate change through their Internet and social media usage?
- *Context:* Are there barriers to interacting with climate change information online?
- *Sharing:* How do Internet users share information with others?

These focus groups have been coded (See Table 5.1) into key themes that emerged from developing the analytical framework of the information society: context of Internet use, sharing, information overload, and junk information. The subsidiary themes emerged from the discussion about the Internet in the participants' day-to-day life and whether (and if so how) they engage with climate change information. The focus groups tease out participants' wider engagement with online discussions and use of the Internet to engage with serious issues. A wider exploration of how participants viewed the Internet is important, as the initial focus groups highlighted a significant lack of engagement with climate science in the majority of participants. This included an unexpected finding of significant barriers to climate change discussion online. It found that the Internet is not a place to discuss serious issues, and also that there is a fear of negative responses or harassment from others. These perceptions of Internet communication and barriers to online climate change engagement were explored in more depth in the final three focus groups.

Table 5-1: Focus group coding

Theoretical themes	Subsidiary themes

Contextual	• Usage
	    o When
	    o How
	    o Why
	• Connectivity with friends and family
	• Community
	    o Online
	    o Offline

Sharing	• Memes
	    o General entertainment
	    o Shock
	    o Environmental
	• Accessing information
	    o Hobbies
	    o News
	    o Environmental
	    o Amusement
	    o Internet as a medium to discuss issues

Information Overload	• Tailoring
	    o Selection
	    o Ignoring
	    o Novelty
	    o Distractions

Junk Information	• Misleading information
	    o Climate sceptic material
	    o Untrustworthy sources
	    o Memes

This chapter is split into two key sections. Firstly, I explore participants' perception of their usage of the Internet in their day-to-day lives. Secondly, I explore the participants' sharing of climate change information online and their perception of online communication. This second section is split into five sub sections to explore the engagement with the sharing of information through social media, their perceptions of information overload and junk information. These subsections will explore themes related to each of these as well as examples that cross between these categories, such as whether there is a cross over between

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sharing and junk information. Overall, this chapter seeks to produce an in-depth understanding of the range of ways young people use the Internet, how they connect and share information with other users, and whether they engage with climate change information online, and if so how. Ultimately, there appears to be significant barriers to viral sharing of climate change information, because the sharing of information being motivated by entertainment. At the same time, viral media is being untrustworthy. Other issues included the problem of barriers to public engagement in general, with a fear of backlash and a view that discussing climate change online is not a productive activity. These exploratory research findings suggest that disengagement is a much larger issue for climate change communication that requires future research.

5.1: Use of the Internet

This section will examine the use of the Internet among the participants of the focus groups [FGs]. There are two key areas of interest. Firstly, this section will explore how the participants use the Internet, including when and how they are connected. Secondly, this section will examine how they use social media in their day-to-day lives. The use of the Internet was normalised among all participants in all focus groups with social media playing a significant role in their lives for both connecting with others, and also receiving information.

5.1.1: Connectivity

There was a general consensus in all FGs that they always felt constantly connected. This was evident from the response to the question 'how do you use the Internet in your daily lives?' In FG1 the first response was from Participant [P] 4 who said "I literally use it 24/7". This response was met by slight laughter from the group with other participants agreeing and highlighting that their day-to-day usage of the Internet was similar. In FG2, P highlighted that they used the Internet "As soon as I wake up and before I go to sleep" (See line 28). Other participants in the group agreed with P9 giving the example of moving to a new house:

> "… put it this way if you move into a new house and it's [the Internet] not there at all it feels like you are back in the Stone Age."

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Other participants echoed this sense of being constantly connected:

"P1: It's part of my routine. I need to get up and check my Facebook and Instagram and do the same before I go to sleep.

P2: I… we… I use it more than I think I do and I only notice that when you don't have Internet. If you're bored or waiting for a bus whatever you just find yourself on the Internet. No Wifi and then you realise that."

The slip of 'we' suggests that P2 thinks this is normal behaviour but he corrects it to describe his own experiences. Constant connectivity is expected by the participants from FG2.

The Internet has become a normalised part of the participants' day-to-day lives and it's only noticed when the constant connection is not available. This was reflected by P4 in FG5 who highlighted that constant connectivity was an expectation from many of their peers with an example of a recent incident on campus where the Internet was down for a short time:

"We lost connection to the Internet for ten minutes the other day and everyone was freaking out."

Another participant in FG5 acknowledged the constant connection with the Internet being used to access music:

"P1: When I am home I always have music on and when I am at a mate's house we always have music on. So even if we are not actually browsing the Internet we have Youtube or Soundcloud or something up playing in the background of our lives."

Youtube is a video hosting website that was created in 2005 and has more than one billion users (Youtube, n.d.-a, Youtube, n.d.-b). Soundcloud is a social media website built around uploading music to be shared with other users, which also has integrated support to share the user created music on larger social media websites, while also being available as a smart phone app (Soundcloud, n.d.). Again this reflects that constant connectivity to the Internet has become normalised. This expectation of constant connectivity has become normalised with smartphones and tablets enabling Internet access on the go. Mobile devices

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used to access the Internet have rapidly increased with Vincent and Harris (2008) showing that more people are accessing the Internet through these devices which is exceeding desktop computers (Fortunati and Taipale, 2014, p. 318). This is reflected in the focus groups as mobile devices are the main way some of the participants regularly access the Internet. An example can be seen when P2 of FG2 informed the group that their smartphone "… with me absolutely everywhere". The convenience of mobile phones to access the Internet has meant they are one of the main ways that the participants connected to the Internet.

Another key aspect that emerged immediately in the discussions from all of the focus groups was that they used the Internet for a wide range of purposes. This included using apps on smart phones such as WhatsApp, which enables users to instant message friends and family without paying like a user would using normal mobile phone texting (WhatsApp, n.d.). There were examples of the use of the Internet for accessing music through the Spotify website and phone app. Spotify is a website that allows for the user to listen to millions of music tracks and either pay a monthly fee or allow Spotify to play adverts between songs (Spotify, n.d.). Other uses included online video games such as WoW [World of Warcraft]. WoW is a massive online role-playing game set in a fantasy world that charges a monthly subscription to play, which peaked at 12 million subscribers in 2010 (Kollar, 2014, World of Warcraft, n.d.).

There were also frequent mentions of the use of the Internet for accessing video entertainment. Examples in FG2 included references to the video hosting website Youtube (n.d.-a) to "… connect to just see some funny videos". More traditional television media was referred to with reference to both legal and illegal video streaming websites by P9 in FG2:

"P9: I probably watch a lot of TV shows off the Internet as well through nefarious websites

PA: **laughter**

P9: and legal ones as well…"

This highlights the Internet has absorbed traditional entertainment media with television, music and video games being accessed or operating through the Internet.

Besides entertainment, participants said they used the Internet daily to access a range of information through Google searches or for course information through ELE [Exeter Learning Environment]. In particular, there was a reliance shown on Google by some of the participants. Such as with. P5 and P11 in FG1 with comments such as "I Google everything". The Internet is seen by P5 to be "…essential for me in so much of what I do". FG2 had P9 mention that they used the Internet to directly access news through the *Guardian* app. The *Guardian* app is an electronic version of the *Guardian* newspaper available on tablets which can be viewed offline after download or while connected enables users to view embedded videos in the articles (The Guardian, n.d.). It was clear that the participants in all the focus groups used the Internet for a range of entertainment sources as well as accessing information.

5.1.2: Social media

Another common use was social media for entertainment, connecting with friends and family, and accessing news. The use of social media is to be expected, as young people were the initial adopters of social media and have remained the largest age group using social media (Pew Research Center, n.d.). Social media was referred to frequently within both focus groups. Participants use a range of social media services such as Facebook, Twitter, and Instagram. Facebook is a social networking website which emerged in 2004 and expanded to have 1.35 billion monthly active visitors in September, 2014 (Facebook, n.d., Facebook Newsroom, n.d). Twitter is a social networking website that allows users to connect and send Tweets (short messages) to users who follow them. It has 288 million active users with 500 million Tweets sent per day (Twitter, n.d.-b, Twitter, n.d.-a). Instagram differs from Twitter and Facebook with a much stronger focus on the sharing of pictures and videos (Instagram, n.d.). When FG1 was asked about social media use, there was an immediate response from P3 speaking for everyone in the group:

"I: Ok so how many people here use social media?

P3: everyone

I: everyone?

P3: yep

PA *murmur of agreement*"

General agreement was shown between all the participants in FG1 that they all used social media.

The reasons to use social media varied across individuals. Keeping in touch with friends and family was a common reason to use social media. For example P2 in FG2 highlights:

"P2: I use mine for various reasons. One being keeping in touch with family and friends and we have found even as a group here that it's a much easier, it shouldn't be, way to keep in touch and how far we have gone with our research is on Facebook than Email. It's much more instant so I use it for work and for pleasure."

Social media is not only used to keep in touch with people far from the user, but also the students keep in touch with each other through social media platforms such as Facebook despite seeing each other face to face regularly. An interesting aspect mentioned was that Facebook was used for group work rather than emailing due to the convenience it offers. The use of social media was even referred to as vital by some participants. For example P1 in FG1 said that social media was viewed as vital for the organisation of events that were not online, such as student society events, stating that:

"P1: I wouldn't say I use the Internet as a forum for communication. I think a lot of us use it organise certain things. So as a [student] society. Whatever you do in the real world doesn't happen. You have to use the Internet to organise what kind of communication you will have outside of that."

Social media is not only seen as necessary for communication and organisation of events that are not based online, but also as the only way to

effectively reach people. This view was also seen in FG2 where P9 gave the example of general usage being the organisation of social events:

> "P9: I use it for group taking groups in particular titles that are for different things that get your friends to talk. So you get a bunch of friends to talk about a bunch of subjects between this area and that. So you want to talk about going on holiday together you go to the holiday page or if you want to meet up for a drink then you go to this page and say who's free tonight and instantly you are connecting 10 to 15 people instead of texting. So it's a lot easier to all plan on one page
>
> I: So it's very convenient
> P9: Convenient and very fast"

This highlights the view that social media is an important aspect of the participant's social lives for the convenience it offers for organising and staying connected with people. This was also supported by P1 in FG3:

> "P1: I use it to communicate with fellow students in my course. Mostly through facebook groups mainly to arrange times and practices to it kind of condenses us all into one place where we can arrange and change schedules so I use it in that sense.
>
> I: so it's quite important for daily organisation?
>
> P1: yeah it's organisation. If there is a group of you all together."

This convenience of organisation meant that social media was important to the participants' day-to-day lives.

In contrast, others used social media for primarily engaging with and receiving information. For example, FG3 highlighted that P3 has had a changing use of social media with P4 also supporting the usefulness of social media to receive information:

> "P3: I think I have started using it less for interaction as I have used it more as it use to be a social pull for me and now I very rarely use Facebook for interaction. I spent last year turning from a page full of friends saying what they did in the shower to a page full of alternative media

P4: I use it for research"

The ease and convenience of use for receiving information was also brought up in FG5 who found it particularly useful for following current events:

"P2: News station on Twitter. I know you should not use it for news, but it does come up with new stuff very quickly.
PA: **murmers of agreement**.
P3: I like the new thing they introduced with Facebook. The trends down on the right hand side so you get breaking stories pretty quickly. I got the BBC news app on my phone that give breaking news updates which is quite useful."

An interesting aspect of the response from FG5 was a negative view on using social media for this purpose with the focus group agreeing with the statement made by P2.

In addition to receiving information online, there was also engagement with online communities. The Internet has enabled users to form communities surrounding shared interests and empower the user base on a range of issues such as health information (Kata, 2012). The engagement with online communities received a wide range of responses but there was a general consensus that the participants were members of some form of online communities. For example there was P8 in FG1 who highlighted that they used online communities for specific hobbies:

"I am part of a camera and online photography forum and other sports forums and stuff like that and other like sports forums and stuff like that.".

This use represents the expected use of the Internet for gathering information from individuals with similar interests.

However, there were two very different uses of the Internet for accessing online communities. For example, P9 from FG1 viewed their use of online communities to be essentially people they normally interact with in their day-to-day life. This use of online communities was viewed by P9 as:

"P9: I would say I am part of groups but they are based on. Not like there not Internet. They are like my friendship groups and society groups that have a presence on the Internet for ease of communication and stuff. So I would not say it's an online community. It's more a real life thing that spills out onto the Internet to every now and then.".

P9 views their use of the Internet communities is simply spill over from their offline communities they participate within. In contrast there was P5 who was also in FG1 and is active in a range of online communities:

"P5: I am part of quite a few online communities. Obviously a variety of games on Steam. Civilization forums I tend to go on. I may not comment or post. I tend to have a detailed look at what other people are saying and how that could improve my gameplay so in that respect I am part of that community. In games like Team Fortress 2 I sometimes use the in game chat and there is quite a community feel in that there is information and memes that are within the community itself that don't tend to travel far out of it. I also play World of Warcraft and there is a server community as a whole. Through things like trade chat and sometimes debate or jokes are exchanged between different people.

I: A sort of community feel?

P5: Exactly a community feel. Even though there is a veil of anonymity is present in all of them."

The list of online communities that P5 refers to revolves round an interest in video games and playing online. For example, P5 refers to Steam which is a digital distribution platform for video games that has incorporated social media functions such as the ability to share videos, screen shots, and chat (text based and over microphones) (Steam, n.d.). Steam enables players to buy games and stay connected with friends. This enables friends to play online games together, such as Team Fortress 2, which is a free-to-play online team based first person shooter (Valve, n.d.). An interesting factor that emerged was P5 felt part of a community although the online experience was anonymous through players using pseudonyms. This highlights both the wide range of engagement with

online communities and perception that the Internet is necessary in organising the participants' offline meet ups.

Overall, the Internet is used frequently in the lives of the participants. The ability to access the Internet on the go was commonly seen with examples of the participants' day-to-day usage via smartphones. Access of the Internet has become normalised with participants only noticing their dependency on the Internet when there is no connection. The Internet has become a significant part of their lives with social media in particular being a central way to keep in touch with people. The use of social media extended past keeping in touch with people but was seen as necessary for organising offline events in their day-to-day lives. Therefore, as the Internet is significant in their day-to-day lives it is important to examine how they view online interaction and whether they engage with online communities.

5.2: Information society analysis

This section explores the results from the focus group through the information society analytical framework. The analysis is split using the information society analytical framework to enable me to explore the rich data that was collected from the focus groups. Firstly, this section will examine how the participants viewed the sharing of information and how they perceived their engagement with climate science. Secondly, this section will explore how participants viewed information overload and explores if they tailored their Internet usage to see particular information. Thirdly, this section examines how users perceived junk information and explored whether they engaged with it. Fourthly, this section will explore the overlap between sharing and information overload. Finally, this section will explore the overlap between the sharing of viral junk information.

5.2.1: Sharing

The Internet has enabled the sharing of information with the emergence of online communities, the ability to share memes, and the growth of social media used. For example, the use of online communities to share knowledge was

highlighted by P5 in FG1 to be helpful in their hobbies. The sharing of knowledge for mutual benefit with other members in a community with the same interest is a key aspect to sustain online communities (Faraj et al., 2011, p. 1224). For example, P5 discusses their participation on forums to improve performance in video games such as Sid Meier's Civilization V, which is a strategy game where the player plays as a civilization from the stone-age to space age (Sid Meier's Civilization V, n.d.). The participation on forums with other players of the game allows discussion of tactics and for P5 to improve their strategy when playing.

Another key aspect of sharing was the ability to quickly transmit information to a wide range of users through the use of Internet memes. Memes can be potentially shared for entertainment or potentially used to spread political messages throughout a network or to subvert dominant messages (Cammaerts, 2007, Kien, 2013). Therefore, the participants in the focus groups were asked whether they saw memes online. An example was provided of an environmental meme (See Figure 5.1). When FG2 was shown the example meme it received a response from P12 who highlighted that:

> "P12: I have never seen an environmental meme before. I normally just see silly ones.
> I: Can you give an example of a silly one?
> P12: ummm there is pressure. I'm trying to think
> PA: //**laughter from the group**
> P5: Grumpy Cat"

Grumpy Cat is a popular online meme of a grumpy looking cat (see Figure 5.2), which has had commercial success and has even been made into a movie 'Grumpy Cat's Worst Christmas Ever' (Know Your Meme, n.d.-f, Moylan, 2014). This was also seen in FG1 with P4 stating that they do see memes:

> "P4: yeah just not environmental ones.
> I: What sort of memes do you see?
> P4: Funny ones
> P8: general ones like cats and things
> P11: //Bad luck Brian".

The response of P4 stating that they see funny ones had the reaction from the group to call out memes such as Bad Luck Brian. Bad Luck Brian was an

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image meme of a blond hair teenage boy with braces with a caption describing a negative event (See Figure 5.3) (know Your Meme, n.d.-b). All five of the focus groups showed that memes were shared primarily for entertainment rather than the communication of serious issues.

Figure 5-1: Example of environmental meme

Note: Shared by Greenpeace UK (2014) Facebook page on the 7th December to draw attention to a Petition against coal. This gained 8,491 likes and was shared over 3000 times.

Figure 5-2: Grumpy Cat example

I HAD FUN ONCE
IT WAS AWFUL
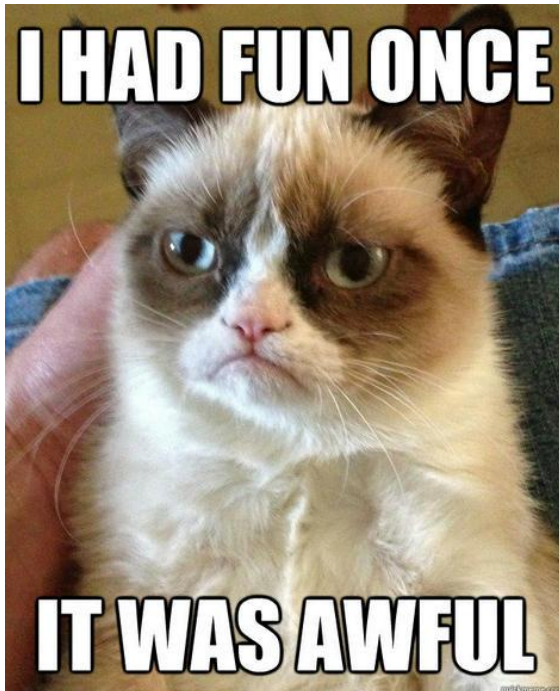
Note: Image taken from Know Your Meme (n.d.-g)

Figure 5-3: Bad Luck Brian example

TRIES TO MUTE PORN
ACCIDENTALLY TURNS VOLUME ALL THE WAY UP

Note: Image from know Your Meme (n.d.-b).

The immediate response to the climate change meme from all FGs participants was negative. The meme example was criticised as too simplistic by participants in FG3:

"P4: this is not a good example of that is it **holds up the environmental meme**

PA**laughter**

 I: That is an environmental meme a UK based one by Greenpeace.

P3: Greenpeace do do some good ones.

P4: not sure this is an example of Greenpeace doing

P3: That's what I'm saying they do do some good ones but maybe not this one

P4: it's pretty simplistic. It's what I was saying about not reducing stuff to 140 characters"

The design of the meme was also criticised by FG4:

P3: that is a crap meme. I have seen a lot better. Like I don't focus on Internet memes

P2: You don't use arrows on a meme. It presumes the user is stupid.

They criticised both the design and message of the example meme provided.

The focus groups highlighted a lack of engagement with memes that focused on serious topics. P3 in FG3 highlighted that they scroll past them only pausing to laugh rather than follow any links to do with them. Those engaged with environmental material such as P4 in FG5 did so through news channels and therefore did not see environmental memes. Instead this resulted in an interesting discussion where the view to ignore serious issues online was agreed because they felt discussing such issues on the Internet was a waste of time. In particular, social media was argued by P8 in FG1 to be used for keeping in touch with people and passing time rather than discussing serious issues:

"P8: I think it's because I don't know how many people see social media as a way as engaging with things and discussing anything. I know I definitely don't at all. Social media is in keeping in contact with people, organising things but mainly, just pass time and stuff. I know I don't go there to discuss any topic with anyone and I think a lot of people have that as well so they go on and then like this is not what I am here for. Even if they did engage it's not a serious discussion. It does not mean anything

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because you then never see it again. You might not even know the person as well so it just does not even matter."

This was supported within the focus groups with the view that social media was a superficial form of communication between users. While in FG2 there was a different view made by P6 but also supported by P5 that put people off having serious discussions due to negative responses from other users even in an anonymous environment:

"P6: I think it is the intimidation. Even though it's anonymous if you don't know what you are talking about then you don't want to put your voice as much, but if you do think you know more about it then you will feel more obliged to sort of to get your comment.
P5: There's always the risk of being drawn into a flame war. Especially on Youtube. It's
PA:// **laughter**
P5: It's not worth. It's not worth it even if you are 100% accurate then somebody would just insult you and say something about your mum
PA://**Laughter**
P5: it's not very worth it"

A potential negative response from other users was seen as a key reason to not bother to engage in online discussion. This negative response is referred to by P5 as a 'flame war', which is Internet slang referring to a group of people arguing over a topic using mostly insults (Know Your Meme, n.d.-d). This perceived risk of backlash from getting involved in climate change discussion was a key demotivation to Internet users.

When the focus groups were asked about engagement with climate change information, they highlighted that apart from the risk of backlash, they perceived climate change to differ from other issues they view online. An example was given by P2 that as climate change was not viewed as a personal issue they would not get involved compared to debates on abortion:

"But when it's more of a personal issue I have some friends who have some very strong opinions about abortion or homosexuality. Hey what are

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you saying? This is not right as it's a personal opinion. That almost forces you to engage with it because it's a personal thing."

Interestingly, P8 also from FG1 shared a similar view that climate change differed significantly from other topics, but instead argued that there was less likely to be a relaxed discussion in contrast to an online discussion on sports or personal hobbies:

"You know it's like discussions on how you should could do this better then someone might disagree and be like this could work better and might have a discussion. It might just be because it's not as big an issue. If you disagree with someone how to best train your calves does it matter to you. You're just going to just carry on doing like you know if you then. I don't know if that's a factor in it because climate change is such a like if you have a genuine opinion and someone is the opposite. As [removed] it effects everyone in a really big way so of course it's kind of that clash its much less important issues they can just have a chat about it and then.".

Due to the topic focus not being considered as a significant political issue P8 had the view that the discussion was much more accessible and enjoyable. The risk of backlash was clearly a shared reason to prevent participants engaging in political debates online. This fear is justified with online communities criticised by Shaw (2014) to allow for the organising of harassment campaigns against those who are critical towards something that the community has a shared interest in to attempt to limit criticism. The risk of getting involved in a 'flame war' and receiving harassment is a factor in undermining the participant's engagement with climate change debates online.

Overall, the sharing of information was seen as important by members of the focus groups. However, a key aspect that emerged was disengagement with climate change information. This was due to the perceived risk of backlash if they got involved in online discussions; this also applied to a wide range of issues that they considered serious. At the same time, the engagement and sharing of memes also reflects this with memes being shared for entertainment purposes rather than to drive political discussion or build understanding of serious issues.

5.2.2: Information overload

The amount of available information has dramatically increased (See Schumann, 2004, p. 241). This means that there is a risk of information overload with the potential for people to become overwhelmed by the amount of information. This concept was explored with the focus groups and a key aspect that became evident in all the focus groups was that the amount of information did not result in a feeling of being overwhelmed. Instead the quantity of information had resulted in competition for the user's attention. When the focus groups were asked about engaging with climate change information the result was a lack of engagement. There were examples such as in FG2 with P1 who rarely saw climate change information:

> "P1: It's quite rare, but it tends to come in clumps. If for example there has been some kind of big study on it then I might see a few in a day, but then I might go months without seeing anything at all and I might see loads again.".

Instead, the only members who regularly received climate change information were already connected to the environmentalist network and followed organisations such as Greenpeace. Interestingly, due to the competition caused by information overload, a number of the participants had tailored their online experience purposively to avoid seeing climate change information. For example in FG1 both P8 and P9 highlighted that they filtered their online experience, in particular their social media accounts. However, both of these participants viewed this differently:

> "P8: because you can tailor your social media to what you want to see. So while that's quite insular in the way I interact with social media it also reflects how social media works. You end up seeing what you want to see. So for me personally I have no interest in climate change so my social media reflects that.
>
> P9: I say personally more that it happens unintentionally. Like I follow or subscribe to things like pages for like human rights groups and things like that and I see tweets all the time about that and I get information about that. I just never like followed it's not intentional I don't want to get any

information about climate change its just I have not clicked anything that then gives me that constant feed of information."

Due to the lack of interest in climate change, their social media usage reflected that, with them not following or subscribing to sources that discuss or share climate change information. This filtering behaviour was argued by Schumann (2004) to be a response to the extremely high quantities of media stimuli to prevent suffering from information overload. This personalisation of information received has negative consequences that values and personal beliefs are reinforced rather than challenged (Schumann, 2004, p. 234). In this case both P8 and P9 received no climate change information and as a result will not see anthropogenic climate change as a serious issue. While P8 has no interest in climate change, they are happy that their general interests are reflected on their social media. On the other hand P9 agrees but argued that this was not intentional behaviour on their part.

The competition for the attention of the user was highlighted in an interesting example from FG1 with P5 spending a lot of time among online communities that reflect their interest of video games. Rather than seeing or engaging with serious information online, they received and shared jokes with online communities focused on video gaming. Their engagement with memes in particular was summarised by P5 as:

> "P5: as a gamer I tend to see a lot of memes that don't tend to make a lot out of sense out of gaming and unlike some memes. With gaming memes there tends to be quite a lot in a very frequent period of time. Especially on some of the bigger games. Especially World of Warcraft. There tends to be new memes every three or four weeks and if you have not played for a period of time then you don't tend to get the in joke. But on going players tend to have meme pages of hundreds of memes inside their head which make perfect sense to them but to other people would just be unfunny. They would be unfunny and the humour would not make sense at all. Those memes tend to be very related to the communities they come from and a lot of the humour tends to be the community's reaction to a boss quote in WOW or a certain viral video associated with Team Fortress 2."

These online communities create a range of in jokes that would not make any sense to someone outside of that online community. When P5 was asked for the example, there were multiple examples given including ": Spy Crab from Team Fortress 2. 'You are not prepared' from WoW…". Spy Crab was a Team Fortress 2 meme where players playing as the spy class could do a crab-like walk if they held the 'disguise kit item', looked up, and crouched while walking forward (Know Your Meme, n.d.-p). An example of the Spy Crab meme can be seen in Figure 5.4. 'You are not prepared' was from World of Warcraft. (See Figure 5.5) which was a quote from a boss in the game called 'Illidan Stormrage' and became viral within the WoW community (Edwards, 2013). This is an example of memes being used for entertainment within the online community with P5 highlighting that "It would not make sense unless someone was a former player and had been involved in that community". These memes are just jokes rather than conveying any serious message like memes attempting to communicate climate change. The memes referred to by P5 are shared for entertainment and sharing in jokes within the WoW community. In particular one of the examples reflects the critique of memes by Kien (2013) who argued that memes can undermine information campaigns to tackle serious societal issues. In this case the 'Spy Crab' meme is a parody of conservation awareness campaigns. P5 became a dominant voice in the group during this section of the focus group and clearly spends a lot of free time within these online video game communities. The consequence of this competition for P5's attention has meant that they engage with content and information that directly appeals to them, in this case for entertainment. This detracts from time that P5 could be spent engaging with climate change or more general serious information while also shaping a perception that memes are just jokes rather than a way of communicating significant messages.

Figure 5-4: Spy Crab meme example
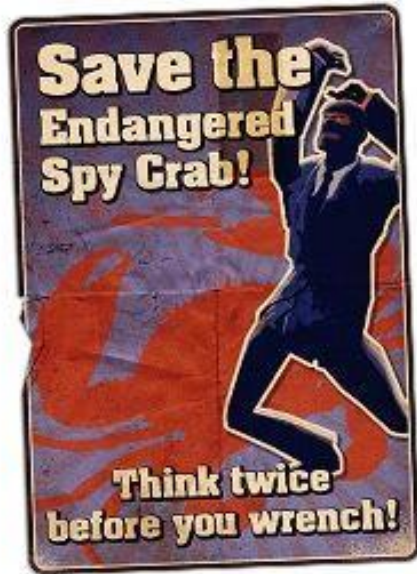
Note: Image taken from Know Your Meme (n.d.-q) Spy Crab image gallery.

Figure 5-5: 'You are not prepared' meme example

Note: Image taken from Edwards (2013)

In addition to competition for the users' time there were also a number of barriers to engagement with climate change information online. For example a small number of participants suggested a lack of confidence in their ability to discuss climate change resulted in them avoiding joining online discussions. This was generally seen as a feeling that they lacked adequate knowledge on the

subject to engage with climate change debates online with P4 from FG5 reflecting that:

> P4: It's hard enough to keep the science in your own subject as opposed to when your interest lies in something completely different trying to keep up with a whole branch of science. You got to trust what people relay to you.

This lack of knowledge did not mean that participants were not interested, with P4 from FG2 highlighting that "…I am interested but I don't know enough about it at the moment…". However, the majority of the focus group participants did not reflect the perception that they lacked knowledge about climate change.

Instead one of the more interesting findings highlighted by the focus groups was that the Internet was not seen as a place to have serious discussions. This has the potential to be a significant barrier to using the Internet to communicate climate change as it suggests users will simply be disinterested in engaging with climate science. This finding is potentially extremely problematic as previous literature suggests that the Internet has amazing benefits to political organisation and communication. For example the Internet enabled the ability to organise global activists and allow for international protests (See Kata, 2012) while also allowing for the public to become empowered with the democratisation of information to be shared throughout online communities (See Bennett, 2004). There are two aspects of this attitude that emerged. Firstly, it was seen as having no real impact. The second issue was that other users did not take online discussions seriously and derail the discussion with ridiculous posts.

The perception of social media from the participants was not seen as a tool to discuss serious issues. In particular, social media was argued by P8 in FG1 to be used for keeping in touch with people and passing time rather than discussing serious issues:

> "P8: I think it's because I don't know how many people see social media as a way as engaging with things and discussing anything. I know I definitely don't at all. Social media is in keeping in contact with people, organising things but mainly, just pass time and stuff. I know I don't go there to discuss any topic with anyone and I think a lot of people have that as well so they go on and then like this is not what I am here for. Even if they did engage it's not a serious discussion. It does not mean anything

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because you then never see it again. You might not even know the person as well so it just does not even matter.".

This was supported within the focus groups with the view that social media was a superficial form of communication between users.

This perception of online discussions being superficial was reflected across the other focus groups. Part of this was due to the view that arguing with others online was ineffective as a form of communication. For example the idea that it was impossible to change other user's minds on significant issues was a major reason for demotivation for the participation in online discussions. P12 from FG2 highlights the experience of online discussion was a time sink rather than a productive experience:

"I just don't think I would not bother as getting into online arguments is really long and I just don't have the energy for it as what happens is people just debate for ages and you're not going to change each others minds so some matters I just keep quiet and scroll past. So yeah that the way I see it."

This perception of it being a waste of time was also reflected by P4 in FG5:

"I usually I will take part if it's not going to lead to anything. Rarely any philosophical debate or argument I use to do that any day I could and its pretty futile. I used to get involved in things I did not know much about which did not help. Not anymore. I stop myself."

Significant or serious topics received a general consensus across all the focus groups that online debating was ineffective or a waste of time.

In comparison offline communication was seen as much more effective with 'proper' engagement with the topic. For example P3 in FG1 highlighted that they felt that individuals online simply did not adequately engage in the discussion:

"I mean when it's done in person it's so much better as its faster replies, proper engagement, and people are going to think about what they say. They are not going to copy past some article they quickly found I think this actually even though I did not think it 30 seconds ago."

Again this reflects the perception that online discussions are simply not seen as a worthwhile use of time as having an impact on others is seen as key to motivate engagement.

In addition to the experience not being seen as a worthwhile experience there is the issue that becoming involved in online discussions was seen as difficult due to the chaotic nature of social media. If a contentious issue emerged FG1 highlights there are already a large quantity of responses:

P11: and there is always arguments on it and there are hundreds of comments and no one gets anywhere. And I don't understand why people comment on it.

P9: Then you get that on comment going guys let's all try to have a proper argument. Why are you bothering to try to control this?

P11:// There are hundreds of comments. No point

P9// You should know there is nothing you can do about this and the people who are commenting then the persons going to forget about it and not take anything from it and move on and then half of them are there just putting funny comments anyway and annoying people. So it's just

Pa: **laughter from group**

In addition to the quantity of people posting comments there is also the problem of others posting comments to derail the discussion.

Even then, the quality of other comments is a factor that deters the participants engaging with serious discussion. The view that other users' comments are low quality are highlighted as a reason for disengagement in FG3, but the participants do suggest they get some enjoyment from the comment section even if they do not engage with it:

"P6: There is that really good meme that says I'm just here for the comments

P3: The Michael Jackson one

P4: sometimes scary

P6: //It's sometimes terrifying but often funny"

The meme they refer to is seen below in Figure 5.6 which is an image showing Michael Jackson eating popcorn. This reflects back to the previous section, where viral content was seen as a form of entertainment, which appears to be the case for comment sections online as well. Engaging with online discussions is seen as a waste of time and the spaces to engage in discussion are seen as low quality while also being entertaining by how awful the quality of the comments are.

Figure 5-6: Michael Jackson Popcorn meme

Note: Image taken from Lima (2016)

Overall, the view that the Internet is unsuitable for serious discussion was prevalent in all of the focus group discussions. The opportunity to engage in serious discussions was seen as a waste of time. This is a troubling finding as there are serious consequences to communication serious issues in society as the Internet use has grown massively over the last decade (See The World Bank, n.d.) with social media growth and becoming increasingly normalised in society (See Ofcom, 2015, p. 32).There was a consensus that engaging in climate change debates would not benefit anyone and be unlikely to influence others. In some cases the suggestion that they might engage in online discussion was just

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seen as funny. Potentially this is a major barrier to effective climate change communication online as there is the risk that people just won't feel that there is any benefit from engaging.

An interesting finding from the focus groups was the fear of negative backlash from other users as a major demotivating factor in the decision of whether to engage in online discussions. A reason for this perception of risk is due to the Internet providing anonymity to users which increases aggressive behaviour to others due to a disconnect between seeing other users as human beings and the highly unlikely chance of reprise as their identity is unknown (See Santana, 2014, Smith et al., 2007, Sproull and Keiesler, 1991). This was highlighted as a significant risk to engaging with climate change online across all of the focus groups.

The idea of behaviour change due to this disconnect with other users was reflected in FG2 when P3 suggests that their interaction changes if they don't know who they were talking to:

> "I: what if you knew the person from your day-to-day life?
>
> P3: Yes I think we are more respectful if you know them. So on Facebook… people comment and they don't know each other and it's a bit tense and your going everyone just calm down so you just try to avoid it all together."

This suggests that the negative behaviour caused by the breakdown of social behaviour norms is a significant factor in reducing the likelihood of the participants taking part in climate change discussions.

Consequently, the fear of backlash was highlighted by P4 in FG5 as a factor in deciding whether to engage with issues online or avoid them entirely:

> "I: What do you get in engaged with then? What sort of topics?
>
> P4: Not very much at the minute really. I will do some things about science on things like Reddit. The non-contentious stuff like genuine questions, which we are pretty sure about. I try to avoid contentious things. Stuff like pesticides people get angry very quickly."

The idea of an issue being contentious is essentially seen as a warning sign, potentially leading to aggressive responses which P4 highlights they only want to take part in online debates if they "… know its not going to lead angry discussion".

The fear of backlash is not unfounded as there is the risk of negative responses from other users and there have been examples of organised attacks on individuals due to the victim sharing their opinion online. An example of this can be seen in the response to a Kickstarter campaign started by Anita Sarkeesian, asking for $6,000 to fund a video series examining female representations in video games, which resulted an organised online attack (Lewis, 2012a, Shaw, 2014). The attack (See Figures 5.7 and 5.8) was both directly targeted messages and vandalism of her online pages including:

> "… her Wikipedia page was vandalized, she was sent (and continues to receive) rape and death threats, images were posted of her being raped by video game characters, and a flash game was created that allowed players to "Beat Up Anita Sarkeesian" by clicking a picture of her until it turned into a bloody pulp" (Shaw, 2014, p. 3).

Despite being targeted by a portion of the online gaming community, Anita Sakessian has continued with production of the series and received well above the initial asking money for her Kickstarter, as the attack resulted in producing large scale awareness for her project (Shaw, 2014, Lewis, 2012a). The outrage of a community of gamers meant this received massive public attention and highlighted the issue of sexism in the online gaming community.

Figure 5-7: Example of online abuse targeted at Anita Sarkessian

Note: This was one of many tweets sent within a week to the Feminist Frequency Twitter account. Image taken from Feminist Frequency (2015).

Figure 5-8: Interactive "Beat up Anita Sarkessian" game
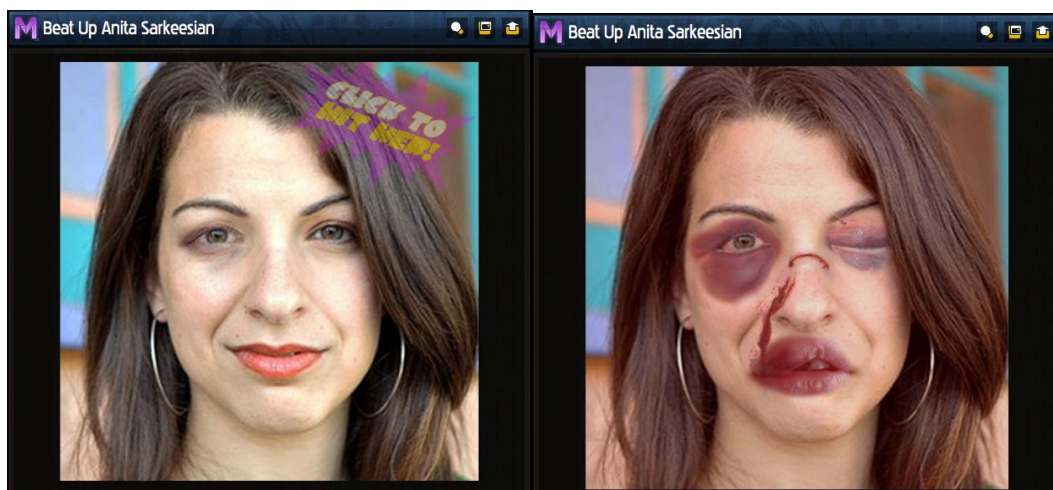
Note: Images taken from Lewis (2012b).

This harassment campaign was a response to criticism of gender portrayal in video games, which suggests that the fear of backlash is a potential for not engaging with climate change communication. The risk of harassment online was a determining factor in what the participants decided to engage with online. For example, P8 in FG1 argued that they engage with hobbies online, as the risk of aggressive behaviour from other users was low:

"You know it's like discussions on how you should could do this better then someone might disagree and be like this could work better and might have

a discussion. It might just be because it's not as big an issue. If you disagree with someone how to best train your calves does it matter to you. You're just going to just carry on doing like you know if you then. I don't know if that's a factor in it because climate change is such a like if you have a genuine opinion and someone is the opposite. As [removed] it effects everyone in a really big way so of course it's kind of that clash it's much less important issues they can just have a chat about it and then."

Due to the focus not being on significant issues in society there was a view that people were not as likely to have strong emotional responses to disagreements.

Even with users being anonymous they were put off taking part in serious discussions. The potential of a negative response from other users was seen as a key reason to not bother with engage in online discussion and the idea of engaging in online comment sections seen as a funny prospect by the other participants. This perceived risk of backlash from getting involved in climate change discussion was a key demotivation to Internet users.

The fear of harassment and backlash appears to be a strong motivation to avoid discussing climate change online and other serious issues in society. The anonymous environment and the ease to make new accounts means that there is a risk that an individual or group can easily engage in harassment of an individual. This perception of the risk of backlash appears to be a major factor in the participants' decision to engage with climate change online and wider issues in society. As a result this is a major barrier to the communication of climate change online as it means that users are less likely to actively engage with the information.

Overall, a clear response from the focus groups was that information overload had resulted in the filtering of the information they receive with competition from differing topics for their attention. This section has highlighted that some participants felt they lacked knowledge on the subject to adequately engage with climate change online. This is reflected by previous research (See Bord et al., 2000) which shows that the general population has a low understanding of climate science. In addition to the lack of confidence, there is another problematic issue where the participants viewed the Internet as a place

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for entertainment and not serious communication of issues in society. This had consequences, as climate change was filtered out along with more serious issues, to instead receive information through social media on hobbies and entertainment. In the case of FG1, P5 was spending a lot of free time within online communities that appealed to their interests, which meant they were less likely to engage with more serious issues such as climate change. This is a particularly worrying finding when these focus groups previously established that the Internet is the primary method that the participants engage use to with information. However, one factor that explains this lack of engagement can be seen in the fear of backlash, validated by examples of individuals being targets of harassment by organised groups.

5.2.3: Junk information

The Internet has enabled anyone to produce content and there is a risk of junk information. In the case of climate change, junk information is climate sceptic material, which goes against the climate consensus of anthropogenic climate change. To explore the reaction to junk information, the focus groups were asked what they did if they received unwanted information in their social media. The general response, if they received information that challenge their' worldview, or someone posted something of questionable content, was that it would be ignored. For example, P3 in FG1 noted that climate sceptic content can simply be ignored by not engaging the poster:

> "The great thing about the Internet you can just scroll past it and refuse to engage with it. That is the beauty of it. You don't have to be ignored by it and no obligation to comment. It's just simply you scroll past it and get on with your day. The propensity to engage with that sort of media is very very low."

The way that P3 phrases this statement is very positive to the fact that you can filter the information you receive through social media. This approach of simply ignoring something was particularly interesting, as P11 from FG1 would not reply online to someone posting the climate sceptic meme even if they knew him or her in person, but instead highlights:

"P11: I think if I saw it on my Facebook and I knew the person and they were actually posting it seriously I would really want to go ask them why they would post something like that and try to understand. But not something I would reply to on the Internet. I would have to talk to them and I have to know them."

A confrontation over why something was posted required P11 to know the person in their day-to-day life but a face-to-face discussion was desired rather than directly questioning them online.

A climate sceptic meme was handed round each of the focus groups (see Figure 5.9). This received a negative reaction from every focus group. FG1, for example were critical of the person who produced it:

"P11: A total lack of misunderstanding of basic facts.
P7: Seems like shit pulled off of a Fox News report."
A similar reaction was seen in FG2:
"P4: my gut reaction depending on how you feel about obviously the gut reaction you have towards one of them which is like the climate sceptic one which is like yeah but shut up. It's not what anyone is saying.
P1: I almost feel that was made to take the piss out of climate sceptics as it's too silly.
P4: I get climate sceptic discourse if you were to discuss it but that's the lowest hanging fruit. The climate is not changing as it's snowed.
I: that's actually from a climate sceptic blog.
P1: really wow"

There was a general consensus across all the focus groups that they would ignore content of this sort with others highlighting that they do not see climate sceptic memes with P3 in FG3 commenting "I don't think I have ever seen even actively looking at anything they got...".

Figure 5-9: Climate sceptic meme example

Note: Image taken from climate sceptic blog (Neoavatara, 2010).

There was a limited range of reactions from this potential circumstance of someone posting questionable content that they knew on Facebook. One reaction from P5 in FG1 was to also ignore the person "… but I would have a look at the article and have a quiet chuckle at its idiocy". A much stronger reaction was from P11 in FG2 who instead would "Stop following whoever posted them…". However, most of the participants would not have engaged with an online discussion and instead simply ignored the post.

There was only one participant in FG1 that said they would say something if questionable content was posted or shared by someone that they are friends with or follow on their social media.

"P4: I can get like well I did not engage in an argument then if something really crosses the line I would let that person know they are an idiot. Like on Twitter the earlier day like the Jordanian pilot who got burnt alive with some boys putting up the photo of him on his knees burning and putting

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comments on top that were taking the piss. I can't remember what. I just let some guy know he's not ok in his head. There are just some things that I can't hold myself back from as they are crossing the line thinking they are funny when they are not. I do tend to get a bit emotional sometimes when they go too far. But like I can still scroll past but I am still like you're an idiot but I won't say it all the time."

P4 is referring to images from a video showing the Jordanian pilot Moaz al-Kasasbeh who was burnt alive in a metal cage by Islamic State (BBC, 2015). The reaction by P4 was not to engage in discussion but instead respond to the poster of the offensive material to let them know that they found the post to be in bad taste. Even then, P4 highlights there is a chance they would simply ignore junk information by scrolling past material.

In the case of the reaction to climate change junk information, there were participants in FG2 who were climate sceptics. Both P10 and P7 believed in natural causes for climate change:

"P10: Call me controversial but I believe in the sunspot theory. Like the number of sunspots around the sun is causing more heat to come here. I don't really believe this carbon malarkey. I do like the idea that there are resources that are running out in this world and we need to conserve them and I do think just burning coal is not great for this natural environment of this earth and I do believe in renewables.
P7: I don't believe it's human created but human influenced. I did research into it and it seemed to be that the Earth goes in a natural cycle, but we are pushing it further much further out which is dangerous. I don't think it's completely our fault, but we're not helping."

This view that climate change is a natural occurrence is a common climate sceptic belief. The sunspot theory mentioned by P10 is recognised by many to be a climate sceptic myth with a belief that the sun has increased in activity and as a result has increased the amount of heat the Earth receives. Instead, the sun has been in a slight cooling trend since the 1960s (Damon and Laut, 2004). When P10 was discussing accessing climate change information there was a key element of doubt:

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"P10: I'm very sceptical on all these climate reports generally. I mean ever since that scandal with that East Anglian University and since then I have been very conscious of what's being reported."

There was a mistrust of climate change information with P10 directly referring to 'Climategate' as one of the key reasons he directly mistrusts coverage of climate change he sees. 'Climategate' (see chapter 2) initial coverage started online with climate sceptic blogs seeking to create mistrust of climate scientists (Nerlich, 2010). This attack on climate scientists appears to have created or reinforced the climate sceptic beliefs of P10.

Interestingly, while the climate sceptics had little interest in engaging with climate change information, there were non-sceptic participants in FG2 who did not see engaging with climate change worthwhile. For example, P11 argued that while they agree with human caused climate change, they saw little point in engaging with climate change online:

"P11: I'm very much on the same page. I think it's definitely caused by us. They are incredible bores. They just can't be reasonable. They just want to put their views out there as loudly as possible so it's not very interesting. They repeat themselves endlessly.
I: So you don't see it as worthwhile to engage with it?
P11: No because the sort of people don't want to be engaged because you're not going to change their minds and they're not interested in changing yours. Just going to have a go at you if you disagree with them. And that's either side.".

Online discussion of climate change was viewed as a waste of time by P11. A key aspect that made this a waste of time to P11 was a perceived political bias and a belief that it was ineffective to have a political debate online.

Overall, junk information potentially causes a risk to young people's understanding of climate change if climate sceptic discourse was to go viral. An interesting finding from FG2 was that the disengagement with climate change was found in those who were self-identified climate sceptics. Climate sceptic discourse has the potential to persuade people and possible cause further

disengagement with climate change as doubt about the seriousness of climate change is created. Again, this stems from previous findings that the Internet is not seen as a place to debate serious issues. When coming across junk information like climate sceptic material, the main response from participants was to simply ignore it. This suggests that the greater issue is disengagement rather than climate sceptic discourses.

5.2.4: Sharing and Information overload

The focus groups highlighted an interesting overlap between sharing and information overload. Despite participants filtering the content they received, there was the potential for viral content to reach a wide audience. An example was brought up by P5 in FG1 who mentioned a shocking meme that was shared within their network:

> "…for example if anyone has heard of 'Shrek is Love Shrek is life'
>
> PA: **a mixture of chuckling and groans**
>
> P5: that was used quite extensively within our Facebook chat by certain members who actually struck upon it a lot earlier before it became a general meme back when it was just a meme focused within the gaming community."

'Shrek is Love, Shrek is Life' was a shock meme of a story of a young boy being sexually assaulted by Shrek which was originally posted on 4chan (See Figure 5.10) (Know Your Meme, n.d.-n). This original post was then turned into an animation using video game characters (See Figure 5.11) which has over 8 million views (Sykotic, 2014). The reaction from the group highlights that the meme was either viewed or the other participants were aware of it. While the shocking nature of the meme is surprising, it also led to a series of reaction videos on Youtube with the Youtubers react video by The Fine Bros (2014) reaching over 16 million views. This shock meme has spread due the shocking nature and the entertainment found in watching peoples' reactions to the video which means it has been shared like the previous meme examples for entertainment purposes.

Figure 5-10: Shock meme example - 'Shrek is Love, Shrek is life'

Note: Image take from Know Your Meme (n.d.-o) with the worst expletives edited to blur out.

Figure 5-11: 'Shrek is love, Shrek is life

Note: Screen shots take from the Youtube video by Sykotic (2014).

There is the potential for viral content to overcome steps taken by users to avoid information overload. The shock meme of 'Shrek is love, Shrek is Life' received a strong reaction from the focus group members. However, in the context of climate change communications, non-climate change shock memes shared for entertainment are a distraction from serious issues. The shocking nature means that they become widely shared and viewed despite potentially having only entertainment value. Shock memes highlight the potential distractions the Internet can provide.

5.2.5: Sharing, information overload and Junk information

Another overlap occurred between sharing, information overload and junk information. In the focus group discussions of memes, it emerged that the majority of FG2 viewed memes negatively as a way for communicating serious issues. For example, P9 said that when they did see political memes they were "… normally a one-shot issue" and simply suggested that memes are not designed for transmission of serious issues. The communication of political issues via memes was criticised by P11 and P5 who highlighted a mistrust of memes in memes:

> "P11: A political one I saw doing the rounds recently with two photos of the House of Commons with one labelled MPs discussing their pay and the other one was discussing child abuse. I think the political ones tend to be ill informed.
>
> P5: I have seen a lot of memes to do with feminism and especially anti-feminism in comment sections of things. Then again a lot of it seems to spout from misinformation. I don't think you could see memes as a reliable source."

Both P11 and P5 highlighted a mistrust of memes as a reliable source of information. An example given by P11 is the images of Members of Parliament [MP] in the House of Commons with labels on the images of the House of Commons with very few MPs debating a topic such as 'debating the living wage' while contrasted with an image of parliament packed with the label 'debating MPs' pay' (See Figure 5.12). This meme is criticised by Hardman (2014) who highlights

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that the 'debating MPs pay' was an image of the first day of the new Parliament after the 2010 election and the information on each of the images is misleading. This meme plays into the current levels of public distrust towards UK politicians and Hardman (2014) suggests that if public trust was higher then these memes might not spread so well. This is one of the risks of viral content with low quality or incorrect information remaining immortal on the Internet with many simply seeing the meme and believing the message without exploring further. As a result, it reinforces the belief that politicians are untrustworthy (Kien, 2013).

Figure 5-12: House of Commons debates meme
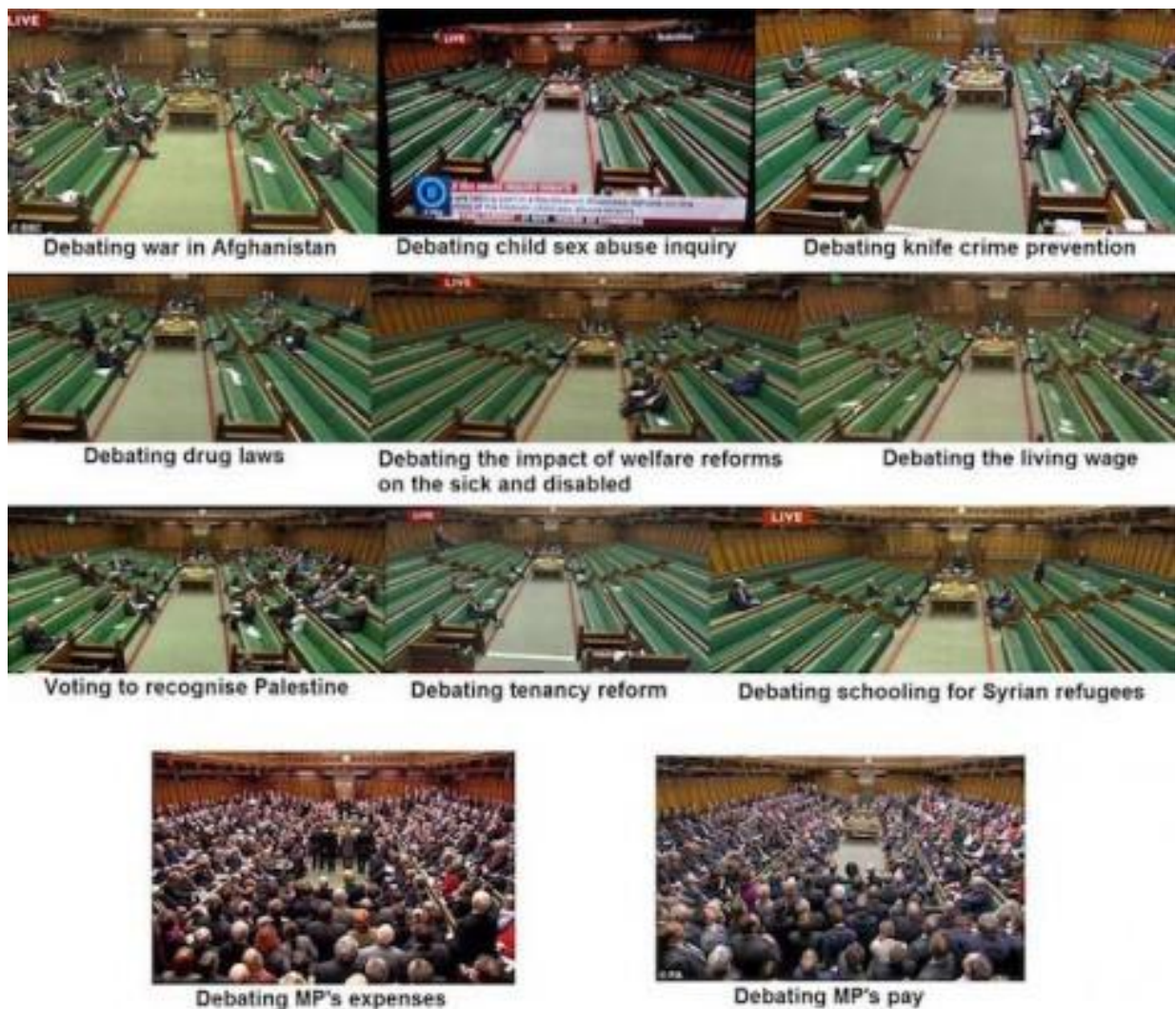
Note: Image taken from Hardman (2014)

This example highlights the ease of transmitting junk information through social networks while distracting from other serious issues in society. The focus

groups suggest that junk information can potentially spread rapidly if it falls into pre-existing views or judgements. This demonstrates that viral content cannot be viewed as a inherently trustworthy source of information and the spread reinforces the mistrust of memetics found in the focus groups as a form of communication. In Particular, FG2 showed there was distrust towards them as a source of information, presuming instead that they were incorrect or misleading. As a result, the use of memes is potentially limited as a way of communicating serious issues like climate change if the information is seen as unreliable then it will be ineffective at mobilising people to take action or influencing their pre-existing views.

Overall, social media has offered the opportunity for the viral communication of climate change. However, this to be undermined by a variety of issues. There was a lack of engagement with climate change information online. Instead, the sharing of memes over social media was done for entertainment rather than for communicating serious issues. The participants demonstrated that they filtered out topics that were not of interest, with climate change being shown to be in competition for their attention with a vast range of subjects. There were some examples that showed it was possible that viral content could bypass this filtering, but it was shocking material and even then it was shared for the purpose of entertainment. In addition, memes were seen as an untrustworthy source of information, which decreased the participants' motivation to engage with them. Therefore, the key strength of Internet communication, that a vast range of people can be reached, is undermined by the perception of viral content and a lack of trust in it. This suggests that attempts at viral communication of climate change will most likely be unsuccessful.

5.3: Summary

The focus groups have provided a useful insight into the impact of Internet aspects of the information society (sharing, junk information, and information overload) upon public understanding, attitudes, and perception of risk of climate change. In all of the focus groups, the participants had a sense of always being connected with the Internet, in particular social media, playing an important role in the organisation of social events, work, and accessing news in their day-to-day

lives. This connectivity was only noticed in the absence of the Internet for some of the focus group participants. However, the consequences of the sharing, information overload, and junk information (and their intersections) were reflected in the findings of the focus groups.

The focus groups highlighted that all participants were aware of and engaged with memes. However, there was a consensus that memes were a form of entertainment and not a method to communicate information about issues in society. Participants engaged with memes for entertainment, and the majority simply did not see climate change or environmental memes. Instead of engaging with climate change, the participants had shared experiences of entertainment memes such as '*Grumpy Cat*'. The '*Shrek is life, Shrek is love*' shock meme that FG1 participants had a shared awareness of, had reached a wider audience due to its shocking nature. Despite its shocking nature, the main driver of its viral success was entertainment created from watching other people reacting to the video. The FGs reflect that the main driver of the success of Internet memes in general appears to be the entertainment value of the content.

Examples that emerged from the focus groups highlight that viral communication was seen as a form of entertainment while there was also awareness of the Internet being echo chambers and concern over junk information (See figure 5.13). The examples from the focus group have been placed on the information society model previously discussed in chapter 2. Memes such as '*Grumpy Cat'* and '*Bad Luck Brian'* were widely shared for entertainment purposes and a distraction from serious issues rather than for communicating serious messages. This reflected the arguments made by Chesterman (2011) that memes were successful if they are simple and entertaining messages rather than complex serious topics, which is why there are so many more successful MLP memes to climate change memes (See chapter 3). Interestingly, there was awareness of the filtering and echo chamber nature of the Internet, but this was generally seen as a good thing. Examples given in FG1 with video game memes from the WoW community reflect the echo chamber nature with a series of in jokes being shared within a community. However, despite the filtering behaviour, viral content can successfully reach a larger audience with '*Shrek is life, Shrek is Love*'. There was also a distrust of virally shared information as there was awareness of false information shared with the

example of the '*MP voting*' meme. Despite this, the vast majority did not see climate sceptic material, and some presumed the example sceptic meme was a joke. The focus groups suggest that while there is a risk that climate sceptic material can go viral, it has difficulty achieving this compared to more emotive domestic politics, which reflects the information processing discussed in chapter 3.

Figure 5-13: Memes shown on the dark side of the Information society analytical framework
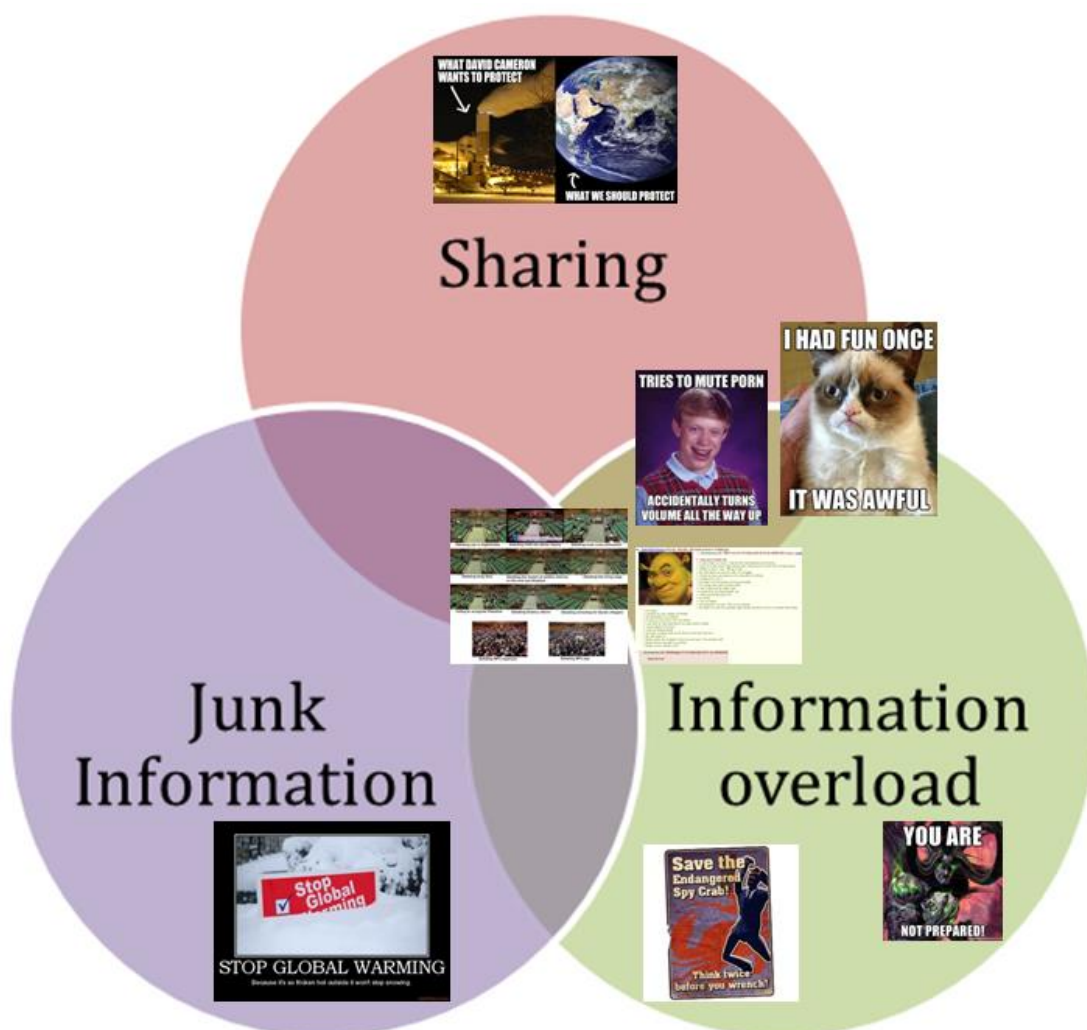
The perception that memes are for entertainment means there is a barrier for viral communication of climate change information. The spread of memes requires engagement from users and a lack of interest or engagement with climate change is going to undermine the potential viral spread of information. The lack of interest or desire to engage with climate change has been shown in previous research by Lorenzoni et al. (2007) to be a key obstacle to developing

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public understanding of climate change. The focus groups also doubted the ability for memes to spread serious information as the memes that the participants were familiar with were shared for entertainment rather than for communication of political issues (Kien, 2013). Even when political memes were shared, the focus groups showed distrust towards them as a source of information, believing memes to be simply used for jokes than serious communication. Memes were seen as junk information and simply not engaged with as a serious form of communication, with climate change memes simply not being seen or engaged with.

This highlights that Internet poses new challenges to climate change communicators as the personalisation of the experience means that users can easily opt out of media coverage of the issue. This is both a conscious and unconscious process as users select what they wish to engage with, while at the same time automated filtering based on past user engagement is taking place. However, some of the participants were aware they engaged in filtering, but as they had no interest in climate change they did not see it as an issue. The information rich environment meant that the ability to filter out climate change information was even seen as a positive by some of the focus groups members to avoid being overloaded with information. Therefore, rather than there being too much climate change information, the experimental design will include additional topics in competition for the participant's attention. The focus groups highlighted that engagement with climate change information took place if a participant was already connected to environmental networks such as following Greenpeace on Twitter or Facebook.

However, if the participants' were interested in engaging with climate change information there was two key barriers that undermined engagement. There was a clear view held by the participants that the Internet was not seen as a place to have serious discussions, and there was little motivation to access climate change information. A key barrier was a fear of online harassment and backlash of getting involved in climate change discussions. In addition to this fear, there was a view that social media was a place for entertainment and not serious discussion. Considering the dominance of the Internet in the participants' lives, with most participants not using traditional forms of media, this view that social media was a place for entertainment undermines climate change communication

online. This suggests that a major issue with climate change communication is the lack of engagement, and producing content to bypass the filtering behaviour used by users to avoid information overload. Communicating climate change through the Internet has barriers and to improve engagement with young people by making sure climate change is covered within the school curriculum (See chapter 3).

The focus group results may be interpreted by some readers to mean that climate change is unsuitable as a case study to explore the impact of the Internet. However, I strongly believe that this disengagement with climate change makes it more important to study. The seriousness of climate change and how people are impacted by information they see online is extremely important to study. The development of public understanding of climate change is challenging, but important to create political pressure for effective resolution. The findings from the focus group have been taken into consideration in the experimental design with information overload reflecting the idea that climate change is in competition with a sea of other information competing for user attention. The information overload treatments reflect the competition with other information online. Therefore, the following chapter examines the consequences of climate change engagement in an information rich environment and the potential for the public to be misled by junk information.

Chapter 6 Experimental analysis

This chapter analyses the results from the experimental treatment groups. The experimental data is examined in four sections. Firstly, I examine the affects of post-stratification propensity scoring on the control variables. Secondly, this examines the impact of the media stimuli on the participants' basic understanding of climate science. The third section evaluates the impact of each of the treatments upon the participants' perception of risk that climate change poses. The final section examines the consequences of each treatment on support for action to tackle climate change. The data analysed using logistical regressions and has been weighted using propensity scoring (See chapter 4).

6.1 Control variables

The control variables have been weighted due to the additional non-randomised surveys to reduce the impact of confounding variables. The frequencies of the data weighted and not weighted can be seen below in Table 6.1. The weighted results are generally closer with similar results between the control and the treatment groups. Therefore reducing the impact of confounding variables skewing the experimental results. This weighting worked particularly well for control variables such as understanding of the experimental method, which had before variations between 0.7 (Junk information and information overload) as the lowest with 0.85 (information overload) as the highest. After weighting the lowest score was 0.71 (both the information overload treatment and junk information and information overload treatment) with the highest being 0.73 (junk information). Weighting worked less well for the control variable for the rejection of pseudoscience, which had a low score of 0.33 (information overload) and a highest 0.59 (junk information). After weighting the range is narrower with the lowest being 0.39 (junk information) and the highest of 0.56 (control).

Table 6-1: Mean scores for the control variables before and after statistical weighting

Control variable	Control	Junk information	Information overload	Junk information and information overload
Physical science mean score out of a total of 6 points	5.25 (5.25)	5.05 (5.06)	5.05 (5.23)	5.73 (5.65)
Biological science mean score out of a total of 7 points	5.86 (5.86)	5.19 (5.73)	6.08 (5.6)	5.83 (5.68)
Understands the experimental method	0.72 (0.72)	0.76 (0.76)	0.85 (0.71)	0.7 (0.71)
Understands probability	0.94 (0.94)	0.6 (0.82)	0.91 (0.83)	0.97 (0.94)
Understands the scientific method	0.77 (0.77)	0.58 (0.76)	0.84 (0.68)	0.84 (0.82)
Rejects pseudoscience	0.56 (0.56)	0.59 (0.39)	0.33 (0.46)	0.49 (0.38)

Note: Questions examining understanding of experiments, probability, scientific method, and rejection of pseudoscience were binary results of either 0 or 1. Basic physical science knowledge was out of a total of 6 and basic biological knowledge out of a score of 7. Scores in parenthesis are post-weighted with the pre-weighted score being before.

The poor matching for pseudoscience could be due to a huge imbalance of non-randomness across the sub sample. Another possibility of the weakness in the pseudoscience weighting could be due to the nature with the measurement approach of asking about belief in astrology as Afonso and Gilbert (2010, p. 332) argue pseudoscience to be a continuum rather than a binary true and false with examples such as acupuncture being found to have some "… limited scientific acceptance following carefully controlled experiments". As a method of examining scientific understanding it is questionable as the assumption underlying the measurement is that belief in pseudoscience is caused by a lack of scientific understanding. In much the same way that attitudes towards science depends on a variety of other factors (See Sturgis and Allum, 2004) there is an argument by Afonso and Gilbert (2010, p. 332) that while surveys have found widespread belief in pseudoscience "… the individuals concerned must have

some necessarily non-scientific grounds, for their trust". Belief in pseudoscience can be produced by a lack of understanding of scientific methods, but also by personal beliefs (Afonso and Gilbert, 2010, p. 343). Despite these issues with measuring belief in pseudoscience the inclusion of whether or not astrology is scientific has been included as a control variable, as it does offer some insight into how the participants perceive what is scientific or not and whether they can reject scientifically incorrect claims.

Overall, the participants have demonstrated a generally high level of scientific literacy with the majority scoring highly in basic knowledge and understanding of the scientific process. However, there appears to be difficulty in rejecting pseudoscience compared to other control variables. All these control variables have been used in the linear regression models to examine whether they have influenced the results to the dependent variables. The following section provides descriptive statistics for the dependent variables and whether the media stimulus has had significant effects on the understanding, perception of risk, and attitudes to climate change mitigation.

6.2: Dependent variables:

There were nine dependent variables analysed with the use of linear regressions presented as three models. The data used in these models were weighted as the inclusion of non-random control data (see chapter 4) resulted in all variables being non-significant with some close to being significant at $p>.05$. Once propensity scoring had been used to weight the non-random data the results found a wider range of significance that will be discussed in this sections. These models compare each treatment to the control group. Model 1 compares the junk information treatment to the control. Model 2 compares the information overload and junk information treatment to the control. Model 3 compares the information overload treatment to the control group. The experimental treatments were designed to critically examine three aspects, to see if there has been an impact. First, examining whether basic understanding of climate science is affected by media stimuli used in the experimental treatments. Second, this section evaluates the perception of risk between each of the treatment groups.

Finally, their attitudes to climate change mitigation. To begin with, this section will examine the impact on basic knowledge of climate change.

6.2.1: Basic knowledge of climate change

This section examines the impact of the media stimuli on three dependent variables. First, it examines whether there has been any significant impact of the treatments upon the knowledge of causes of climate change. Second, it looks at the consequences as to whether the treatment groups were able to correctly tell which climate change statement was true or false. Finally, it evaluates whether the treatments impacted the participants' ability to correctly identify greenhouse gases. Ultimately, this section evaluates whether the treatments have significantly impacted the participant's basic knowledge of climate change.

To begin with this chapter examines the impact of the media treatments on the participants' understanding of the causes of climate change. The responses for the total score for understanding the causes of climate change across treatment groups are shown in Figure 6.1. The median score was 5 out of 8 in all but the junk information treatment which had a median score of 6 out of 8. The control had a lower extreme with a score of 1 and an upper extreme score of 8 which highlights the range of scores for the understanding of the causes of climate change. The information overload had the lowest spread of results with the upper extreme scoring 6 and the lower extreme scoring 3.

Figure 6-1: Understanding the causes of climate change
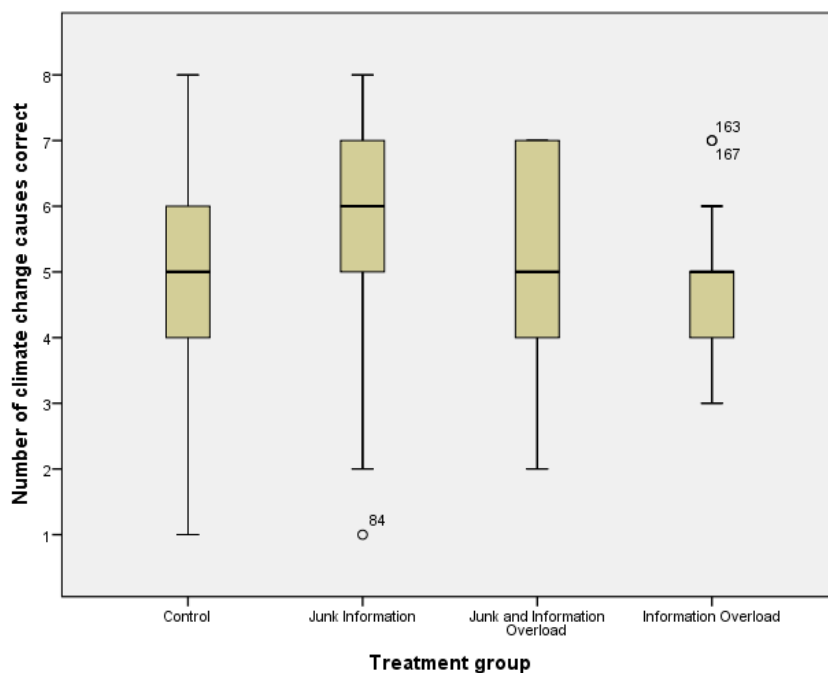
Note: Produced using the weighted data.

Table 6-2: Logistical regression for participant's score for causes of climate change

	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	SE	B	SE	B	SE
Basic Physical knowledge	0.33*	0.16	0.34*	0.17	0.26	0.16
Basic Biological Knowledge	-0.16	0.17	-0.13	0.20	-0.05	0.17
Rejection of pseudoscience	0.79**	0.26	1.00**	0.28	0.74**	0.27
Understanding Experimental method	1.75***	0.45	1.10	0.63	0.43	0.62
Probability	0.48	0.68	0.52	0.78	0.63	0.66
Scientific method	0.56	0.31	-0.65	0.58	-0.16	0.60
Junk info	0.16	0.09				
Junk and info overload			0.03	0.34		
Information overload					0.32	0.30
Adj. r^2			0.09		0.27	

* $P < 0.05$; ** $P < 0.01$, and *** $P < 0.001$

The results of the logistical regression (See Table 6.2) for Model 1 found a similar result with junk information not having a significant impact on the participants' understanding of the causes of climate change. It also found the rejection of pseudoscience having a positive impact being a significant control variable at $p<.01$. Additional control variables in Model 1 found that basic knowledge of physical science having a positive impact, and their understanding of the scientific method having a negative impact were both significant at $p<.05$. In particular, the control variable that was significant at $p<.001$, was the understanding of the experimental method which had increased the score on model 1. Model 2 found no significant impact of the junk information and information overload treatment, but also found that the rejection of pseudoscience was a positive significant result at $p<.01$ to the participants' scores for the causes of climate change. In addition, model 2 found that basic knowledge of physical science had a positive impact at $p<.05$. Finally, Model 3 found that climate consensus material, in an environment of information competition, did not have a significant impact on the understanding of the causes of climate change. Instead, the rejection of pseudoscience was found to be a significant control variable, at the $p<.01$, impacting the score for the information overload treatment. The findings from all three models show that the experimental treatments did not have a significant impact upon the participants' understanding of the causes of climate change, and instead shows that scientific literacy had a greater impact, with participants' in model 1 able to reject incorrect scientific information.

The second dependent variable to be examined was the total count correct from six true or false climate change statements. The responses to the true or false statements about climate change had an interesting result (See Figure 6.2). Information overload had the largest result with a median score of 6 and the extreme low being a score of 4. In comparison both the other treatment groups and the control had a median score of 5 with the extreme low being a score of 3 in both junk information and junk and overload information treatments. The control had one person scoring an extreme low of 0. This suggests that exposure to climate sceptic information negatively impacted the knowledge of climate science. This dependent variable tested whether they were able to reject climate sceptic arguments, such as the changes to the climate was due to natural causes,

or awareness of the consequences such as the melting of the ice caps. These found generally consistent responses with the majority of all participants aware that the ice caps were melting, but there was more variation in awareness of the scientific consensus (See Table 6.3). Those who received junk information were much more likely to be answering that there is disagreement surrounding climate science with 81.03% getting the question incorrect compared to 17.28% incorrect in the control group. This is not surprising considering examples of junk information provided in the media stimuli directly questioned the validity of climate science with articles such as WhoReallyKnows (2016) which directly claims that climate science is a hoax. However, this shows the worrying impact of junk information at undermining the perception of the climate consensus (see chapter 2).

Table 6-3: Example of results for two of the statements from climate change true false statements

Statement	Control	Junk information	Junk and information overload combined	Information overload
Correctly knew that climate change is causing the majority of glaciers and sea ice to melt around the world	82.72%	88.97%	82.25%	91.35%
Reject that scientists disagree about whether humans are causing the Earth's climate to change	82.72%	18.97%	37.23%	82.69%

Figure 6-2: True or False climate change statement results
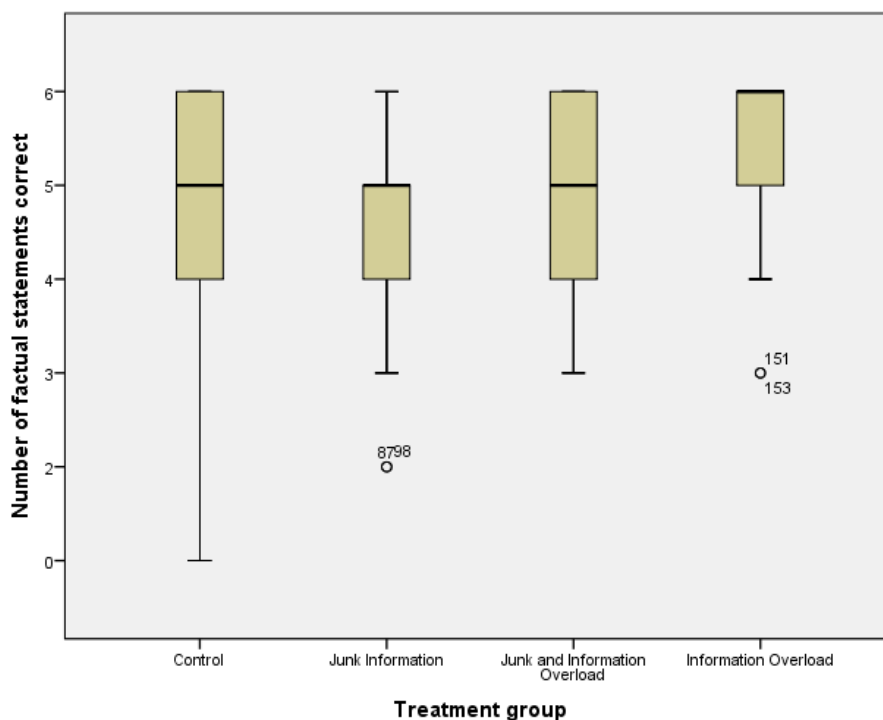
Note: Produced using the weighted data.

Table 6-4: Logistic regression for participants' score for true and false climate statements

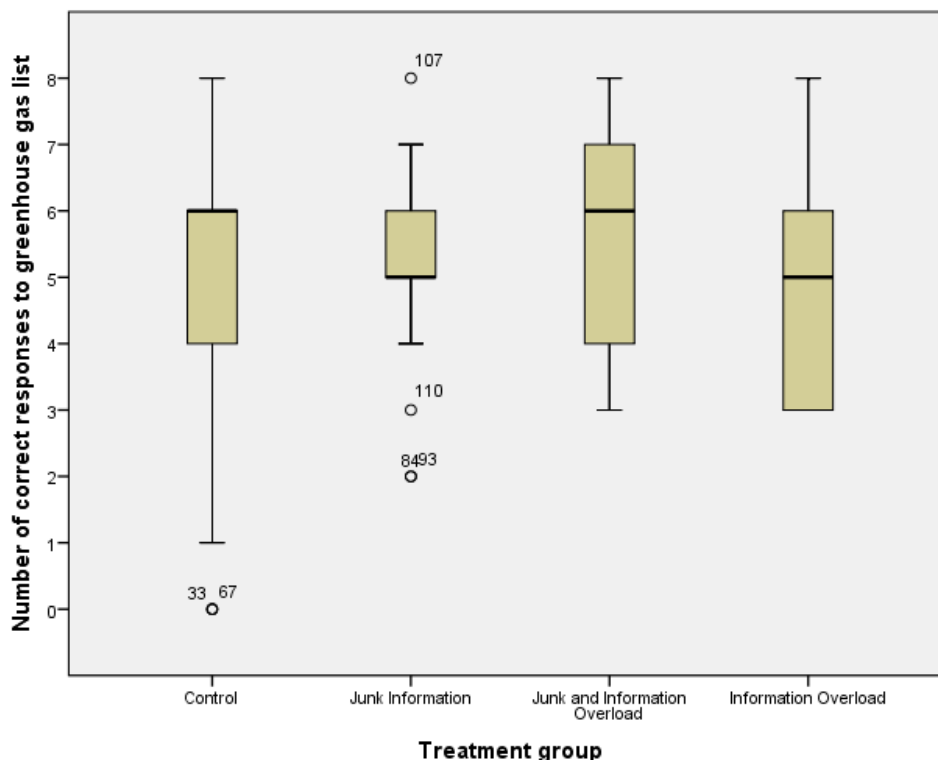|	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	**SE**	**B**	**SE**	**B**	**SE**
Basic Physical knowledge	0.42**	0.13	0.34*	0.13	0.26*	0.13
Basic Biological Knowledge	-0.09	0.14	0.08	0.15	0.02	0.14
Rejection of pseudoscience	0.19	0.22	0.12	0.22	0.05	0.21
Understanding Experimental method	0.54	0.37	-0.07	0.48	0.05	0.49
Probability	0.45	0.56	0.79	0.59	0.91	0.53
Scientific method	-0.29	0.41	-0.04	0.44	0.09	0.47
Junk info	-0.22	0.26				
Junk and info overload			-0.06	0.26		
Info overload					0.74**	0.24
Adj. r^2	0.09		0.13		0.10	

* $P < 0.05$; ** $P < 0.01$, and *** $P < 0.001$

Model 1 found that junk information had a negative impact on the score, but this was not statistically significant (See table 6.4). Instead, the control

variable of the participants' basic physical science knowledge was found to have positive and statistically significant impact on their score for true and false climate change statements at p<.01. Model 2 found that the junk information and information overload treatment had a slightly negative impact on the participant's score, but this was not statistically significant. Instead, like the other two models, the control variable for basic physical science knowledge had a positive impact on their score for correct responses to the true and false climate change statements, and was statistically significant at p<.05. The logistic regressions for the climate change statements found in model 3, that the information overload media stimuli have a positive impact, was statistically significant at p<.01. In addition, the control variable for basic physical science knowledge was also found to have a positive impact on the score for true and false climate change statements. The findings from all three models show that basic knowledge of physical science had a greater impact on the participants' knowledge of climate science than the media stimuli of the treatments.

The final dependent variable to examine for basic climate change knowledge, is whether the treatments impacted the basic knowledge of greenhouse gases (See Figure 6.3). The lowest scores for this variable were found in the control group with the extreme low being a score of 1. The median for the control and junk and information overload was a score of 6, while junk information and information overload had a median score of 5. The range of correct answers varied between the control and the treatment groups, with the control having the lowest extreme low with two participants having a score of 1. These results suggest that the participants' in all treatment groups and the control had a generally good knowledge of greenhouse gases.

Figure 6-3: Basic knowledge of Greenhouse gases

Note: Produced using the weighted data.

Table 6-5: Logistic regression for participant's score for greenhouse gases

	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	**SE**	**B**	**SE**	**B**	**SE**
Basic Physical knowledge	0.92***	0.17	0.95***	0.20	0.93***	0.19
Basic Biological Knowledge	0.26	0.20	-0.15	0.23	-0.11	0.20
Rejection of pseudoscience	0.60*	0.30	0.40	0.33	0.65*	0.32
Understanding Experimental method	-0.24	0.50	0.84	0.74	0.40	0.74
Probability	0.16	0.77	0.66	0.91	0.79	0.79
Scientific method	-0.02	0.56	0.00	0.68	-0.08	0.71
Junk info	0.50	0.35				
Junk and info overload			-0.03	0.40		
Info overload					-0.18	0.36
Adj. r^2	0.23		0.25		0.28	

* $P < 0.05$; ** $P < 0.01$, and *** $P < 0.001$

Model 1 (See table 6.5) showed that junk information did not undermine the participants' knowledge of greenhouse gases it found that the control variables that had statistical significance was basic knowledge of physical

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science at p<.001, and rejection of pseudoscience at p<.05. Both of these had a positive impact on the scores on the participants' knowledge of greenhouse gases. Model 2 found that the junk information and information overload treatment did not have a statistically significant impact. This found that the basic knowledge of physical science was a key control variable that was statistically significant at p<.001 with a positive influence on the scores of the participants' knowledge of greenhouse gases. Finally, model 3 found that the information overload treatment had no significant impact on the participants' knowledge of greenhouse gases. There were two control variables that had a statistically significant impact on Model 3. First, basic knowledge of physical science was found to be significant at p<.001 that positively impacted the participants' score. Second, the rejection of pseudoscience had a positive impact of their scores and was found to be statistically significant at p<.05. Overall, this dependent variable highlights the importance of basic physical science knowledge as a key factor on greenhouse gas knowledge regardless of treatments groups.

In summary, the basic knowledge of climate change appears to be much more influenced by the participants' knowledge of basic physical science rather than the experimental treatments, with only Model 1 finding information overload to be significant in the true and false climate change statement score. Other control variables were shown to have significant impacts. Despite the lack of impact from the experimental treatments, this result has highlighted the importance of scientific literacy in improving the publics' knowledge of climate change.

6.2.2: Perception of risk

This section will examine whether the experimental treatments have influenced the participant's perception of risk from climate change. There are four dependent variables being examined. First, examining whether the treatments have impacted the participant's perception of the risk of climate change has on an individual level. Second, examining their perception of risk climate change poses to society. The third and fourth dependent variables examine whether there are differences in how they perceive risks to the UK from climate change compared to the perception of risk posed by climate change internationally.

The perception of risk to the individual compared to the perceived risk of climate change to society, has some clear differences in the distribution of responses. There is a greatly reduced perception of risk to the individual in comparison to the perception of risk to society (See Figure 6.6 and Figure 6.7). The perception of risk to the individual was lower in the junk information treatment group, with a median score of unlikely, compared to the control group which had a median score of likely. There was a larger range of responses to the risk posed by climate change to the individual. In comparison, the risk to society was seen as much greater, with all treatments having a smaller range of scores, but junk information had a median score of 4 compared to the other treatments and control that had a median score of 5.

Figure 6-4: Perception of risk from climate change to the individual
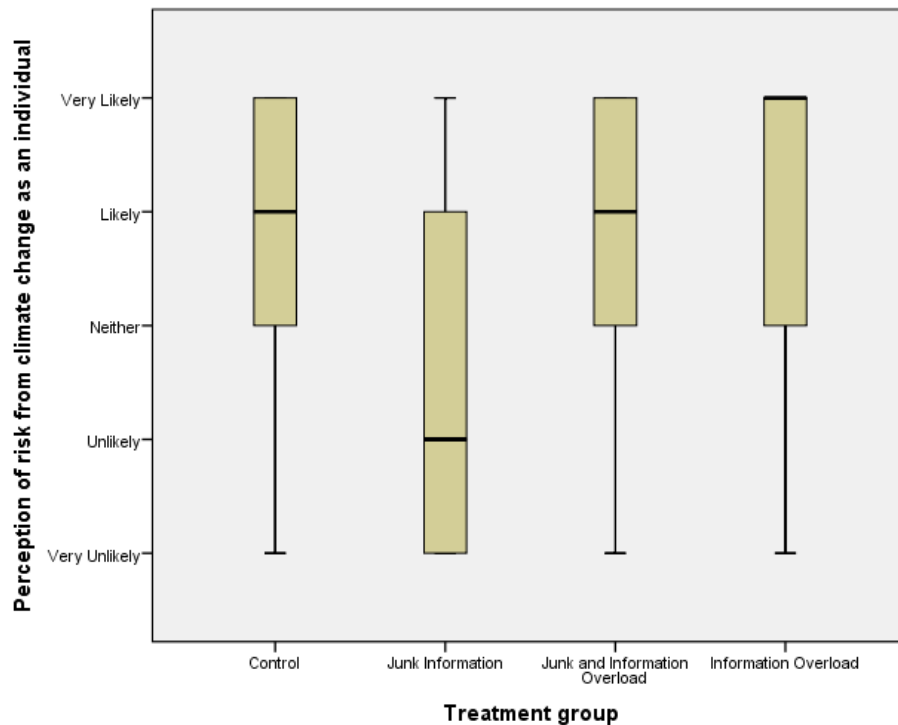
Note: Produced using the weighted data.

Table 6-6: Logistic regression for participants' score for perception of risk to the individual from climate changes

	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	**SE**	**B**	**SE**	**B**	**SE**
Basic Physical knowledge	0.30*	0.14	0.18	0.15	0.28*	0.14
Basic Biological Knowledge	0.13	0.16	-0.05	0.18	0.05	0.15
Rejection of pseudoscience	-0.37	0.24	-0.06	0.25	-0.21	0.24
Understanding Experimental method	-0.44	0.41	0.03	0.56	0.48	0.56
Probability	0.55	0.63	0.58	0.69	0.29	0.60
Scientific method	0.33	0.46	0.07	0.51	-0.42	0.54
Junk info	-0.55	0.27				
Junk and info overload			-0.05	0.30		
Info overload					0.43	0.27
Adj. r^2	0.2		-0.04		0.03	

* $P < 0.05$; ** $P < 0.01$, and *** $P < 0.001$

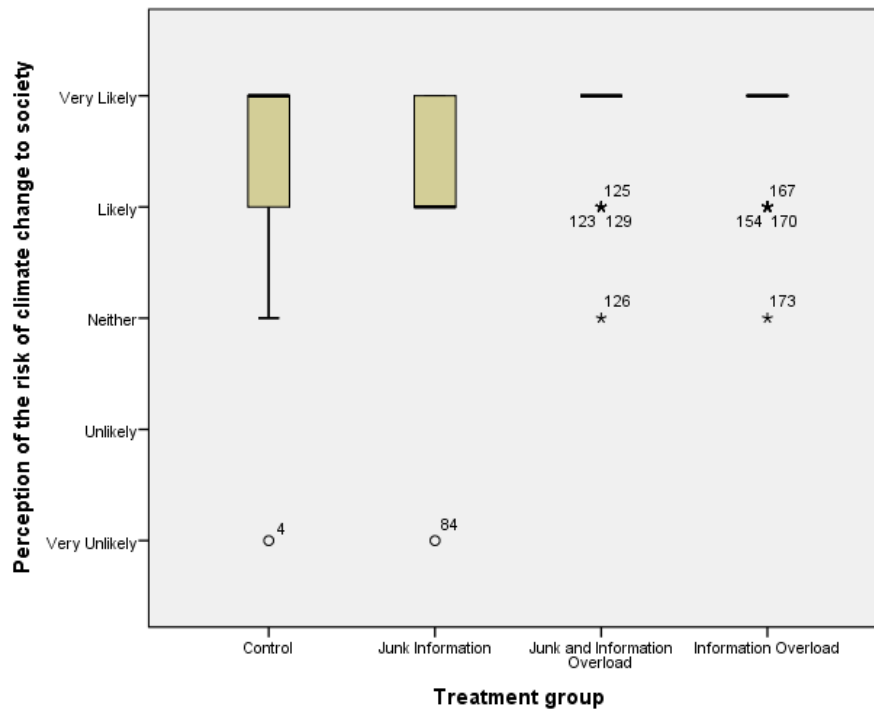**Figure 6-5: Perception of the risk of climate change to society**

Note: Produced using the weighted data.

Table 6-7: Logistic regression for participants' score for perception of risk to society from climate change

	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	**SE**	**B**	**SE**	**B**	**SE**
Basic Physical knowledge	0.22**	0.08	0.14	0.08	0.15*	0.07
		0.09				0.08
Basic Biological Knowledge	-0.07		-0.03	0.09	0.03	0.09
Rejection of pseudoscience	0.02	0.13	0.19	0.12	0.14	0.12
Understanding Experimental method	0.55*	0.22	0.02	0.28	-0.08	0.28
Probability	0.92**	0.33	0.71*	0.34	0.59	0.30
Scientific method	-0.58*	0.24	-0.12	0.25	-0.04	0.27
Junk info	-0.49**	0.15				
Junk and info overload				0.15		
Info overload					0.26	0.14
Adj. r^2	0.09		0.16		0.25	

* $P < 0.05$; ** $P < 0.01$, and *** $P < 0.001$

This dependent variable, measured the perception of risk posed by climate change to the individual level (See table 6.5). Model 1 showed that junk

information had a negative impact but was not statistically significant on the perception of risk to the individual. It also found that the only control variable that had a positive significant impact was the basic knowledge of physical science at $p<.05$. Model 2 found that the junk information and information overload treatment had a very slight impact on the score, but did not have statistical significance on the perception of risk to the individual. This also differs from Model 3 and Model 1 as none of the control variables were significant. Model 3 shows that the information overload treatment did not have a significant impact on the perception of risk of climate change at the individual level. There was only one control variable that was significant at $p<.05$, and this showed that basic physical science knowledge increased the perception of risk.

This dependent variable examined the impact of the experimental treatments on the perception of the risk that climate change poses to society. Model 1 (see Table 6.6) shows that junk information undermines the perception of risk that climate change poses to society with a statistical significance at $p<.01$. There were three control variables that had a statistically significant positive impact on the score. The participants' basic knowledge of physical science was found to be significant at $p<.01$. The understanding of probability was found to be significant at $p<.01$, and the understanding of the experimental method was significant at $p<.05$, both having a positive influence on the result. However, the understanding of the scientific method had a negative influence on the participants' score and was statistically significant at $p<.05$. Model 2 found that the junk information and information overload treatment had no significant impact on the perception of risk to society posed by climate change. There was only one control variable that was statistically significant, with the understanding of probability having a positive impact on the perception of risk to society at $p<.05$. Model 3 found that the information overload treatment did not have a statistically significant impact. Only one control variable was found to be significant. This found that basic knowledge of physical science was significant at $p<.05$ with a positive effect on the score.

However, the impact of the treatment groups on the perception of risk to the UK and internationally, highlights an interesting difference where the participants viewed climate change as a greater risk to others (See Figure 6.6 and Figure 6.7). The box plots show there was a clear perception in all treatment

groups that the risk that climate change posed was a greater risk internationally. The median score in the international risk of climate change found that the control and the treatment scored between 8 to 9 points out of 10 with only one outlier scoring less than 6. In contrast, the risk to the UK, received a wider array of scores in the control and the treatment groups. There was a median score of between 6 to 7 points out of 10, with the range of responses varying considerably. For example, the control ranges from 3 to 10 points. This finding reflects the attitude that climate change is seen as an international issue rather than domestic (See chapter 3).

Figure 6-6: Risk of climate change internationally
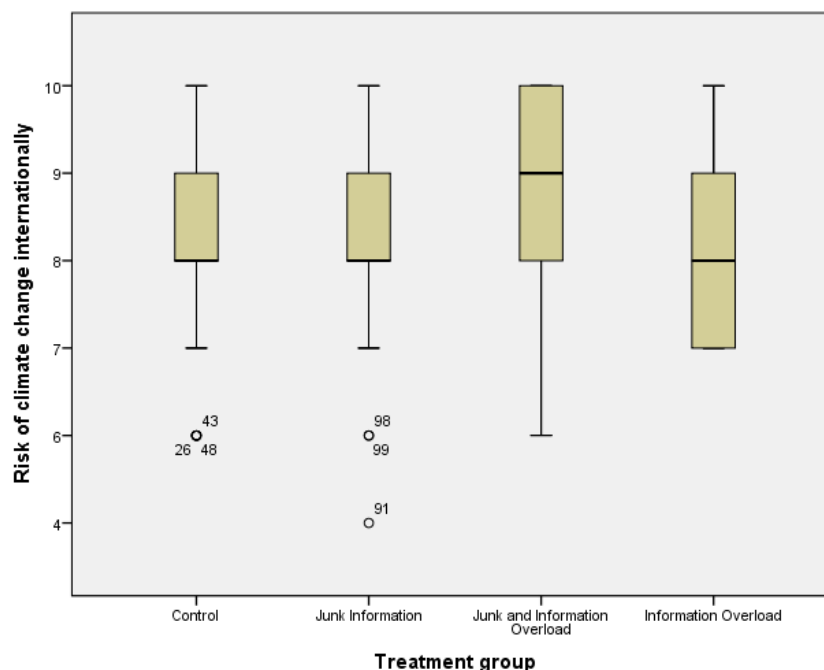
Note: Produced using the weighted data. The results from for the risk of climate change internationally are from two questions; "Climate change is likely to cause severe food shortages in places like Africa and India" and "Extensive and long-lasting flooding caused by climate change is likely to take place in low-lying countries like Bangladesh and the Netherlands". Participants were asked to respond on a scale of strongly agree to strongly disagree. These scores were combined, as they focused on international consequences of climate change.

Table 6-8: Logistic regression for participants' score for perception of risk that climate change poses internationally

	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	SE	B	SE	B	SE
Basic Physical knowledge	0.20	0.13	0.10	0.14	0.16	0.13
Basic Biological Knowledge	-0.15	0.15	-0.19	0.16	-0.16	0.14
Rejection of pseudoscience	0.25	0.22	0.59**	0.23	0.61**	0.22
Understanding Experimental method	0.24	0.38	0.97	0.51	0.66	0.52
Probability	0.63	0.58	0.70	0.62	0.55	0.56
Scientific method	0.55	0.42	-0.36	0.46	-0.06	0.50
Junk info	0.06	0.27				
Junk and info overload			0.27	0.27		
Infor overload					-0.29	0.25
Adj. r^2	0.16		0.08		0.08	

* $P < 0.05$; ** $P < 0.01$, and *** $P < 0.001$

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Model 1 (See table 6.8) found that the junk information treatment did not have a significant impact. There were also no significant control variables. Model 2 found that the junk information and information overload treatment was not significant. However, like Model 3, the rejection of pseudoscience was found to be significant at p<.01, and have a positive impact on the perception of risk climate change poses internationally. Model 3 found that information overload treatment did not have a significant impact on the perception of risk at the international level. The only control variable in Model 3 that was significant was the rejection of pseudoscience at p<.01, that was found to have a positive influence.

Figure 6-7: Risk of climate change to the UK
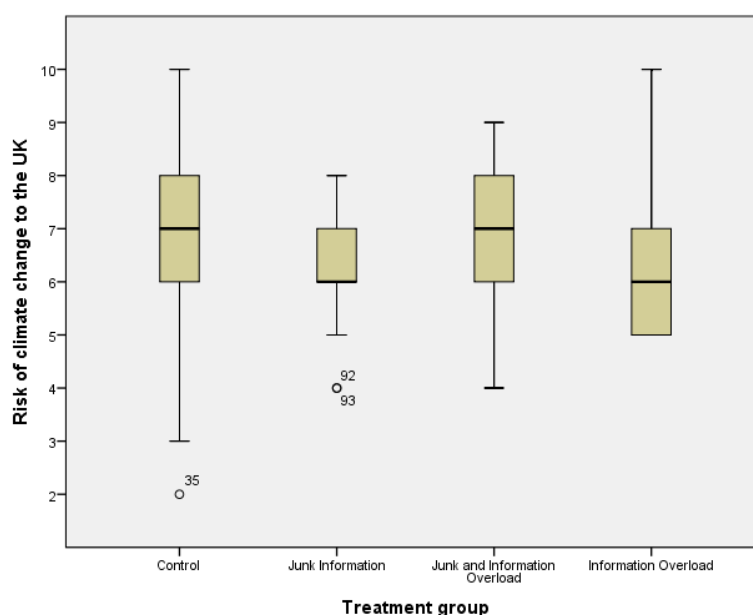
Note: Produced using the weighted data. The results for the risk to developing countries are from two questions; "Climate change is likely to cause severe food shortages in the UK" and "Extensive and long-lasting flooding caused by climate change is likely to take place in the UK". Participants were asked to respond on a scale of strongly agree to strongly disagree. These scores were combined as they both measured the consequences to the UK.

Table 6-9: Logistic regression for participants' score for perception of risk that climate change poses to the UK

	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	**SE**	**B**	**SE**	**B**	**SE**
Basic Physical knowledge	0.39*	0.18	0.35*	0.17	0.28	0.16
Basic Biological Knowledge	-0.08	0.21	-0.30	0.18	0.08	0.18
Rejection of pseudoscience	0.38	0.30	0.45	0.29	0.37	0.28
Understanding Experimental method	0.98	0.67	1.18	0.67	0.03	0.47
Probability	0.46	0.82	0.99	0.72	0.42	0.72
Scientific method	-1.14	0.61	-1.00	0.64	-0.47	0.53
Junk info	-0.23	0.33				
Junk and info overload			0.06	0.36		
Info overload					-0.36	0.32
Adj. r^2	0.08		0.02		0.05	

* P < 0.05; ** P < 0.01, and *** P < 0.001

Model 1 (see table 6.9) found that the junk information treatment had no significant impact. The control variables also had no statistical significance. Model 2 found that the junk information and information overload treatment had no significant impact. There was only one control variable found to be significant at p<.05, with basic knowledge of physical science having a positive impact on the score of the treatment group. Model 3 found that the information overload treatment did not have a significant impact on the perception of risk to the UK. The only control variable that was found to be significant was the basic knowledge of physical science at p<.05 with a positive influence on the overall score.

Overall, junk information reduces the perception of risk to society from climate change. However, there was no significant change in how they viewed risk of climate change at an individual level, or how they perceived risk to the UK specifically or internationally. There was a perception that climate change was an external issue rather than an issue that will directly impact the participants, which reflects previous research (see chapter 3). The external view means they view there is a risk to society in general, but means that they believe they are not necessarily going to be directly affected. An interesting result from the models was a low adjusted R2 score on three of the four dependent risk variables with the exception of the risk posed to society. This suggests that additional factors not contained in the model influence the perception of risk. For example, ideological belief may be a factor at the individual level of perception of risk in comparison to the perceived risk to society (See Lakoff, 2010).

6.2.3: Attitudes towards climate change mitigation

The final dependent variables that this chapter will explore are the attitude to the mitigation of climate change. There are two dependent variables that measured whether the impact of the treatments influenced support for climate action. The first measured whether the participants supported action by the UK to reduce emissions or not due to climate change being an International issue. Second, this section examines whether the treatments have impacted whether the participants view climate change as too far away to be of concern.

The first variable measured whether attitudes to the UK taking action to tackle climate change were impacted by the treatments. All the treatment groups and the control had a median score of 1 out of 5 to the statement that it is not

worth the UK taking action to combat climate change (See Figure 6.8). There was more variation in the control, junk information, and junk and information overload treatment with their extreme high score being 3 out of 5. There were a number of outliers. In particular, junk information treatment had one outlier scoring 4 points and another scoring 5, suggesting that there were some rejecting climate action.

Figure 6-8: Not worth Britain trying to combat climate change
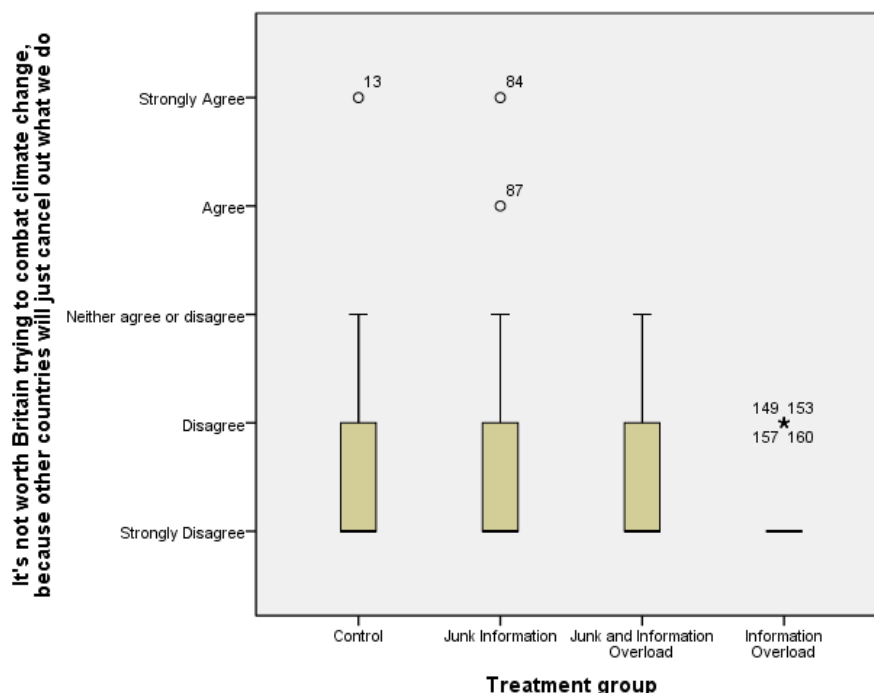
Note: Produced using the weighted data.

Table 6-10: Logistic regression for participants' score for support for UK action to deal with climate change

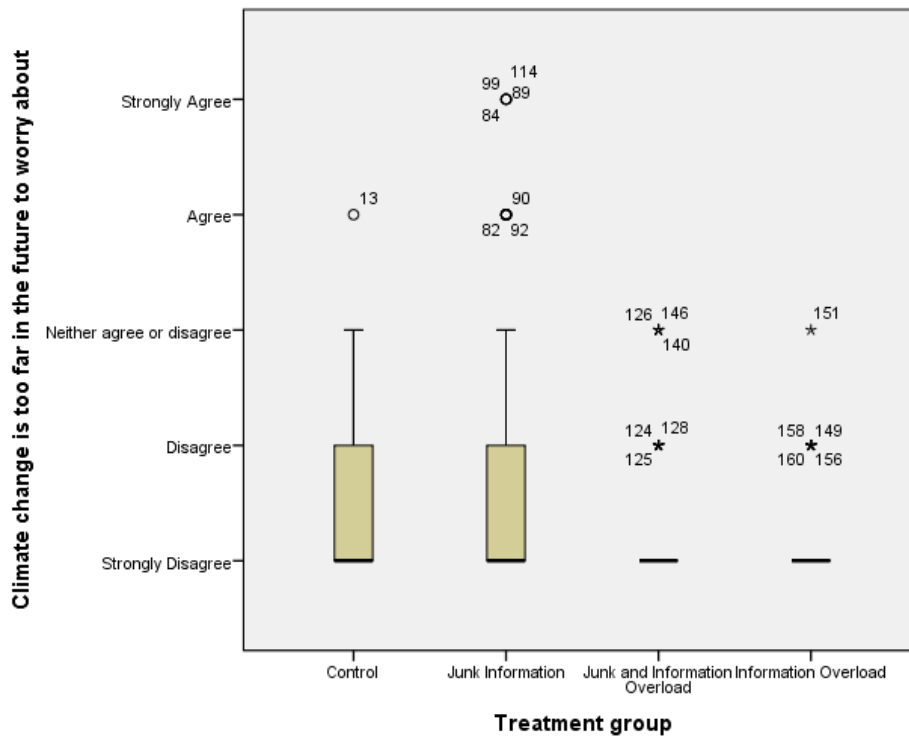|	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	**SE**	**B**	**SE**	**B**	**SE**
Basic Physical knowledge	0.02	0.08	0.06	0.07	0.09	0.08
Basic Biological Knowledge	-0.05	0.09	-0.06	0.08	-0.04	0.10
Rejection of pseudoscience	-0.07	0.13	-0.08	0.12	-0.27	0.15
Understanding Experimental method	-0.65*	0.29	-0.57*	0.27	-0.38	0.25
Probability	-0.47	0.36	-0.60*	0.29	-0.34	0.38
Scientific method	1.03***	0.26	0.94**	0.26	0.75**	0.28
Junk info	0.37*	0.17				
Junk and info overload			-0.02	0.16		
Info overload					-0.26	0.13
Adj. r^2	0.11		0.09		0.1	

* P < 0.05; ** P < 0.01, and *** P < 0.001

Model 1 (See Table 6.10) found that junk information had a significant impact at p<.05, which had a positive influence on the score, meaning that they were more likely to accept that it is not worth Britain taking action to tackle

climate change. However, a larger impact was the control variable, which was the understanding of the scientific method being significant at p<.01. Model 2 found the junk information and information overload treatment was not significant. Instead two control variables were found to be significant. The understanding of experiments was found to be significant at p<.05, and a good understanding increasing the attitude on the UK taking action to climate change. The second control variable in Model 2 that was significant, was the understanding of the scientific method, which was significant at p<.001. Model 3 found no significant impact of the information overload treatment on the participants' attitudes to climate action. Instead, the difference between the information overload and the control is explained by three control variables. Both the understanding of experiments and understanding of probability control variables were statistically significant at p<.05 and negatively impacted the score. The other control variable that had an impact, was the understanding of the scientific method, which was statistically significant at p<.01.

The second dependent variable examined, was whether the treatment groups impacted whether the participants perceived climate change mitigation as important or whether climate change was too far in the future to be a concern. The media score in all treatment groups and the control was 'strongly disagree' with the statement that climate change is too far in the future to worry about (See Figure 6.9). However, the junk information treatment had multiple outlier cases outside the range with scores in strongly agree and agree. This suggests climate sceptic material undermined some of the participants' support for climate mitigation.

Figure 6-9: Climate change is too far in the future to worry about

Note: Produced using the weighted data.

Table 6-11: Logistic regression for participants' score for perception that climate change is too far in the future to be a concern

	Model 1 - Junk info		Model 2 - Junk and Info overload		Model 3 - Info Overload	
	B	**SE**	**B**	**SE**	**B**	**SE**
Basic Physical knowledge	-0.04	0.10 0.11	-0.03	0.07	0.02	0.06
Basic Biological Knowledge	-0.09		0.00	0.08	0.01	0.07
Rejection of pseudoscience	-0.31	0.16	-0.12	0.12	-0.14	0.11
Understanding Experimental method	0.06	0.28	-0.51	0.27	-0.57*	0.25
Probability	0.57	0.42	-0.28	0.33	-0.28	0.27
Scientific method	0.17	0.31	0.60*	.245	0.63**	0.24
Junk info	0.70***	0.19				
Junk and info overload			-0.08	0.14		
Info overload					-0.22	0.12
Adj. r^2	0.05		0.11		0.02	

* P < 0.05; ** P < 0.01, and *** P < 0.001

Model 1 (See Table 6.11) found that junk information was significant at $p<.001$ on influencing attitudes to reject climate action. None of the control variables were found to be significant, meaning that junk information can have a serious impact on support for climate action. Model 2 found that the junk information and information overload treatment was not significant. Only one control variable was significant, with the understanding of the scientific method at $p<.05$, which suggest that this meant that the participants were able to reject such statements that attempts to undermine support for climate action. Model 3 found that the information overload treatment was not significant, but there were two control variables that were significant. The participants' understanding of the experimental method, was significant at $p<.05$, and the other control variable was the understanding of the scientific method, which had a significance at $p<.01$. An interesting result from the models was a low adjusted r^2 score suggesting that the perception of the need to take action was not inherently linked to scientific literacy. Potentially ideology could be a factor in motivating action (See Lakoff, 2010).

In summary, junk information has been shown to be significant in reducing the support for climate change mitigation. However, junk information in an information overload environment has no significant impact. There was also little impact of climate consensus information in an information overload treatment. This suggests that climate change information, both consensus and climate sceptic, have little impact when there is competition for the users attention.

6.2: Summary:

Overall, this chapter has demonstrated that despite the generally high level of scientific literacy, there was also limited knowledge on climate change causes, which provides a barrier for changing behaviour (see chapter 3). The impact of the treatments on the dependent variables was mixed. The basic understanding of climate change was not impacted by the treatments, except for information overload stimuli being significant at positively predicting in the general knowledge of climate change, but apart from that no other treatment was significant. Instead, the key influence was found to be the control variable of basic knowledge of physical science.

Rather than impacting the understanding of climate change, the junk information treatment has been shown to undermine both perception of risk to society and support for climate action. In particular, Junk information had significant results to attitudes towards whether it was worth the UK aiming to combat climate change or if climate change was too far into the future to be a concern. However, the effect of junk information when in a situation of competition for the users' attention, was non-existent, with no significance in any of the dependent variables. The impact of the stimuli of climate consensus material combine with information competition was also greatly diminished. These experimental findings suggest that junk information online is unlikely to mislead people, as they are unlikely to engage with climate change online, which reflects the findings of the focus groups (See chapter 5). This poses significant barriers to climate change communication as users are filtering out climate change information online due to the number of other topics in competition for attention (See Chapters 2 and 3)

Chapter 7 - Discussion

The information society literature has been used to produce an analytical framework using the 'dark side' of the information society. The information society was visionary and there was the large scale increase of sharing and knowledge production. However, the light side was utopian and optimistic of the impact of information on society. The light side did not notice the negative consequences the dark side did, with both the potential spread of junk information (See chapter 2) and information overload resulting in self-selection of information (see chapter 3). The three aspects that emerge from the analytical framework of the dark side of the information society literature has enabled in depth analysis of the consequences for climate change communication online.

This chapter will firstly summarise the research question findings and whether the hypotheses have been supported. Second, I will compare my findings to previous knowledge and examine if my findings contrast with the established knowledge base or support it. The third section will evaluate the utility of the information society analytical framework and discuss where the visionaries of the light side went wrong. Finally, this chapter will discuss the changing trends in media consumptions.

7.1: Summary of hypotheses

This section evaluates the findings from the experiments and there was mixed results on the hypotheses. Firstly, junk information had some interesting results. The participants had a generally good knowledge of climate science which was not impacted by the treatment which means that H1 can be rejected.

H1. Contradictory information from the scientific consensus reduces young people's understanding of climate science.

However, there were consequences on perceptions of risk and support for climate action. The junk information treatment has reduced the perception of risk and was also found to be significant in reducing support for climate action so H2 has some support.

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H2. Climate sceptic material reduces young people's perception of risk that climate change poses to society and undermines their support for climate mitigation.

In contrast junk the information overload treatment findings means that H3 is partially supported but H4 is rejected:

H3. Even with competition from differing topics in an information competitive environment the impact of climate change information on young peoples' understanding of climate science will improve.

H4. Despite the increased amount of information the perception of risk that climate change poses to society and support for climate mitigation will improve.

H3 is partially supported as climate science information even in an information competition environment was found to be statistically significant on the true and false statement questions about climate change. The other dependent variables measured had no significant results with control variables being found to be significant in the participants' understanding of climate science. However, H4 can be rejected with the research finding no significance in any of the perception of risk or support for mitigation dependent variables suggesting the climate change information lacked impact on the participants when there were was competition for their attention.

A similar result can be seen in H5 and H6 with both being supported as junk information had no significant impact on any of the dependent variables when presented among over environmental issues:

H5. This effect is reduced when presented alongside other topics competing for the young people's attention.

H6. Junk information in an information competition environment does not reduce young people's perception of risk from climate change and does not undermine their support for climate mitigation.

This highlights that climate change is undermined when there is competition for the attention of users.

7.2: Findings

The key finding from both the focus groups (see chapter 5) and the experimental analysis (see chapter 6) was the worrying behaviour to opt out of interacting with climate change online. The focus groups highlighted a self-selection bias and many simply did not see climate change information online, but there were also barriers to them engaging with climate change. This was reflected in the focus groups that that online communication was seen as a form of entertainment (see chapter 5) with examples of the online sharing of material being shared online due to humour rather than being informative. Viral communication has the promise to reach large numbers cheaply and for dominant messages in politics to be challenged and subverted (See Cammaerts, 2007, Kien, 2013). While there is some environmental material that achieves viral success (see chapter 3), such as '*A Cheesy Love Story – the Ad Doritos don't want you to see*' (SumOfUs, 2015a), the focus groups reflected the failure of viral environmental content. The focus groups had a negative response to climate change information with many saying they simply did not see any online. This is due to the ever increasing amounts of information (See chapter 2) the Internet allows users access, which results in users developing strategies to reduce the diversity of information they receive (See Schumann, 2004).

In addition to information overload the junk information given to the participants has been shown to undermine their perception of risk. This reflects other research into the consequences of junk information on risk perception such as Kata (2012) who found public perception of risk from diseases was decreased and risk from vaccinations were increased by anti-vaccination material (see chapter 2). The reduction in the perception of risk is problematic as it undermines pressure for climate action (See chapter 3). However, basic understanding of climate science is important for the public to adequately process information about climate change.

The experiments have highlighted the risk of junk information on public perception of climate change. The Internet is problematic in this sense as anyone is able to produce online content. Climate sceptic material undermines the perception of risk and support for climate change mitigation. In particular, junk

information about climate change directly influences the perception of risk to society. This reflected previous research by Gavin (2009) and Sampei and Aoyagi-Usui (2009) which found that the public perceive climate change as an external risk and therefore, prioritised domestic issues such as healthcare and the economy.

The information overload treatment group, which represented the information rich environment of the Internet, resulted in a decreased impact of climate sceptic material in undermining the participants' perception of risk and attitudes towards climate mitigation. This suggests that junk information is not a particularly worrying aspect of Internet communication as the consequences are lesser than expected. While junk information could be engaged with there was little impact in an information overload environment. There is still a risk that junk information can be spread and has been shown to reduce the perception of risk and attitudes to mitigation, which means that it could be potentially damaging.

However, climate consensus information was also found to have little impact in the information overload treatment group. This may have been due to the generally high level of climate change concern and support for climate action, but it may also suggest a lack of engagement with climate change when there are other topics available. The latter is strongly inferred when both treatments for overload found little impact of climate change information both of the scientific consensus and climate sceptic on perception of risk and support for climate action. Therefore, information overload appears to be a significant impact on climate change communication online with users being simply able to opt out of coverage entirely.

This is a worrying result and highlights a barrier for communication of climate change. The Internet has the potential for the public to filter out climate change information as the user has become empowered and the sheer quantity of content results in filtering behaviour (see chapter 3). Climate change also struggles to gain attention online due the competition for user attention mainly being content shared for entertainment (see chapters 2 and 3). One positive aspect that this research has revealed is that the majority of young people in the experimental treatments view climate change as a significant risk to society and see the importance in political action to mitigate. Despite this perception being

embedded there will not be improvements in the understanding of climate science if there is no engagement with climate change coverage. It would have been interesting to run additional focus groups with those who took part in the experiments to see how they perceived this experience and how much the artificial environment of the experiment differed from their day to day experience with the Internet.

7.3: The information society analytical framework

The information society was conceptualised into a framework, but unfortunately the promises of the light side of the information society were too optimistic and failed to predict consequences of increased information sharing. The dark side of the information society has provided a key framework to facilitate an explanation of the difficulties of climate change communication online. The light side was inherently flawed as there was a belief that more information was inherently good. There was also the belief that increasing information being created would also beneficial. Unfortunately, the biological limitations of information processing (See chapter 3) have meant that information overload is a significant threat (See chapter 2). In addition, the creation of junk information, which also become harder to tackle in high information environments, that can mislead the public and reinforce previously held climate sceptic beliefs (See chapter 2).

The Internet has been shown in previous research by Anderson (2009) to be the key way that people receive climate change information. The focus groups highlighted a lack of engagement with climate change and instead people used the Internet to engage with entertainment. The main finding for this research question was the significant disengagement with climate change online. Instead there was an active behaviour by some participants to filter out climate information. Attempts at communicating climate change virally through social media are also problematic while engagement with viral communication was normalised.

Information overload poses a key problem with a lack of engagement with climate change information. This is potentially a broader issue for science communication in general as the public are more likely to come across science

in popular culture. Popular culture representations of science are generally misleading or promote myths for example Nisbet et al. (2002) highlight *the X Files* series for representing science as negative or not adequate to explain events. For example, an episode called '*F. Emasculata*' represents scientists as immoral, while also playing into fears of the pharmaceutical industry, with the episode plot set in a prison where scientists from a pharmaceutical corporation are destroying evidence of the testing of a deadly contagion on the prison population (Bowman, 1995).

Therefore, there is a concern that climate change understanding can be undermined by poor portrayals in entertainment and reducing scientific inaccuracy is important as the information rich environment potentially results in the public opting out of climate science information (see chapter 3). An example of climate change in popular culture can be seen in the film '*The Day After Tomorrow*' which the plot focuses on rapid extreme weather events triggered by climate change causing large scale destruction (Emmerich, 2004). This was a concern highlighted by Leiserowitz (2004) that the extreme portrayal and representation of science might result in the public rejecting climate science altogether. Instead, Leiserowitz (2004) found that perception of risk was increased and encouraged viewers to change their behaviours. Despite the fact that risk perception increases due to the impact of the film, there was limited long-term impact with surveys suggesting no change in the US publics' attitudes to climate change (Leiserowitz, 2004). This is concluded by Leiserowitz (2004) that for information salience there requires repeated exposure.

This lack of engagement was reflected when exploring the sharing of information with others online. This was explored using the following research questions:

- *Context:* How do Internet users perceive their engagement with the Internet and connectivity?
- *Context:* Do users receive and engage with information about climate change through their Internet and social media usage?
- *Context:* Are there barriers to interacting with climate change information online?

- *Sharing:* How do Internet users share information with others?

The development of web 2.0 resulted in the rise of social media where information is shared amongst networks of users. This has enabled the potential of viral sharing of climate change information with the sharing of climate memes. Internet memes have the potential to enable the communication of climate change to the public quickly and on a large scale. Environmental non-governmental organisations [NGOs] are argued by Schafer (2012, p. 530) "… to be the champions of online climate communication" with them adopting digital campaigning to share climate change information, increase awareness, and raise campaign funds. However, there is a lack of engagement with climate change information online.

The experiments have been used to explore the impact of the Internet on climate change communication. The experiments were used to examine the consequences of both junk information and information overload on participants' understanding of climate change, their perception of risks, and their attitudes towards climate mitigation. The experiments found the treatments in particular impacted their perception of climate risk and support for climate action. This section will answer the following subsidiary research questions:

Junk information: To what extent does information on climate change that contradicts the scientific consensus undermine public understanding of climate change?

Information overload: Does the competition for the user's attention reduce the effectiveness of climate change information?

Information overload and junk information: Does information that contradicts the scientific consensus have less of an impact when there is competition for young people's attention?

The experiments have shown that junk information alone is problematic and can negatively impact perception of risk and support for mitigation in society. However, the information overload treatments reflect the findings from the focus groups with a lack of engagement with little significant differences between the information overload treatment groups and the control.

The consequences of dark side of the information require further research, but this exploratory research does suggest that the dark side of the information

society has unfortunately become dominant and will continue to do so with the use of the Internet normalised across wider society. This poses new risks of junk information, but in particular, information overload poses a very significant threat to climate change information with the public being able to opt out of climate change coverage. This behaviour was shown in the experiments with youg people. However, further research is discussed in chapter 8 to see if these findings are generalizable to wider society and whether there are differences in cross national contexts.

The analytical framework produced using the dark side of the information society is particularly useful for contextualising diverse Internet use for exploring climate change communication online. These three aspects overlap significantly, but exploring sharing in a controlled environment was not possible in this experimental design, but these did allow for measurement of the impact of junk information and in a limited capacity information overload. However, the focus on scientific literacy as the control variables in the model does not necessarily predict reactions to climate change information. For example, the low adjusted r^2 scores on three of the perception of risk models and the attitudes to climate change being too far in the future to be a concern could be influenced by additional factors. This can include pre-existing ideological filtering of information posing a barrier to climate change communication (See Lakoff, 2010). Therefore, there is the potential to improve the application of the analytical framework in future research with the additional of ideological control variable. In addition, the control variables in the regression models could have potentially benefited from measure pre-existing attitudes to climate change, but if this was added it could have potentially changed the participant's in the information overload treatments as they would have been aware of the focus on climate change.

7.4: Changing media consumption

In my research, I have found two key issues with communicating climate change using the Internet. Firstly, there is a risk of decreased engagement with young people opting out of climate change information. The key findings from the focus groups found that young people engage with online content for entertainment and were worried about potential backlash when engaging with

serious issues. Secondly, the level of understanding of climate science was also found to be very low. The exposure to junk information was found to undermine the perception of risk and decrease the participant's views on climate change mitigation. However, this effect was greatly reduced in an information overload environment, which reflected the findings of the focus group, that there was a lack of engagement with climate change information. This is problematic as the Internet becomes increasingly important to receive information and news as people will simply filter out and opt out of climate change coverage which would undermine support for climate mitigation.

As previously discussed in chapter 1 we have seen the decline of traditional media with newspapers in decline. However, the meta-medium that is the Internet is increasingly becoming dominant in our lives. This was reflected by a key finding from the focus groups was that the Internet was significant in all the participants' lives. There was a feeling that they were always connected and often only noticed this when they lost access. The Internet was a key source for information and connections with other users with social media playing a key role. These results were expected considering previous studies Pew Research Center (n.d.) showing the rising social media use across society and Ofcom (2015) highlighting the number of hours people spend online averaging 20.5 hours a week with young people averaging 27.6 hours.

- *Context:* How do Internet users perceive their engagement with the Internet and connectivity?

The focus groups found that the participants' viewed their engagement with the Internet as constant. Some even went so far as to suggest they only noticed their dependency on the Internet when it was not available. The Internet was shown as significant in their lives, but not simply for accessing information, but for a wide range of social and entertainment reasons such as social media and online gaming (Ofcom, 2015). Therefore, the presumption of climate change engagement is questionable as the Internet enables access to climate change information, but also potentially distracts users.

The Internet empowers users with more control over the content they receive online and potentially result in users to filtering out information that challenges their world views (See Garrett, 2009). Along with this filtering out of

climate change information viral communication also reflected the argument of Chesterman (2011) that survivability of Internet culture requires viral content to have variety and mutability. The focus group participants have shown a key motivation of young people to engage with viral content is not due to knowledge transfer but instead for entertainment purposes.

Instead the participants gave examples that they had engaged with entertainment memes, such as '*Grumpy Cat*', with engagement being driven by recreation rather than for education or information gathering purposes. There were some instances where viral content reached the participants despite the filtering of content with shocking material shared for entertainment such as '*Shrek is Life, Shrek is Love*'. FG1 had shared awareness of this shocking viral content, but a key reason this reached such a large audience was due to the entertainment of getting other people to react to it.

The risk of distracting can seriously undermine climate communication by simply getting the public to choose not to engage with climate change information or due to automated algorithms simply never showing them climate change or wider environmental information. The lack of engagement is also driven by the continued amount of information available online with video content on Youtube increasing by one hundred hours every minute (Youtube, n.d.-b). In this situation junk information itself is not the largest problem as actually getting users to engage with climate change is becoming harder.

Unfortunately, this has meant that attempts at viral communication of climate change are not engaged with due to the personalisation of the Internet experience. This means that attempts at viral sharing climate change communication will reach those already interested in climate change while information competition persists due to the information rich environment. Therefore, those reached through the use of viral communication were predominately already interested in climate change. Those who were not already interested are unlikely to be reached unless the content was shocking enough or entertaining to get their attention. Still a problem with media is that we do not know the impact on the end user so something shocking or shared for entertainment may not significantly educate or inform the user.

Successful viral communication requires engagement with an audience online to share the content to a wider audience and without this engagement climate change struggles to become widely shared. The difficulties SumofUs (n.d.) faced highlight the issue for getting environmental content shared. Even if content manages to reach a wide enough audience to achieve a viral reach, such as the '*Advert Doritos Don't want you to See*' by SumOfUs (2015a), there is still the problem that the content will not survive long within Internet culture. This is why MLP memes have been so successful. In the case of the SumOfUs (2015a) as there is the initial viral success, but declines relatively quickly as it is a single video so it lacks variety and it is also not easily mutable. This contrasts with other content such as *Shrek is Life Shrek is Love* by Sykotic (2014) had a wider reach due to wide range of reaction videos that came from the initial viral video providing both variety and mutability of the meme.

These previous examples are mapped onto the model of successful viral content previously discussed in chapter 3 (See Figure 7.1) which highlights the problem faced with attempts at communicating climate change virally. Climate change messages fails to reach enough people to get the momentum required for viral sharing and instead only generally reach networks of environmental activists who are already engaged with the subject. This means that environmental content declines quickly and instead distracting memes that simply seek to entertain the user are much more successful at becoming viral. This highlights the problem the produce viral climate change content that will survive in Internet culture to have long term impact rather than rapidly fading.

Figure 7-1: Model of sharing illustrated with examples
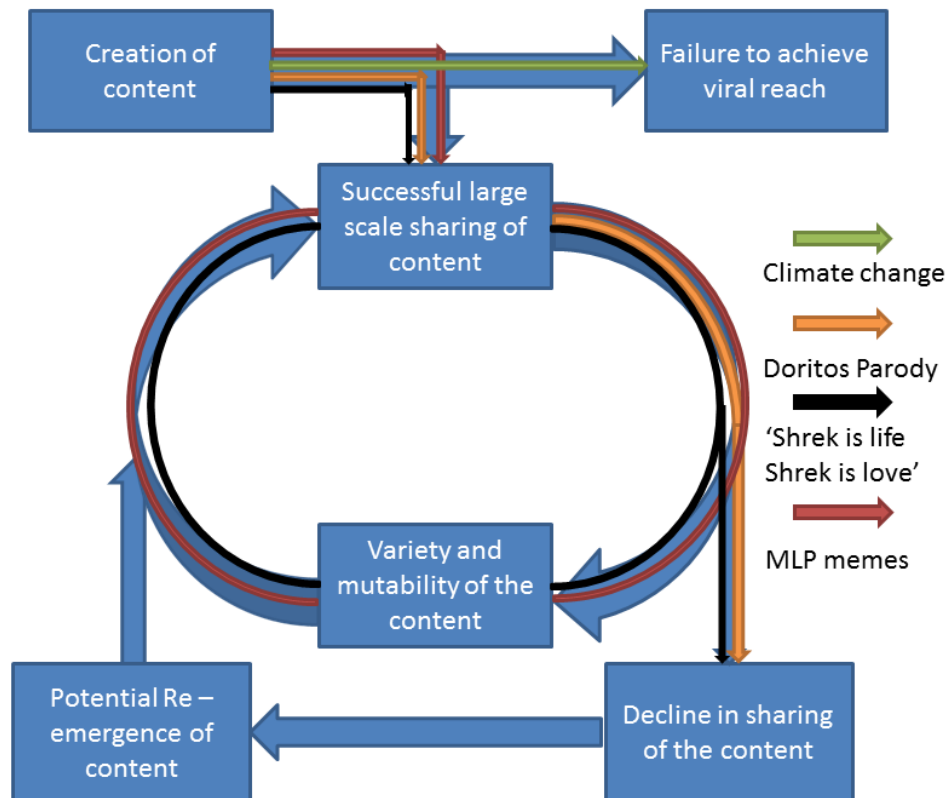
In addition, the focus groups highlighted that there were additional barriers to getting young people to engage with climate change due to a fear of backlash if the participants took part in climate change discussions. The lack of engagement was further intensified with the Internet not being seen as a serious place to engage with discussions online. Therefore, the Internet poses a key challenge with getting young people (and possibly the general public) to engage with climate change with the ease of being to opt out of coverage meaning that the chance of content become viral is lessened and the social media is instead dominated by viral content for entertainment.

7.5: Overall summary

The findings of this research suggest the Internet is problematic for the communication of climate change. The personalised Internet experience means that it is easy for users to simply opt out of climate change coverage. However, the focus groups highlighted three potential barriers for climate change

information to achieve large scale sharing. Firstly, there was disengagement with climate change generally with participants filtering out climate science information. Secondly, there was a lack of trust surrounding shared content. Finally, there was a fear that sharing climate change material may result in a backlash from other users online. Even with the fear of backlash there was the additional issue that young people simply viewed the Internet as a place for entertainment and has limited interest in engaging with serious issues. The fear of backlash just motivates users to opt out of coverage of significant issues as they do not feel that engagement with the issue is of their interest and concerns about their own safety.

The opportunity to share information virally, while being a cheap method of reaching a large audience, is flawed for climate communication. Viral communication is generally shared for entertainment purposes and the speed of Internet culture requires content that can easy be mutated to continue long-term viral success. Even then there are significant barriers to developing young peoples' online engagement with climate communication as online discussions were seen as a waste of time in comparison to face-to-face discussions. At the same time the quality of online discussions were seen as very low with other users posting jokes or derailing discussions of serious issues in particular with the result of a lack of engagement due to fear of online harassment or simply wasting their time.

The lack of sharing of climate change information and the lack of engagement with information about climate science is deeply disturbing. The Internet has become central in young people's lives with connectivity constantly expected. However, this is being used to opt out of climate change coverage and other serious issues in society. Finding an approach to encourage the sharing of climate change information online is important, but there are additional barriers to engagement with the Internet in generally being seen as a waste of time to discuss serious issues online and the fear of backlash from other users.

Therefore, the Internet has had significant impacts on the effectiveness of climate change communication. Junk information being widely shared is a potential risk to undermining public reactions to climate change, but more important are the consequences of information overload. The ability of users to

opt out of climate change coverage is the major problem posed, as by opting out they do not develop their understanding of climate science and this undermines public pressure for climate action.

Chapter 8 Conclusion

My research has found there are very concerning key issues with online communication of climate change. This thesis has made a distinctive contribution to the field by developing the information society theory into an analytical framework. This has built on an interdisciplinary range of subjects engaging with information processing, science communication, and media theory. The research has expanded beyond media trends and discourse analysis to examine the consequences of the meta media of the Internet on communication of climate change and how it has shaped reactions to climate science.

In particular, the dark side of the information society has provided an analytical framework to explore the impact of the Internet on climate change communication. While theorists such as Bell (1973) and Masuda (1980) had overly optimistic views with predictions of the light side of the information society it is important to note that their work was visionary. The sharing of information and increased freedom of access to information has occurred with increased knowledge creation (See chapter 2), rather than producing collective intelligence (See Masuda, 1985) and collective processing, we have instead witnessed the biological limits to information processing which has resulted in information overload with consequences of disengagement with climate change as users filter out information (See chapter 3), while it has also become potentially easier to mislead the public with junk information (See chapter 2). This chapter will first examine the findings of this research on key aspects, sharing, junk information and information overload, of the dark side of the information society. This will be followed by an examination of the implications of this study and how we can seek to improve climate change communication online with recommendations for future research.

8.1: Sharing

The focus groups reflected the impact of the Internet on the participants' day to day lives. However, the key finding from the focus groups is that the Internet poses significant barriers to engagement with and sharing of climate

change information. A core barrier is a lack of interest or the view that the topic is depressing. This results in users spending their time looking at other topics rather than engaging with climate science. This poses an even greater problem with the personalisation of the Internet providing a major barrier for climate science communication. The lack of interest undermines the potential use of the Internet to spread climate change information virally as the public are much more likely to ignore it rather than share it on social media. Instead the focus groups highlighted that they shared online content for entertainment rather than for communication of serious issues in society. These findings generally corroborate research on information processing (chapter 3) and online sharing of information (chapter 2). There were some additional findings with examples of online sharing being driven by shock humour and viral content being seen as a form of entertainment rather than information sharing (See chapter 5). This is problematic for environmental organisations trying to communicate global issues through the platform. Even if content is virally successful it is unclear whether there is a significant impact on the audience (See chapter 3).

Alongside the use of the Internet for entertainment, there were a number of additional barriers to communicating climate change online found in the focus groups that further undermined engagement with climate change online. In particular, there were three barriers to public engagement and sharing of climate change information. Firstly, there was a perception that the Internet was not a serious place for discussion. This was due to online discussions being seen as having a lack of impact or at worst being a waste of time in comparison to face to face discussions. Secondly, the focus groups also highlighted a perception that virally shared information was untrustworthy. Finally, engagement is further undermined by a fear of negative backlash and the potential of online harassment. There was a perception that this risk was less or unlikely to occur when discussing hobbies or entertainment in comparison with issues that they considered serious societal issues. All of these factors potentially significantly limit them seeing and sharing of climate change information online.

8.2: Junk information and information overload

Even if users engage with climate science, there is a risk that they can be misled by junk information. The Internet poses a problem with the fact that anyone can create content. In addition to this, there is the chance that incorrect information can be virally successful and attempting to contest successful viral material is a challenge. Climate sceptic information can mislead the public and reduce their perception of the risk from climate change while also making the public feel uncertain about climate science as it appears that the science is still debated. This is even more potentially problematic as the publics' understanding of climate science has been shown as low (See Bord et al., 2000, Pidgeon, 2012). In contrast, the findings from this research found that young people had a good understanding of climate science.

However, the risk posed by climate sceptic material was reflected in the experimental results that found the junk information treatment reduced the perception of risk and support for climate change mitigation. The level of understanding between the treatment groups was unaffected by the media stimuli and shaped instead by scientific literacy. The impact that junk information had was only present when there was no competition for the user's attention. Instead there was no significant impact on the perception of risk posed or support for climate change mitigation when there was competition for the user's attention when given a choice of environmental information.

The experimental design for information overload used three environmental science issues with climate change being in competition with genetically modified organisms and pesticides. Unfortunately the Excel sheets could not record what was clicked on and the open question at the end of the experiment asking the participants' what they looked at and why resulted in useless answers of "what interested me". This gave the participants choice between three environmental issues to focus on, but the Internet poses a greater challenge as climate change is in competition for attention from a vast array of topics and entertainment such as cat (See chapter 2) or MLP memes (See chapter 3). The impact of junk information in an information overload treatment did not have an impact and was found to not be significant. However, there was no significant finding with climate consensus treatment when there was information competition suggesting that when given other choices they simply did

not engage with the material to make any significant impact to their perceptions or understanding. This highlights the need for further research as the simplification of the Internet experience means that the Internet holds nearly unlimited distractions.

These results from the experimental treatments reflect the findings from the focus groups which have shown a lack of engagement with climate change information. This is a serious issue for public communication of climate change and creating political pressure for mitigation. In addition this is problematic for the public to build understanding of the issue of climate change it requires engagement and time to build the frames necessary (See Lakoff, 2010). This is completely undermined if people are simply opting out of climate change coverage.

The findings of the experiment are even more concerning given that the information overload is only very simplistic version of the experience of the Internet. The Internet gives access to a massive and ever growing range of topics and content which is accessible whenever a user wants. This is problematic as we can only focus on a limited number of issues at any one time (See Dunaway et al., 2010). Therefore, the Internet, while providing us new opportunities to communicate climate change with the public, has also made this process increasingly difficult and is a significant barrier to getting engagement with climate science or support for climate action.

The information society which we live in has offered us new approaches to climate change communication with social media and viral sharing of content. However, both the focus groups and experiments have found disengagement with climate change as a major issue facing the communication of climate science. This is compounded by the perception of viral content as untrustworthy and for entertainment online. This suggests that viral attempts to communicate climate change will have limited success or simply fail to gain a viral reach. Even then we face the problem that the public filter out climate change content. This means that the Internet has both provided easy access to climate science, but at the same time created significant barriers to encouraging public understanding and for creating support for climate action.

8.3: Implications of the findings:

The implications of these findings are deeply concerning. They highlight that rather than the optimistic predictions of the light side of the information society we instead have the consequences of the dark side to contend with. The major problem facing communicating climate change to the public is information overload resulting in people filtering out climate change information (See chapter 2). This is due to biological limitations on information processing (See chapter 3). However, the consequences of users being able to choose which information they engage with means that simply opt out of climate change coverage.

While the experiment produced a simplistic replication of the Internet experience, the findings are particularly worrying that information overload is a significant issue in communicating climate change. In the real world, there would be an even greater array of distractions from climate change which makes this finding even more worrying. The use of students can cause debates in generalisability, but the findings were also an unsettling result when the focus of students was done because young people are early adopters of social media (See chapter 1). This means as the Internet becomes increasingly normalised within society, there is the risk that communicating climate change to the general public will become increasingly more difficult as more people simply opt out of coverage.

The findings also suggest that junk information is not as problematic as presumed by previous research which has primarily focused on climate sceptic coverage and discourses (See Nerlich, 2010, Oreskes and Conway, 2010, Painter and Gavin, 2016). Climate sceptic information was simply not engaged with or ignored with no significant impact on the reactions of the participants. However, climate consensus was also found to have no significant impact in the information overload treatment. Therefore, this research differs significantly from previous research that has been concerned about climate sceptic material online as instead the Internet poses the more significant problem of even getting the message to the wider public in the first place, whether it is sceptical about climate change or not.

This leaves us with the problem of how do we improve climate change communication online. There have been examples of successful environmental

messages shared online, but these have failed to survive for a long time in the fast-moving online environment. Instead, information overload means that climate change messages need to be designed to be emotive and entertaining yet mutable so they survive longer (a key factor to the success of MLP memes discussed in chapter 3). This could be explored in greater detail and using a larger sample but due to the limitations of the PhD, with both limited budget and limited time, made recruiting additional participants problematic.

8.4: Future research

These findings suggest that there are three key areas to explore in future research. Firstly, the generalisability of the findings needs to be tested with further research looking at a wider range of ages. Secondly, how we can seek to improve climate change communication online and whether we can improve the spread of environmental messages through viral content production. Finally, the potential cultural differences between the UK and other countries when it comes to Internet use and climate change engagement.

The first area for further research would be the expansion of research to compare young people (18-25) to other age groups. The exploratory nature of this research meant that the focus was on young people due to them being early adopters (see chapter 1). While Internet use in other age groups has caught up the personalisation of the Internet experience means that there may be significant differences in types of use and the potential impact of junk information could be greater on older age groups or differences in how reliable the Internet is viewed as a source of information. This can be explored through experiments examining whether climate sceptic material or in right wing newspapers has greater impact on differing age groups or whether there is a difference between young and older participants in trust of information sources. Additional experimental research would be interesting to carry out to examine whether videos have a larger impact on participants' reactions to climate change information. This would be important to examine as videos are shared just as easily as blogs and news articles. Therefore, it would be important to examine whether they have a reduced impact in an information overload environment.

Secondly, this means that there are areas for future research to examine how to improve climate change communication in an information overload environment. Research to explore how climate change information is transferred through social networks would be valuable. Network analysis would enable exploration of whether climate change information simply only reaches environmentalists or if there is wider audiences receiving climate change information. Network analysis can also allow for the analysis of the success and longevity of climate change memes. This analysis approach would also allow examination of the size and organisation of climate sceptic networks on social media and also examine whether they have the ability to influence the general public or if these networks simply reinforce climate sceptic beliefs in those who already hold them. In particular, Twitter would be a good case study to focus on as users do not receive an experience controlled by an algorithm, but instead everything is self-selected by the user (See chapter 3). This would enable exploration of climate change communities and content analysis of what makes a successful Tweet with a climate message or whether they fail to reach a wider audience.

Additionally, it would be useful to explore the motivations of those who produce viral content and whether they significantly differ from those trying to communicate climate change virally. This could also evaluate whether there is a difference in reception and online engagement, potentially exploring whether there are online behaviours that could be encouraged to benefit the spread of climate change content online. There is a potential for a qualitative study with digital campaigners for key environmental NGOs and those who make popular viral content, for example from the Brony subculture (See chapter 3), which would enable examination of differing motivations, perceptions, and attitudes to content creation. Information overload poses a serious difficulty in effective online communication of climate change and finding a method to create successful viral content online is important to avoid people filtering out climate science entirely. It is important to find ways to present accurate climate science information in an entertaining way and to motivate the public to mutate the content to continue its spread.

Finally, there is also the potential to examine whether there are cultural differences. For example there is the potential to compare countries which

support the climate consensus, such as Germany, and those where climate change is seen as much more controversial, such as the United States. This form of comparative exploration would allow to explore whether cultural differences in both attitudes and Internet use impact climate reactions.

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Appendix A: Example focus group consent form

The gathering of information on climate change and usage of the Internet

Purpose

You are being asked to participate in a focus group that seeks to gather information over the use of the Internet to gather information on topics. In particular, this research is aiming to gain an awareness of how you gather information on climate change and your wider usage of the Internet such as activity in online communities.

Results from the focus groups will be used in my PhD thesis to inform the academic debate about climate change communication and maybe used in other academic publications.

Procedure

If you decide to participate, you will be asked to take part in a focus group of four to six participants lasting approximately an hour. Participants are invited to express their views and discuss how they engage with the Internet to find information on topics such as climate change. The focus group will be recorded on a Dictaphone.

Risks

There are no risks to you for participation in this study.

Anonymity

Any information you give will be strictly anonymous. Your name and any other identifying or personal information will not be used. Data will be stored securely and anonymised.

Costs

There will not be any cost to you beyond the time and effort that is required in taking part in the focus group.

Right to Refuse or Withdraw

Participation is voluntary. If you decide to participate, you may change your mind at any time and withdraw from the study. Your refusal to participate will not affect you in any way. During the focus group, you may decline to answer any questions.

Questions

If you have any questions then please contact myself, Phillip Passmore at:

Email: psp205@exeter.ac.uk

If you have any concerns and wish to contact someone else at the University of Exeter please email my PhD supervisor Dr Clare Saunders at C.Saunders@exeter.ac.uk or telephone 01326 259466.

Consent Statement

I agree to take part in this research and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the researcher and that my identity will remain anonymous in the publication of any findings.

Consent: TICK HERE: ☐

Please indicate if you would like to see copies of research reports that use data collected in these focus groups. These will be provided via email.   TICK HERE: ☐

Note: Your contact details are kept separately from the collected experimental data.

Name:_____

Email: _____

Signature: _____

Date: _____

Researcher: Phillip Passmore

Signature of researcher _____

Two copies will be signed with a copy provided for the participant.

Appendix B: Example experiment consent form

Impact of the internet upon public understanding of science

Purpose

You are being asked to participate in a research experiment. This research is aiming to gain an awareness of the impact of the Internet upon public understanding of science.

Results from the experiment will be used in my PhD thesis and possibly used in academic publications.

Procedure

If you decide to participate you will be asked to take part with a group of participants where an experiment will be carried out which will take around 30 minutes of your time. This experiment requires you to complete a scientific literacy test (results are completely anonymous and recorded as group average), and a series of survey questions. Instructions will be given before the experiment begins.

Risks

There are no risks to you for participation in this study.

Anonymity

Any information you give will be strictly anonymous. You name or any other identifying characteristics will not be used. Data will be stored securely and anonymised.

Costs

There is no cost to you beyond the time and effort that is required in taking part in the experiment.

Right to Refuse or Withdraw

Participation in this study is voluntary. If you decide to participate you may change your mind at any time and withdraw from the study. Your refusal to participate will not affect you in any way.

Questions

If you have any questions then please contact myself at:

Email: psp205@exeter.ac.uk

If you have any concerns and wish to contact someone else at the University of Exeter please email my PhD supervisor Dr Clare Saunders at C.Saunders@exeter.ac.uk

Consent Statement

I agree to take part in this research and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the researchers and that my identity will be protected in the publication of any findings.

Consent: TICK HERE: ☐

Please indicate if you would like to see copies of research reports that use data collected in these experiments. These will be provided via email.   TICK HERE: ☐

Note: Your contact details are kept separately from the collected experimental data.

Name:_____

Email: _____

Signature: _____

Date: _____

Researcher: Phillip Passmore

Signature of researcher   _____

Two copies will be signed with a copy provided to the participant.

Appendix C: Stage One Focus group Interview plan

Research Question:

How do Internet users engage with climate science and policy debates surrounding anthropogenic climate change?

Do users select information that fits into their pre-conceived ideas?

Where do users engage with climate change debates?

Do users receive information about climate change through social media?

Start of interview:

[Participant consent forms handed out and collected when signed]

Introduction

Thank you for spending your time to help my research. This focus group will seek to gain an awareness of how you gather information of climate change and your usage of the Internet to engage with current events. The focus groups will be used to inform my research examining the impact of the Internet upon public understanding of climate change.

The discussion should take no longer than an hour of your time.

There are no right or wrong answers with differing points of view. Please be respectful to each other.

My role as the focus group facilitator is to guide the discussion and prompt for more information.

To start can we go round in the circle introducing ourselves.

Questions:

To begin how do you use the Internet in your day to day lives?

Why do you use the Internet?

What do you use the Internet for?

When do you use the Internet?

Potential follow up questions:

Do you consider yourself a participant in on an online community? [Do you regularly contribute to online forums; to blogs; to Youtube discussions; etc.]

How do you use social media? For example to gain information about specific interests, for entertainment, to stay in touch with friends?

Gauge levels of interest in climate change

Gauge levels of understanding about climate change; what do they believe about climate change. How do they react to information that challenges what they believe?

Do you see climate change information and discussions online? Which online sources do you see climate change information?

Do you actively seek information on climate change, or do you come across climate change content when browsing the Internet?

What proportion of what you see online is on climate change?

Prompt: For example do you see environmental memes? (Examples in Appendix A will be printed in colour on A4 paper and shown to participants at this point)

Do you engage with climate change information or participate in climate change discussions?

Read

Share

Discuss

Sign online petitions

Take in some memes (one warmists, one from sceptics) how would you react to this if you saw it online? Appendix B

Closing statement:

Thank you for your time for helping with this research. A summary of the research findings will be provided if ticked on the consent form.

Hand out 1: Example of an environmental meme

Hand out 2: Examples of competing climate change memes -Warmist meme and climate sceptic meme
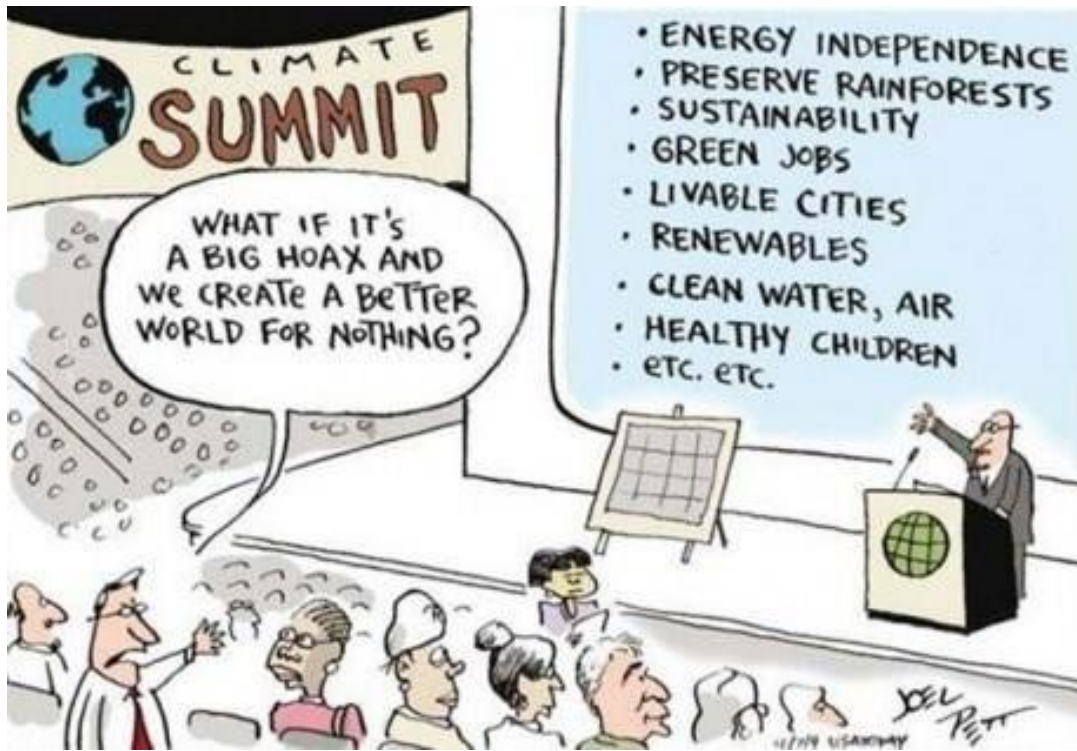
Appendix D: Phase Two Focus Group Interview plan

Research Question:

How do Internet users engage with climate science and policy debates surrounding anthropogenic climate change?

- Do users select information that fits into their pre-conceived ideas?
- Where do users engage with climate change debates?
- Do users receive information about climate change through social media?

Start of interview:

[Participant consent forms handed out and collected when signed]

Introduction

Thank you for spending your time to help my research. This focus group will seek to gain an awareness of how you gather information of climate change and your usage of the Internet to engage with current events. The focus groups will be used to inform my research examining the impact of the Internet upon public understanding of climate change.

The discussion should take no longer than an hour of your time.

There are no right or wrong answers with differing points of view. Please be respectful to each other.

My role as the focus group facilitator is to guide the discussion and prompt for more information.

To start can we go round in the circle introducing ourselves?

Questions:

To begin how do you use the Internet in your day-to-day lives?

Why do you use the Internet?

What do you use the Internet for?

When do you use the Internet?

Do you read newspapers or watch television news?

Do you use social media?

How do you use social media?

Do you use it to connect to friends and family?

Do you access information through social media?

Are you a participant in online community? [Do you regularly contribute to online forums; to blogs; to Youtube discussions; etc.]

Do you receive information through online communities?

What motivates you to engage with online communities?

Do you trust information you see online?

Do you engage with online discussions?

Do you engage in online political discussions?

Do you engage with debates surrounding science and technology?

Do you see memes in your general Internet usage? [Show Appendix A example of a meme]

Do you share memes?

Do you see them as a way of communicating issues or topics?

Gauge levels of interest in climate change

Are you aware of any current or recent stories about climate change in the media?

Do you care about climate change? Why, why not?

Do you believe that human greenhouse gas emissions are responsible for climate change?

Do you see climate change information and discussions online? Which online sources do you see climate change information?

What proportion of what you see online is on climate change?

Gauge levels of understanding about climate change; what do they believe about climate change. How do they react to information that challenges what they believe?

Do you actively seek information on climate change, or do you come across climate change content when browsing the Internet?

Do you engage with climate change information or participate in climate change discussions?

Read

Share

Discuss

Sign online petitions

Do you see climate change focused memes (prompt of appendix C of one warmist meme and one meme from sceptics)

How would you react to this if you saw it online?

Closing statement:

Thank you for your time for helping with this research. A summary of the research findings will be provided if ticked on the consent form.

Hand out 1: Meme example

Hand out 2: Example of an environmental meme

Hand out 3: Warmist meme and climate sceptic meme
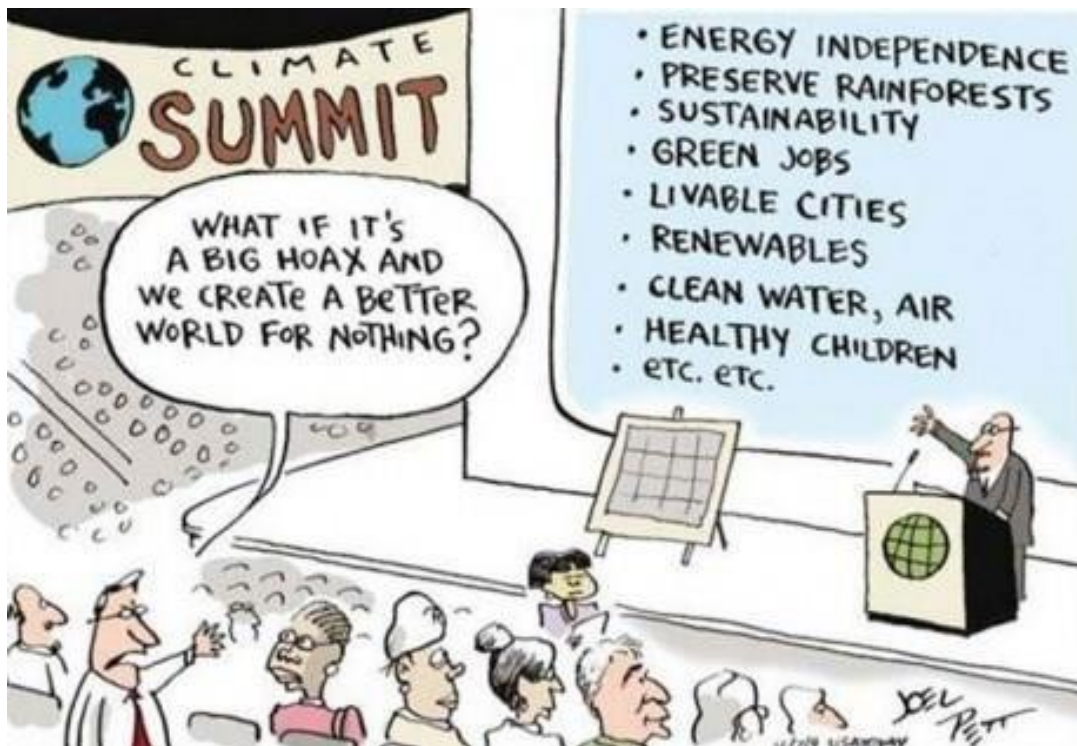
STOP GLOBAL WARMING

Because it's so fricken hot outside it won't stop snowing.

Appendix E: Online survey

Welcome!

Thank you for participating in this survey. This research seeks to explore the impact of the Internet on the understanding and perception of climate change.

This survey takes around 20 minutes to complete. All data is anonymous. In particular, this survey asks questions focusing on Internet use, scientific understanding, and climate change.

The information collected in this survey will be used in my PhD and possibly in future academic publications.

Once again thank you for your time in helping my research.

If you have any questions you can contact me at psp205@exeter.ac.uk

Phillip Passmore
Environment and Sustainability Institute
University of Exeter
Penryn Campus
Penryn
Cornwall
TR10 9FE

Online engagement

The questions on this page seek to build an understanding of Internet use and engagement with information online

* 1. Approximately how often do you see information about science online?

○ Several times a day

○ Daily

○ Weekly

○ Fortnightly

○ Monthly

○ Rarely

○ Never

* 2. Approximately how often do you see information about climate change online?

○ Several times a day

○ Daily

○ Weekly

○ Fortnightly

○ Monthly

○ Rarerly

○ Never

* 3. In the past 7 days, roughly how many total hours have you spent using the Internet? Please DO NOT include time spent on email or performing tasks related to your job.

○ None

○ 1 to 5 hours

○ 6 to 10 hours

○ 11 to 15 hours

○ 16 hours or more

* 4. In the past 7 days, roughly how many total hours have you spent using the Internet for work?

○ None

○ 1 to 5 hours

○ 6 to 10 hours

○ 11 to 15 hours

○ 16 hours or more

* 5. In the past 7 days, roughly how many hours have you spent watching television shows (e.g. cable television, network television, internet streaming, etc.)?

○ None

○ 1 to 5 hours

○ 6 to 10 hours

○ 11 to 15 hours

○ 16 hours or more

* 6. Which of the following activities do you use the Internet for? Do not include activities for your Work

☐ Check the weather forecast

☐ Find local events

☐ Find people you know

☐ Find recipes

☐ Get directions

☐ Keep in touch with current or former coworkers

☐ Keep in touch with friends

☐ Keep up with current events

☐ Make or receive phone calls

☐ Make travel arrangements

☐ Pay bills

☐ Play games

☐ Play music

☐ Play podcasts

☐ Play videos (other than video games)

☐ Practice using a new language

- [ ] Purchase products or services
- [ ] Read other people's comments (on blogs, news stories, etc.)
- [ ] Record videos
- [ ] Research academic articles or books
- [ ] Search or apply for jobs
- [ ] Send or receive instant messages
- [ ] Send or receive photos
- [ ] Send or receive videos
- [ ] Start new dating relationships
- [ ] Start new friendships
- [ ] Take online academic classes
- [ ] Take online professional training classes
- [ ] Take or post surveys
- [ ] Use social networking websites
- [ ] Other (please specify)

[   ]

* 7. Which of the following activities do you use the Internet at work for?

- [ ] Check the weather forecast
- [ ] Find local events
- [ ] Find people you know
- [ ] Find recipes
- [ ] Get directions
- [ ] Keep in touch with current or former coworkers
- [ ] Keep in touch with friends
- [ ] Keep up with current events
- [ ] Make or receive phone calls
- [ ] Make travel arrangements
- [ ] Pay bills
- [ ] Play games
- [ ] Play music

- [ ] Play podcasts
- [ ] Play videos (other than video games)
- [ ] Practice using a new language
- [ ] Purchase products or services
- [ ] Read other people's comments (on blogs, news stories, etc.)
- [ ] Record videos
- [ ] Research academic articles or books
- [ ] Search or apply for jobs
- [ ] Send or receive instant messages
- [ ] Send or receive photos
- [ ] Send or receive videos
- [ ] Start new dating relationships
- [ ] Start new friendships
- [ ] Take online academic classes
- [ ] Take online professional training classes
- [ ] Take or post surveys
- [ ] Use social networking websites
- [ ] Other (please specify)

_____

* 8. How important is the Internet for each of the following activities?

	Not at all	Not very	Somewhat	Quite	Very much
Check the weather forecast	○	○	○	○	○
Find local events	○	○	○	○	○
Find people you know	○	○	○	○	○
Find recipes	○	○	○	○	○
Get directions	○	○	○	○	○
Keep in touch with current or former coworkers	○	○	○	○	○
Keep in touch with friends	○	○	○	○	○

	Not at all	Not very	Somewhat	Quite	Very much
Keep up with current events	○	○	○	○	○
Make or receive phone calls	○	○	○	○	○
Make travel arrangements	○	○	○	○	○
Pay bills	○	○	○	○	○
Play games	○	○	○	○	○
Play music	○	○	○	○	○
Play podcasts	○	○	○	○	○
Play videos (other than video games)	○	○	○	○	○
Practice using a new language	○	○	○	○	○
Purchase products or services	○	○	○	○	○
Read other people's comments (on blogs, news stories, etc.)	○	○	○	○	○
Record videos	○	○	○	○	○
Research academic articles or books	○	○	○	○	○
Search or apply for jobs	○	○	○	○	○
Send or receive instant messages	○	○	○	○	○
Send or receive photos	○	○	○	○	○
Send or receive videos	○	○	○	○	○
Start new dating relationships	○	○	○	○	○
Start new friendships	○	○	○	○	○
Take online academic classes	○	○	○	○	○
Take online professional training classes	○	○	○	○	○
Take or post surveys	○	○	○	○	○
Use social networking websites	○	○	○	○	○

Other (please specify)

* 9. In a typical weekday, do you use the internet most often for work, for leisure, or about an equal amount on both?

○ 100% for work

○ 80% for work and 20% leisure

○ 60% for work and 40% leisure

○ 50% for both work and leisure

○ 40% work and 60% leisure

○ 20% for work and 80% leisure

○ 100% for leisure

* 10. In the past 30 days, which of the following activities did you use the Internet for? (Please select all that apply.)

☐ Logged into an online dating website

☐ Logged into a social networking website (e.g. Facebook, Myspace, etc.)

☐ Followed, liked, or became a fan of something or someone

☐ Uploaded video or photos to a website

☐ Wrote an online blog

☐ Read an online blog

☐ Read news stories

☐ Streamed audio content (e.g. music, news, podcasts)

☐ Streamed video content (e.g. movies, television, news)

☐ Played video games online

☐ Used an online gambling site

☐ Made a restaurant reservation

☐ Made a phone call

☐ Obtained medical information

☐ Logged into an online banking website

☐ Looked for employment

☐ Made personal or business travel plans (e.g. lodging, air travel)

☐ Made a purchase for business use

☐ Made a purchase for personal use

☐ Compared prices for a product or service

☐ Searched for a product or service

☐ Rated or reviewed a product or service

☐ None of these

* 11. Online how do you decide which media to engage with?

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* 12. Do you engage with certain content online more than others and if so why?

[   ]

* 13. In a typical day, how likely are you to use social networking websites?

( ) Not at all likely

( ) Slightly likely

( ) Moderately likely

( ) Very likely

( ) Extremely likely

* 14. On a typical day, about how many hours do you spend looking at content on a social networking website?

[   ]

Understanding of science

* 1. The centre of the Earth is very hot (True or False)?

  ○ True

  ○ False

  ○ Don't know

* 2. The continents have been moving their location for millions of years and will continue to move (True or False).

  ○ True

  ○ False

  ○ Don't Know

* 3. Lasers work by focusing sound waves (True or False).

  ○ True

  ○ False

  ○ Don't Know

* 4. All radioactivity is man made (True or False)

  ○ True

  ○ False

  ○ Don't Know

* 5. Electrons are smaller than atoms. (True or False)

  ○ True

  ○ False

  ○ Don't know

* 6. Does the Earth go round the sun, or does the sun go around the Earth?

  ○ Earth goes round the sun

  ○ Sun goes round Earth

  ○ Don't know

* 7. It is the father's gene that decides whether the baby is a boy or girl

○ True

○ False

○ Don't know

* 8. Antibiotics kill viruses as well as bacteria (True or False)

○ True

○ False

○ Don't know

* 9. Human beings, as we know them today, developed from earilier species of animal (True or False)

○ True

○ False

○ Don't know

* 10. Would you say that astrology is very scientific, sort of scientific, or not at all scientific?

○ Very scientific

○ Sort of scientific

○ Not scientific at all

* 11. A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness. (1) Does this mean that if their first child has the illness, the next three will not?

○ Yes

○ No

○ Don't know

* 12. (2) Does this mean that each of the couple's children will have the same risk of suffering from the illness?

○ Yes

○ No

○ Don't know

* 13. Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? (Scientist 1 or scientist 2?)

- ◯ Scientist 1
- ◯ Scientist 2
- ◯ Don't know

* 14. Why is it better to test the drug this way?

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* 15. When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms. First, some articles refer to the results of a scientific study. When you read or hear the term scientific study, do you have a clear understanding of what it means, a general sense of what it means, or little understanding of what it means?

- ◯ A clear understanding
- ◯ A general understanding
- ◯ Little understanding

* 16. In your own words, could you tell me what it means to study something scientifically?

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Climate change

* 1. Regardless of whether you know much about Climate change, please indicate whether you think each of the following is a major or primary cause of Climate change, a minor or secondary cause, or not a cause at all.

	Major or primary cause	A minor or secondary cause	Not a cause at all
Pollution/emissions from business and industry	○	○	○
Use of aerosol spray cans	○	○	○
Use of chemicals to destroy insect pests	○	○	○
People driving their cars	○	○	○
Use of coal and oil by utilities or electric companies	○	○	○
Depletion of ozone in the upper atmosphere	○	○	○
Destruction of tropical forests	○	○	○
Nuclear power generation	○	○	○
People heating and cooling their homes	○	○	○

* 2. Are the following statements about climate change true or false?

	True	False	Don't know
Human activity is a significant cause of climate change	○	○	○
Climate naturally varies over time so we should not worry	○	○	○
Climate change is causing the majority of glaciers and sea ice to melt around the world	○	○	○
There is nothing we can do about climate change. It's already too late.	○	○	○
Scientists disagree about whether humans are causing the Earth's climate to change	○	○	○
Global warming is a good thing, because it will rid us of frigid winters and make plants grow more quickly	○	○	○

* 3. The following gases are greenhouse gases (True or False)

	True	False	Don't Know
Argon	○	○	○
Water Vapour	○	○	○
Methane	○	○	○
Nitrogen	○	○	○
Carbon Dioxide	○	○	○
Chlorofluorocarbons (CFCs)	○	○	○
Oxygen	○	○	○
Nitrous Oxide	○	○	○

* 4. In your judgement, how likely are you, sometime during your life to experience serious threats to your health or overall well-being as a result of each of the following

	Very Unlikely	Unlikely	Neither	Likely	Very Likely
Violent crime	○	○	○	○	○
Auto accidents	○	○	○	○	○
The disease AIDS	○	○	○	○	○
Cancer	○	○	○	○	○
Heart disease	○	○	○	○	○
Hazardous chemicals	○	○	○	○	○
Air Pollution	○	○	○	○	○
Climate change	○	○	○	○	○
Water pollution	○	○	○	○	○

* 5. In your judgement, how likely is it that each of the following will have extremely harmful, long-term impacts on our society?

	Very Unlikely	Unlikely	Neither	Likely	Very Likely
Violent crime	○	○	○	○	○
Auto accidents	○	○	○	○	○
The disease AIDS	○	○	○	○	○
Cancer	○	○	○	○	○
Heart disease	○	○	○	○	○
Hazardous chemicals	○	○	○	○	○
Air Pollution	○	○	○	○	○
Climate change	○	○	○	○	○
Water pollution	○	○	○	○	○

* 6. Do you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
"Extensive and long-lasting flooding caused by climate change is likely to take place in low-lying countries like Bangladesh or the Netherlands."	○	○	○	○	○
"Extensive and long-lasting flooding caused by climate change is likely to take place in the UK."	○	○	○	○	○
"Climate change is likely to cause severe food shortages in places like Africa and India."	○	○	○	○	○
"Climate change is likely to cause severe food shortages in the UK."	○	○	○	○	○
"People in the UK will be affected by climate change in the next 30 years."	○	○	○	○	○
"People in the UK will be affected by climate change in the next 200 years."	○	○	○	○	○

* 7. Do you agree or disagree with the following statements:

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
It's not worth Britain trying to combat climate change, because other countries will just cancel out what we do	○	○	○	○	○
The effects of climate change are too far in the future to really worry me	○	○	○	○	○

* 1. In politics people sometimes talk of "left" and "right". Where would you place yourself on this scale, where 0 means left and 10 means right?

	0	1	2	3	4	5	6	7	8	9	10	N/A
Scale	○	○	○	○	○	○	○	○	○	○	○	○

* 2. In what country do you live?

[   ]

3. Which region of the country do you live in?

[   ]

* 4. What year were you born?

[   ]

5. What is your gender?

○ Female

○ Male

○ Other (please specify)

[   ]

* 6. What is your highest educational qualification? Or if you are a student, at what level are you studying? (Please write full name of qualification)

[   ]

7. If a student what subject are you studying?

[   ]

Thank you

Thank you for taking part in the survey!

Appendix F: Experiment coding

Physical science:

Question	True	False	Don't Know
The center of the Earth is very hot (True or False).	1	0	0
The continents have been moving their location for millions of years and will continue to move (True or False).	1	0	0
Lasers work by focusing sound waves (True or False).	0	1	0
All radioactivity is manmade (True or False)	0	1	0
Electrons are smaller than atoms. (True or False)	1	0	0

Question	The Earth goes round the Sun	The Sun goes round the Sun	Don't Know
Does the Earth go round the sun, or does the sun go around the Earth?	1	0	0

Scores from these questions are combined to give a basic physical science knowledge score ranging from 0 to 6.

Biological science:

Question	True	False	Don't Know
It is the father's gene that decides whether the baby is a boy or a girl. (True or False)	1	0	0
Antibiotics kill viruses as well as bacteria (True or False)	0	1	0
Human beings, as we know them today, developed from earlier species of animal (True or False)	1	0	0

Question	Yes	No	Don't Know
A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness. (1) Does this mean that if their first child has the illness, the next three will not?	0	1	0
(2) Does this mean that each of the couple's children will have the same risk of suffering from the illness?	1	0	0

Question	Scientist 1	Scientist 2	Don't know
Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? (Scientist 1 or scientist 2?)	0	1	0

Open question	Shows some understanding of the use of control groups for comparison	Does not show understanding for the need of comparison or simply puts does not know.
Why is it better to test the drug this way?	1	0

Scores from these questions are combined to give a basic knowledge of biological science score ranging from 0 to 7.

Scientific methods:

Understands statistics:

Question	Yes	No	Don't Know
A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness. (1) Does this mean that if their first child has the illness, the next three will not?	0	1	0
(2) Does this mean that each of the couple's children will have the same risk of suffering from the illness?	1	0	0

If both of these are answered correctly then a score of 1 is given to the understanding statistics variable if scoring 1 or 0 then a score of 0 is given to the variable.

Understands experiments:

Question	Scientist 1	Scientist 2	Don't know
Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? (Scientist 1 or scientist 2?)	0	1	0

Open question	Shows some understanding of the use of control groups for comparison	Does not show understanding for the need of comparison or simply puts does not know.
Why is it better to test the drug this way?	1	0

If both of these are answered correctly then a score of 1 is given to the understanding experiments if scoring 1 or 0 then a score of 0 is given to the variable.

Understands the scientific method:

Question	Clear understanding	A general sense	Little understanding	Don't know
When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms. First, some articles refer to the results of a scientific study. When you read or hear the term	1	1	0	0

scientific study, do you have a clear understanding of what it means, a general sense of what it means, or little understanding of what it means?				

Open question	Some awareness of experimental methods, knowledge creation, or scientific process	Does not demonstrate understanding or put 'Don't Know'
In your own words, could you tell me what it means to study something scientifically?	1	0

Open question	Shows some understanding of the use of control groups for comparison	Does not show understanding for the need of comparison or simply puts does not know.
Why is it better to test the drug this way?	1	0

For a participant to be classified as understanding the scientific method they needed to have been classified as understanding statistics and also getting at least one of the open questions correct. If both this criteria was achieved the participant was given a score of 1 if both open questions were incorrect and they were not classified as understanding statistics they would be given a score of 0.

Rejects pseudoscience:

Question	Very Scientific	Somewhat scientific	Not Scientific at all	Don't Know
Would you say that astrology is very scientific, sort of scientific, or not at all scientific?	0	0	1	0

The rejection of pseudoscience is measured based on whether they recognised that astrology was not scientific. If they rejected astrology they were considered able to reject pseudoscience.

Basic knowledge of climate change

Question	Statements	Major	Minor	Not a cause	Don't know
Regardless of whether you know much about Climate change, please indicate whether you think each of the following is a major or primary cause of Climate change, a minor or secondary cause, or not a cause at all.	Pollution/emissions from business and industry	1	0	0	0
	Use of aerosol spray cans	0	0	1	0
	Use of chemicals to destroy insect pests	0	0	1	0
	People driving their cars	1	0	0	0
	Use of coal and oil by utilities or electric companies	1	0	0	0
	Depletion of ozone in the upper atmosphere	0	0	1	0
	Destruction of tropical forests	1	0	0	0
	Nuclear power generation	0	0	1	0
	People heating and cooling their homes	1	0	0	0

Question	Statements	True	False	Don't know
Are the following statements about climate change true or false?	Human activity is a significant cause of climate change	1	0	0
	Climate naturally varies over time so we should not worry	0	1	0
	Climate change is causing the majority of glaciers and sea ice to melt around the world	1	0	0
	The hole in the ozone layer causes global warming	0	1	0
	There is nothing we can do about climate change. It's already too late.	0	1	0
	Scientists disagree about whether humans are causing the Earth's climate to change	0	1	0
	Global warming is a good thing, because it will rid us of frigid winters and make plants grow more quickly	0	1	0
The following gases are greenhouse gases (True or False)	Argon	0	1	0
	Water Vapour	1	0	0
	Methane	1	0	0
	Nitrogen	0	1	0
	Carbon Dioxide	1	0	0
	Chlorofluorocarbons (CFCs)	1	0	0
	Oxygen	0	1	0
	Nitrous Oxide	0	1	0

Perception of Risk:

Question	Statements	Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly Disagree
In your judgement, how likely are you, sometime during your life to experience serious threats to your health or overall well-being as a result of each of the following	Climate change	5	4	3	2	1
In your judgement, how likely is it that each of the following will have extremely harmful, long-term impacts on our society?	Climate change	5	4	3	2	1
Do you agree or disagree with the following statements:	"Extensive and long-lasting flooding caused by climate change is likely to take place in low-lying countries like Bangladesh or the Netherlands."	5	4	3	2	1
	"Extensive and long-lasting flooding caused by climate change is likely to take place in the UK."	5	4	3	2	1
	"Climate change is likely to cause severe food shortages in places like Africa and India."	5	4	3	2	1
	"Climate change is likely to cause severe food shortages in the UK."	5	4	3	2	1
	"People in the UK will be affected by climate change in the next 30 years."	5	4	3	2	1
	"People in the UK will be affected by climate change in the next 200 years."	5	4	3	2	1

Attitudes to climate change mitigation:

Question	Statement	Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly Disagree
In your Do you agree or disagree with the following statements:	It's not worth Britain trying to combat climate change, because other countries will just cancel out what we do	5	4	3	2	1
	The effects of climate change are too far in the future to really worry me	5	4	3	2	1