Environment and Planning A, Volume 42, Issue 12, 2010, Pages 3023 – 3038

# Flood perception and mitigation: the role of severity, agency and experience in the purchase of flood protection, and the communication of flood information

**Emma Soane**
London School of Economics and Political Science
Department of Management, Houghton Street, London, WC2A 2AE
Tel: +44 (0)20 7405 7686
Fax: +44 (0)20 7955 7424
Email: e.c.soane@lse.ac.uk

**Iljana Schubert**
Kingston University
Department of Leadership, HRM and Organisation, Kingston University,
Kingston upon Thames KT2 7LB
Tel: +44 (0)20 8417 9000
Fax: +44 (0)20 8547 7026
Email: iljanaschubert@hotmail.com

**Peter Challenor**
National Oceanography Centre,
European Way,
Southampton SO14 3ZH
Email: p.challenor@noc.soton.ac.uk

**Rebecca Lunn**
University of Strathclyde
John Anderson Campus
16 Richmond Street,
Glasgow G1 1XQ.
Scotland
Email: rebecca.lunn@strath.ac.uk

**Sunitha Narendran**
Kingston University
Department of Leadership, HRM and Organisation, Kingston University,
Kingston Hill, Kingston upon Thames KT2 7LB
Tel: +44 (0)20 8417 9000
Fax: +44 (0)20 8547 7026
Email: s.narendran@kingston.ac.uk

**Simon Pollard**
Cranfield University
Collaborative Centre of Excellence in Understanding and Managing Natural and Environmental Risks, Cranfield, Bedfordshire, MK43 0AL
Tel: +44 (0)1234 754101
Fax: +44 (0)1234 751671
Email: s.pollard@cranfield.ac.uk

**Abstract**

Protection of human life and property from flooding is a strategic priority in the UK. We examine how to encourage home owners to protect themselves and their residences. A model of factors that influence the decision to buy flood protection devices is tested using survey data from 2,109 home owners. The results showed that the majority of respondents have not purchased domestic flood protection (N=1,732; 82.1%). Purchase of flood protection devices was influenced by age; perceived seriousness; and beliefs about, and trust in, the role of regulators in managing flooding. In younger respondents, the perceived seriousness of the dangers of flooding acted as precursors and barriers to action depending on individual sense of responsibility and agency. The second part of the study examined responsiveness to information. Information about flooding alone was insufficient to promote behavioural change, particularly among people who have not experienced a flood or who believe that they are not in a flood zone. Implications for understanding flood protection, managing agency issues, and flood communication campaigns are discussed.

**Key words**: flooding; regulation; risk perception; flood protection; responsibility; agency

**Word count** (including references): 8,557

## Introduction

An independent review of the flooding emergency of 2007 in the UK concluded that extreme weather events are increasingly likely (Pitt Review, 2007; UKCIP in Water UK, 2008). Recent events in the UK and other countries have shown that flooding is a widespread hazard that is not merely restricted to people living on the coast or near rivers. Flooding is often attributed to building developments on flood-plain areas, combined sewer overflows (Environment Agency, 2003; Evans et al., 2004) and climate change (Stern, 2006). Current approaches to flood preparation involve shared responsibility and have several main components. At the national level, a range of flood risk management measures need to be in place, including planning and development controls, physical defences, plans for managed retreat and automated warnings for vulnerable communities. Government, regulators and insurance companies need to plan financially for flood events. Next, and the focus of this study, is individual level preparation reflecting psychological and behavioural adaption, as demonstrated at the household level in some recent studies (e.g. Brown & Damery, 2008; Scolobig, Broto & Zabala, 2008), relevant also to strategic priorities (Tunstall, Johnson and Penning-Rowsell, 2004).

Empirical studies of perceptions of, and responses to, floods yield three important findings that form a background to this study. The first is that an individual's experience of flooding and their purchase of domestic flood protection devices are not necessarily linked (e.g. Blanchard Boehm et al., 2001). Flood experience is neither a necessary, nor sufficient, incentive for domestic flood protection. The second issue is one of agency and responsibility whereby there is appropriate allocation of responsibility between the State and individuals (Parker, Priest, Schildt & Handmer, 2008). The third is that communication about flooding needs to be built on an understanding of residents' perceptions of flooding and receptiveness to information (Krasovskaia, 2001). Communication also needs to take into account the first two points.

Here, we are concerned with how best to encourage individual uptake of domestic flood protection. Our data represent one of the largest UK quantitative studies of individual level perceptions of flooding. The insights raise implications for theoretical developments about property protection, as well as providing information for communicators and policy makers. We focus on individual psychological factors that influence individual decisions about preventative flood risk management. We consider psychological factors since they are relevant to understanding individual choices about flood protection because beliefs, perceptions and interpretations of experiences are important precursors to behaviour. Their combined effects form a lens through which information is interpreted. Working in with this approach, we examine three sets of possible antecedents to flood protection purchase: perceived responsibility and agency, and the related factor of willingness to pay for flood defences; perceptions of flooding; the interaction between information content and presentation with individual differences, and the links with subsequent action. We address three research questions:

1. What are the antecedents of domestic flood protection and the perceived challenges of purchasing domestic flood protection?
2. What are the antecedents of responsiveness to flood related information?
3. What are the optimal ways to present flood risk information?

**Perceived responsibility, agency and individual action**

Flooding presents a challenge to residents, policy makers and institutions tasked with environmental responsibilities. A key theme is the sharing of responsibility and cost for risk management. Individual home owners face an important choice when considering whether to initiate action to protect their home from flooding. Until recently, the prevailing paradigm involved reliance by the individual upon the State or institutionally funded and organised schemes (Bickerstaff & Walker, 2002; Bradbury, 1989, Kerr, 2003). This paradigm has been

eroded over the past few years due to two developments. The first concerns the way that people think about the concept of risk. This debate owes much to the works of Beck (1992) and Giddens (1990) who claim that modern risks are diffuse, transcending geographical or national divisions and creating challenges for the allocation of responsibilities for the reduction or prevention of negative consequences. Thus, since risk itself has changed, approaches to risk management and mitigation also need to change. The second development concerns flooding specifically. Recent events in the UK and other countries have shown that flooding is a widespread hazard not restricted to people living on the coast or near rivers, due to overloading of urban drainage systems (Evans et al., 2004). Furthermore, flood damage has been considerable since existing flood prevention schemes and drainage systems have not been substantial enough to cope with rising waters or rain fall events. There is increasing awareness for the need for flood management, rather than prevention, with roles for the State, regulators and individuals (Johnson & Priest, 2006).

Taken together, these factors have contributed to the development of collaborative approaches to flood management that bring together institutions and individuals and consider flood management as a joint responsibility (Johnson et al., 2005; Johnson & Priest, 2008; Penning-Rowsell et al., 2006). The constructs of responsibility and agency are useful since they are important precursors to action. Responsibility is concerned with both a sense of moral duty and belief that action must be taken (Eden, 1993). Agency refers to a sense that one is able to take effective action (Eden, 1993). To take action, home owners need to accept it is their responsibility to protect their home rather than the responsibility of institutions of the State (Rose, 1999), and believe that their actions will have positive, meaningful consequences. Eden (1993) suggested important links between a perceived ability to influence what is broadly characterised as ‘the environment’, a sense of personal responsibility, and subsequent action. Several factors that influence agency and responsibility have been identified. There must be a recognisable agent or cause for responsibility to be attributed

(Bickerstaff & Walker, 2002). Self-efficacy (i.e. belief in their ability to carry out actions successfully) increases preventive behaviours due to beliefs that actions can be effective (Murray-Johnson et al., 2004; Witte, 1992). Self-responsibility is also relevant, for similar reasons (Takao, 2006). However, the relationship between flood protection and its antecedents is not straightforward.

Harries (2008) noted that many people in flood-risk areas do not have domestic flood protection. Even when residents have experienced a flood, the majority do not purchase flood protection. This could be due to real cost barriers, as well as psychological factors. Harries (2008) used the lens of Maslow's hierarchy of needs (1943) to suggest a tendency not to accept responsibility for protecting the home since the need to feel secure runs counter to the acceptance of a need to defend the home against hazards. This creates dissonance which tends to be resolved by discounting the flooding risk (Burningham, Fielding & Thrush, 2008), or by shifting responsibility to government. De Marchi et al., (2007) found a progressive erosion in the culture of self-protection among people in the Italian Upper Adige/Sarca river basin; an area prone to flash floods, torrent rivers and inter-related events. Residents reported feeling protected by the presence of flood and debris flow protection systems, even though these defences had been overcome during recent floods. There was widespread opinion that the cost of flood protection and public safety were the responsibility of government rather than the individual, thus individuals often chose not to protect their properties from flooding. A third related response is willingness to pay for institutions to provide flood protection thus inferring the transfer of responsibility from the individual home owner to institutions and regulators. For example, Næss, Bang, Eriksen & Vevatne (2005) found that institutional flood protection schemes provided only weak incentives for local flood initiatives as there was seen to be less need for individual action. A similar process could function at the individual level: people might prefer to pay for flood defences than accept the responsibility for protecting their own home. Furthermore, transference of responsibility via flood insurance is also complex.

Insurance could preclude further domestic protection (Blanchard-Boehm et al, 2007), and can be unlikely to be purchased voluntarily when flood defences are in place (Hung Chih, 2009). Thus research into responsibility and agency, reviewed above, has shown that these are salient issues that merit their exploration along with additional, relevant constructs.

**Perceptions of flooding and flood-related risk**

Risk perception is strongly associated with subsequent preventive action (Slovic, Fischhoff & Lichtenstein, 1982). Risk perception could also influence sense of responsibility and agency: if a hazard is perceived as serious enough, it could increase the likelihood of individual level beliefs that personal action is both required and efficacious (Krewski, Slovic, Bartlett, Flynn & Mertz, 1995). Some empirical research has examined the associations between perceptions of flood risk and individual action. The high-risk, low-frequency nature of flooding events is important to consider. Kunreuther and Pauly (2004) demonstrated that people tend to underestimate the likelihood of low frequency events of various kinds. This bias also relates to flooding. Siegrist and Gutscher (2006) examined lay and expert risk perceptions in Switzerland and showed that perceptions of both groups varied within and across high and low risk flood zones. Further, they observed both over- and under-estimation of risk in all zones leading to a mismatch between flood prevention, perceived risk and assessments of risk likelihood. Some participants were too concerned and had made higher levels of investment in flood protection than risk assessments warranted; whereas others in high risk areas were unconcerned and under-prepared. A similar result was found in the 'Flows' project (Floodplain Land use Optimising Workable Sustainability; 2002-2006) which recommended regular assessment of public perception of flood prone areas since people in these areas seem generally unconcerned about flooding and showed limited involvement in flood risk management issues. Takao and colleagues' study of 2051 residents following the Tokai flood in 2000 in Japan showed that preparedness for flood events was determined, in

part, by experience of flooding: worse experiences were associated with greater protection (in contrast to Harries, 2008), particularly when combined with property ownership and fear of flooding. Anticipation of future floods, by itself, did not influence flood protection (Takao, Motoyoshi, Sato & Fukuzono, 2004; Takao, 2006).

In summary, there does not seem to be a consistent, positive relationship between flood experience and flood mitigation via purchase of domestic flood protection. Furthermore, there are individual differences in how risk perception influences flood protection for both lay people and experts. However, the literature on flood perception suggests that preventive action could be enhanced when risk perceptions and assessments of risk likelihood are aligned. One way to achieve alignment is through risk communication.

**Responsiveness to Risk Communication and Information**

Flood risk communication and the responsiveness of the individual to such communication is an important aspect to flood protection and mitigation behaviours. The principle of such communication is that if people are provided with information they will be able to act upon it. One programme incorporating this principle is the Japanese Participatory Flood Risk Communication Support System (Pafrics) (Fukuzono at al, 2006). This has achieved some success in increasing people's knowledge about flooding by providing information via a computerised flood risk literacy programme and workshops.

However, because effective communication is seldom a passive process, information provision alone is insufficient to change behaviour. For example, Krasovskaia et al. (2001) found that fewer than 50% of participants were ready to obey orders from the authorities, e.g. to evacuate their homes. The authors suggested that this is because people do not perceive the real dangers of flooding, and cite similar research into hurricane evacuation (Aguirre, 1991; Gladwin & Peacock, 1997). McCarthy's recent work (McCarthy, 2007; McCarthy et al., 2007) found that flood communication can increase individual level responses when there are

effective partnerships in place between the expert information providers and the lay receivers. In order for change to occur, people need to be receptive to information (Lion, Meertens & Bot, 2002), and their receptiveness depends on several factors. One factor is risk perception Venkatraman, Aloysuis and Davis (2006) showed that people were more receptive to hazard information when they perceived it to be serious and likely, thus attention was focused on salient information that could guide beneficial behaviour.

A second important factor that influences responses to information campaigns is trust (Slovic, 1993). Trettin and Musham (2000) suggested that erosion of public trust in government agencies could be a major constraint on the success of risk communication. In the UK, since its inception, the Environment Agency has embarked on an effective programme of flood risk management and communication. It has radically overhauled the messages and means of communication for flood prone communities (Speller, 2005). Parker et al., (2008) suggested that working with people in flood-prone communities would increase their trust in the Environment Agency due to improved knowledge of flood protection processes as well as providing an opportunity for input into local initiatives. This approach could also increase the likelihood of responsiveness to official information and individual-level flood protection.

Third, the medium and mode of information are important. Krasovskaia et al. (2001) showed that the preference of a Norwegian sample of the general public was a combination of local and national TV and radio. However, older and less educated people preferred direct contact with authorities. Younger and more educated participants preferred the internet. The mode of information presentation is also important. Keller, Seigrist and Gutscher, (2006) found that information presented in a frequency format as well as probabilities given for longer time periods was more effective in emphasising the threat of a risk than short term probabilities. A recent study by Lumbroso, et al. (2009) showed that probabilistic information presentation was rated most useful by Environment Agency flood incident management employees since it enables preparations for floods. However, the authors acknowledged that it

is hard to identify the optimal form of information presentation since information is perceived through an individual, organisational or societal interpretive lens.

Overall, models of individual level flood protection behaviour that include experience of flooding, perceived risk and trust have received some empirical support. Furthermore, models of risk communication suggest that local input into information systems is important. There is also evidence of insufficient preparation for flood events (Siegrist & Gutscher, 2006; Takao and colleagues, 2004, 2006) indicating a critical gap for a research model that integrates the individual and contextual variables relating to individual level flood protection.

**Method**

The study was designed to assess the range of constructs using a large and diverse sample group of people who have signed up to participated in research in exchange of points redeemable against high street goods. Recruitment was via the ipoints market research database since this provided rapid access to people throughout the UK. Participants were invited by email to complete the questionnaire on-line. There were 2,109 UK respondents (51.4% men, 48.4% women, 3 participants did not report their gender; mean age = 43.4 years; sd = 13.0). Participants were all home owners and had a ground floor level to their property. Participants came from a range of educational and occupational backgrounds. There was a range of ethnic groups. 93.2% of participants reported to be White, 4% Asian, 1.1% of mixed ethnic background and 0.4% Black. 1.3% reported to be of other backgrounds than those categories given.

The survey had five sections. Section one assessed biographical factors (e.g. age, gender). Section two asked participants to report a range of flood-related experiences: whether they lived in a flood zone; whether their home had been flooded, and whether they owned flood protection devices. A range of options was presented (e.g. sand bags, protection panels for doors. These items were used to create the first dependent variable: *whether participants*

*had purchased domestic flood protection or not*. Participants were then asked about the factors that influenced their decision to protect their home, e.g. cost of buying and difficulty in installing. These items were aggregated to form the second dependent variable: *challenges in protection purchase*. Section three assessed antecedent variables: perceived seriousness of flooding; trust in government; and trust in scientists to manage flood problems. Items also assessed responsibility and agency by asking respondents to rate responsibility of regulators to solve problems of flooding, responsibility of scientists to prevent flooding, and the value of monetary contributions participants were willing to make toward local and UK-wide flood protection. Section four assessed perception of information. Participants rated availability of information regarding domestic flood protection, and responses to different types of information presentation styles. Participants were asked how they would like information about flood risks to be communicated to them (e.g. via TV news, local papers). Section five examined responsiveness to information. Participants were given the opportunity to click on headings and read additional information about several aspects of flooding: flood risk, health risks associated with flooding, preventive action, likelihood of future flooding, flood location. After reading the information, participants were asked to rate the extent to which the information was useful; their intentions to purchase flood protection devices; how costly it was for them to install flood protection; and how beneficial they thought installation of flood protection might be.

**Results**

Three analytical strategies were used to examine the data. First, we examined frequencies of responses for our main variables of interest. We compared mean scores for categories of respondents using independent samples T-tests and oneway analysis of variance tests. We have also used binary logistic regression to examine antecedents of flood protection

purchase, and linear multiple regression to examine antecedents of perceived accessibility of flood protection. The regression data are not reported here in the interests of brevity, however, results are available from the authors.

**Domestic flood protection purchase and its antecedents**

The majority of participants indicated they had no flood protection (N = 1732, 82.1%). Of those that had bought domestic flood protection, the most popular choice was water repellent sealer for brick or stone walls (N=166, 7.9%). Also relatively common were sand bags (N=100, 4.7%), seals to prevent backflow from toilets (N=99, 4.7%), and seals for garage doors (N=93, 4.4%). Some participants had airbrick protection panels (N=69, 3.3%) and door protection panels (N=66, 3.1%). 21 (1.0%) participants listed alternatives, for example digging additional drainage. Overall, flood protection purchases covered the range of options presented in the survey, yet purchasers only represented a small section of the sample.

In terms of flood experience, 1845 (87.5%) participants reported their home had never flooded. 106 people (5%) said their home had flooded once, and 42 (2.0%) reported their home had flooded more than once. To investigate the interaction of flood experience and flood protection, we calculated the frequency for each combination: 105 people (5.3%) had home protection and a history of flooding; 230 respondents (11.5%) had home protection and no history of flooding; 43 (2.2%) individuals had no home protection yet a history of flooding; and 1615 (81.0%) people had no home protection and no history of flooding. Overall, almost a third of the people that had experienced a flood had not purchased domestic flood protection. There is a cautious segment of the sample which has bought flood protection despite no history of flooding. Yet the majority was people who are potentially at risk of flooding and have no protective devices.

Analysis of the demographic factors associated with flood protection purchase showed that people who had bought flood protection devices were younger, more educated and higher

earners than those who have not. Data suggest that there seem to be cost barriers that prevent domestic flood protection purchase in addition to psychological factors associated with the decision to purchase flood protection. Next we examined factors relating to perceived challenges of flood purchase for the entire sample. Participants were grouped into low, medium and high scores. Figure 1 shows the results for each group.

INSERT FIGURE 1 ABOUT HERE

Mean scores of antecedent variables were compared for each group using a oneway analysis of variance. Data showed that people most likely to perceive challenges associated with purchasing domestic flood protection were younger, more worried, believe that it is the responsibility of scientists to solve flooding problems; trust the government to manage flooding. These participants were more also willing to pay for local and national flood defences (not represented on the chart due to differences in scaling). We also examined the associates of domestic flood protection purchase. The data are summarised in Figure 2 below.

INSERT FIGURE 2 ABOUT HERE

Independent samples T Tests were used to compared the two groups. People who have purchase domestic flood protection were younger; more likely to perceive that the risk of flooding is serious; to believe that it is the responsibility of scientists to solve flooding problems; to trust the government to manage flooding; and be more willing to pay for local and national flood defences. However, this group was less likely to believe that it is the responsibility of regulators to solve flooding problems, or that relevant information is available .

In brief, these results suggest that there are some enablers associated with purchase, such as youth and perceived seriousness. In contrast, there are some barriers to action, e.g. lack of information and belief in regulators' responsibility to manage flooding problems. Interestingly, three enablers also could be barriers since they were significant to both dependent variables: youth, perceived seriousness and willingness to pay for local flood

defences. We explored this in further analysis.

Next, we repeated the regression analyses of the perceived challenges of flood purchase for subgroups within the sample based: first, on whether the participants rated themselves as living in a flood zone and, second, whether they had experienced a flood or not. This enabled us to examine whether there were differences in the antecedents of perceptions about flood protection while accounting for beliefs about flood risk and experience of domestic flooding. There were several significant findings for perceived challenges of flood protection purchase and actual protection purchase. Again, perceived seriousness and youth emerged as key factors. Availability of information, the role of regulators and scientists, trust in government and willingness to pay for flood defences were also significant.

**Responsiveness to flood related information and its antecedents**

Participants were presented with five opportunities to look at additional information about flooding. These items enabled us to examine responsiveness to flood-related information, and the antecedent factors that were associated with responsiveness. Only 320 people (15.2%) chose to look at the additional information suggesting that the majority of participants were not responsive to flood-related information. Of those that did choose to look at the additional information, the most popular choice (N=264) was the extra information on flood risk which linked participants directly with the Environment Agency website where they could check the estimated flood risk of their property. After reading the information only 8 people said that they would install flood protection devices in their home in the next three months and 63 people said that they might. The second highest chosen information choice concerned flood location (N=253) which achieved 6 ‘yes’ and 65 ‘perhaps’ answers to installing flood protection within the next 3 months.

The information that had the highest number of people (N=10) agreeing to put flood protection devices in their homes within the next 3 months was the information on health risks

and flooding (N=209). A further 57 people said that they would consider it. This was followed by information on domestic flood protection (N=218) with 9 ‘yes’ and 63 ‘perhaps’ answers. The information on future flooding (N=211) yielded the least number of ‘yes’ (N=8) and ‘perhaps’ (N=55) answers. When asked about the perceived costs and benefits of fitting flood protection devices after reading each piece of information, the mean score for costs was greater than the mean score for benefits in every case. In summary, these data suggest that most of the sample were not responsive to reading this type of flood-related information. The relatively small proportion of the sample that did read the information were not influenced by the information to consider purchasing flood protection devices, and the perceived costs of doing so outweighed the perceived benefits. These data indicate that information alone is insufficient to promote behavioural change.

We explored the data to examine whether there were significant differences in our dependent variables that might influence responsiveness to information. Of those that looked at additional information, only 18 (5.9%) had previously been flooded and 44 people (11.7%) had already got flood protection installed in their homes. These small percentages indicate that there are some people who have not experienced floods or protected their home who are, or have potential to be, receptive to flood-related information. The antecedents of responsiveness to information were examined. Participants who looked at the extra information were younger; trusted scientists; and believed that flood management was regulators’ responsibility. The data support our previous findings: there seems to be an important interaction between perceived responsibility of regulators and personal choices about information seeking that could guide personal action.

**Optimal modes of information presentation**

Next we considered communication of flood risk information by examining responses to different modes of information presentation. We asked participants whether they have

looked at the Environment Agency website to gauge their flood risk. 418 (19.8%) participants have looked at flood zone information on the Environment Agency's website within the past year; 401 (19.0%) have looked at the information more than a year ago, and 1290 (61.2%) have never looked. 164 people (7.8%) reported living in a flood zone; 543 (73.2) said that they did not live in a flood zone, and 402 (19.1%) were unsure. Given that fewer than one-fifth of the sample have looked at the EA website, the data indicate that further advertisement of this service could benefit homeowners and might contribute to individual-level flood management.

We also examined the format of information presentation focusing on frequency information. Participants were asked to rank four equivalent statements in order of their utility, 1 being the most useful and 4 being the least useful. The most useful statement was 'On average the property will flood once in every 50 years' (mean rank = 1.75). Next was 'The odds of flooding in any year are fifty to one' (mean rank = 2.04). Third was 'The probability of flooding in any year is 0.02' (mean rank = 2.87). Least useful was 'The property is on the fifty year return flood level' (mean rank = 3.07). Next, participants were asked to select their preferred communication channels from a range of options presented. The list included television, radio, print and internet media, and participants could choose as many options as they wished. The preferred media were national television news (2180, 72.6%), newspapers (1563, 52.1%), radio news (1087, 36.2%), and government recommendations (997, 33.2%).

**Discussion**

We examined home owners' choice of engagement with flood mitigation through purchase of equipment to protect their home from flooding and perceived challenges of protection purchase. Perceived seriousness of flood risk and youth were repeatedly significant to both accessibility of flood risk information and domestic flood protection. Critically, these

factors operated differently for the dependent variables. Youth and seriousness were associated with perceived challenges of flood protection suggesting that there could be a generalised perception of difficulty and risk. Yet, high levels of both factors were associated with domestic flood protection. Young people with a long home-owning future ahead are likely to see more value in protecting their homes. Furthermore, these data confirm prior evidence that perceived severity of risk is important to action (e.g. Krewski et al., 1995; Slovic et al., 1982).

The differential effect of seriousness on challenges associated with domestic flood protection and actual flood protection purchase is a novel finding, and an important contribution of this study to the literature. While the importance of responsibility and agency supports prior research (Murray-Johnson et al., 2004; Takao, 2006; Witte, 1992), data also indicated that responsibility and agency could be a cause of the differential functioning of age and seriousness. People who rated the responsibility of regulators as low were more likely to perceive flood protection devices as available and to have purchased them. Thus there was an important interaction between acknowledgement that regulators cannot be fully responsible for protecting home owners from flooding, beliefs that protective devices are available, and action to purchase them. Also related to responsibility and agency was the willingness to pay contributions to local and UK-wide flood defences. Here, there were positive responses that related to both perceived challenges of flood purchase and actual purchase. As with perceived seriousness, there could be important differences in the functioning of willingness to pay. For some participants, willingness to pay was associated with generalised beliefs about the difficulty of domestic flood protection and responsibility of institutions to manage flood risk. Paying for large scale defences could be a strategy to reduce the dissonance caused by awareness that homes are susceptible to flooding and other damaging events and not simply safe havens (Harries, 2008). Other respondents took responsibility for their own domestic flood protection and were also willing to contribute to flood defences to reduce flood risk.

Experience of flooding also had a significant impact on the choice to protect the home. It seems that the experience could change people's thinking about whether they could and should protect their home from flooding, or whether regulators and scientists have responsibility. This supports prior research, notably Blanchard-Boehm et al., (2001). While the relationship between a positive view of scientists, regulators and flood protection is good for the scientific and regulatory communities, it also highlights a potential problem of responsibility. In the current study, people who have experienced a flood were less worried about flooding than those with no experience. Although pre-experience and post-experience data are not available in this dataset, it is possible that individual-level concern changes as a result of the experience of flooding, as suggested by Siegrist and Gutscher (2006). People who have experienced flooding could become less concerned, no longer take personal responsibility for protecting their home, and expect scientists to manage the problem. It is possible they believe that individual home owners are helpless in the event of floods.

In contrast, people who have not experienced flooding had a different set of beliefs that influenced their decision to protect their home. While some of these participants might live in areas that are unlikely to flood, for example hilly areas, this group is important since it typically outnumbers people who have experienced a flood, and is a significant target audience for information campaigns. The most significant issue for this group was the acknowledgement that buying flood protection devices is difficult and costly, and devices can be hard to install or use. They also perceived flooding as serious. As noted above, perceived seriousness can influence positive action when it is combined with beliefs about personal responsibility, thus information campaigns could highlight these factors.

Participants without experience of flooding also believed that regulators have an important role in managing flooding. Related to the role of government and regulators, the willingness to pay for flood protection data provided some useful results. There was a generally good level of support for central funding to build flood defences. While this is

positive in terms of acknowledgement of the problem and the need for flood defences to be funded, it could also link with the lack of personal responsibility and efficacy, as noted above and found in prior research (Murray-Johnson et al., 2004; Witte, 1992).

The finding that most participants did not seek the additional information that was provided revealed interesting differences between people who were receptive to information and those who were not, as well as the relative impact of different types of information. While some participants were receptive to reading the information, the items had very little impact on intended purchase of domestic flood protection. The data indicated that people who are receptive to flooding information are those already concerned about issue. This effect has been noted in prior research (Del Missier, Ferrante, & Costantini, 2007). Cherubini et al. (2003) suggested that people do not focus on all the information they are provided with. Instead, people only focus on information that they believe to be relevant to them, and this could be the case in the current study. Furthermore, concern alone is not likely to be enough to overcome the negative perceptions about the practical issues of buying and installing domestic flood protection. These findings could relate to the difficulty in accepting that flooding is a hazard that is unpalatable yet personally relevant (Harries, 2008). Data from the current study suggest that concern and perceptions of relevance could be requirements for attention to information and subsequent behavioural adaptation, and support prior research (Agirre, 1991; Gladwin & Peacock, 1997; Krasovkaia et al., 2001).

Overall, there are several theoretical implications. First, data from the current study showed that choice to purchase domestic flood protection can be understood by assessing a range of factors including perceptions of flooding; personal responsibility; trust in, and responsibility of, scientists and government/regulators to manage flooding; and, perceived accessibility of information. The implication is that strategies designed to influence behaviour could appeal to each of these factors. While increasing concern is not the goal of such a strategy, it is important that people feel concerned enough to take action without being

concerned to the point of distress. Nor should concern reach the point where the problem is perceived as too great to manage on an individual level. Flood-related communication could convey the seriousness and relevance of flooding to homeowners while also including local information (McCarthy, 2007) that gives practical and detailed guidance.

Second, the data showed that agency, responsibility and experience of flooding had a significant impact on perceptions of, and beliefs about, domestic flood protection. In particular, there was a shift in focus away from individual responsibility and towards external agencies, notably scientists. This emphasises the importance of agency and links with prior research. For example, De Marchi et al.'s (2007) study of residents in a flood prone area of Italy found low levels of individual level domestic protection despite the failure of flood prevention systems. Hung-Chih (2009) found a similar pattern among Taiwanese participants. Self-efficacy has been suggested as an important part of the cycle of communication and behavioural adaptation: people need to believe their actions will have a positive consequence (Murray-Johnson et al., 2004; Witte, 1992). The corollary, supported by the current study, is that models of flood protection behaviour need to integrate appropriate levels of concern with a personal sense of agency and efficacy.

There are several practical implications of our findings. Participants acknowledged that it is expensive to buy flood protection equipment. Furthermore, it can be difficult both to locate and install the equipment. People who had bought flood protection were also younger, higher earners and more educated. While the costs of such equipment are potentially a significant barrier to some people, it is likely that cost combined with low efficacy and diffused responsibility create a more robust barrier to action. Perceived costs were related to beliefs that it is the responsibility of scientists, government and regulators to manage flooding, i.e. the responsibility lies with external agents, not homeowners. It could be useful for national flood protection schemes to include grants for low income households to purchase flood protection since the costs of grants would be low compared with post-flooding clean

ups, as suggested by Kunreuther and Erwann (2009). However, financial motivation alone is unlikely to be sufficient for behavioural adaptation. Flood information and management systems need to demonstrate genuine efficacy of domestic protection to increase responsibility and agency.

The data also showed that information content and presentation were important to encourage active engagement with the message. Information that indicates the likelihood of floods in specific areas could use straightforward presentation methods, such as one in every 50 years, rather than probabilistic data since ease of understanding information relates positively to attend paid to it (Keller and Staelin, 1987; Keller et al. 2006; Pirolli & Card, 1999; Sperber & Wilson, 1995). The current study also indicates that the efficacy of personal action to protect homes is another important component of an information campaign since people need to know that they can take action to prevent their home flooding. They also need to know some details, such as the relative costs and benefits of different flood protection items. These issues were strongly associated with choice to protect the home among the sample in this study. Communication campaigns could also be in the form of information on the relative cost of home protection compared with the wide range of damages and costs associated with flood risk to shift the cost:benefit ratio in favour of benefits (Levin, Gaeth, Schreiber & Lauriola, 2002). News items in TV, radio and newspapers would be effective media for communication.

Whilst the current study has addressed a critical gap in the flooding literature by highlighting the need to understand psychological variables such as perceptions, agency, and responsiveness to information, there are some limitations and suggestions for future research. A larger sample could increase the number of people that have experienced flooding to yield more substantial comparison groups, and focus on people in flood prone areas. Future research could also involve more in-depth testing of specific issues, such as the question of agency. The role of trust could also be researched further to establish the extent to which trust

in information sources is critical to attending to risk messages. Longitudinal studies that gather data before and after flood events would more accurately identify changes in perception and actions. Qualitative research would also add to understanding of the individual and contextual factors that influence flood protection, and the processes through which they act. Each of these developments could contribute to enhanced communication strategies.

## Conclusions

Our study has four main conclusions relating to our research questions. First, we asked what are the antecedents of domestic flood protection? Data showed that there were two sets of factors. In demographic terms, people were most likely to have purchase flood protection when they are younger, better educated and higher earners. The costs of flood protection could be mitigated by grants or loans, however, it is important that an individual sense of responsibility or agency is maintained rather than a belief in reliance upon the State. In attitudinal terms, participants purchased flood protection when they perceived flood risk to be serious, and, critically, they had a sense of responsibility and agency. People need to believe that they can take action, and that their efforts are worthwhile. Experience of flooding seemed to reduce sense of responsibility and agency among some participants. Evidence of the efficacy of flood protection could enhance positive attitudes towards flood protection, responsibility and agency.

Second, we explored the antecedents of responsiveness to flood related information. Participants who chose to access additional information about flooding were those already concerned, however, reading the information did not change participants' intention to purchase flood protection. Information should promote an appropriate belief in susceptibility to flooding and beliefs in responsibility and agency to result in behavioural change.

Third, we examined the optimal ways to present flood risk information. Many participants perceived information as unavailable. Readily accessible information via local

and national television and radio could help these groups of people. Information providing evidence of successful domestic flood protection and emphasising individual responsibility to take action could yield increased action via the mechanisms discussed above.

To conclude, this study has shown that home owners are willing to protect their homes from flooding and, in many cases, to contribute to flood defences. However, home owners must be aware of, and accept, their individual level responsibility to protect their homes. Such responsibility is likely to occur when concurrent with strategic government initiatives to provide both local and national flood defences. Furthermore, communication campaigns need to nurture a shared sense of responsibility in addition to providing accessible information about low cost, effective domestic flood protection devices.

**Acknowledgements**

We would like to thank colleagues involved in projects relating to this research: Professor Mike Christie, Herriot Watt University; Dr Helen Clough, University of Liverpool; Dr Greg Davies, Barclays Wealth; Dr David Newman, Queen's University, Belfast; Dr Stephen Senn, University of Glasgow. We are grateful to the EPSRC for funding this study (grant number EP/E01951X/1). We would also like to thank three anonymous reviewers for their helpful comments in earlier versions of this paper.

**References**


Aguirre B E, 1991 "Evacuation in Cancun during Hurricane Gilbert" *International Journal of Mass Emergencies and Disasters* 9 31 – 45

Beck U, 1992 *Risk Society* (Sage, London)

Bradbury J A 1989 "The policy implications of differing concepts of risk". *Science Technology and Human Values* 14 380 – 399

Bickerstaff K Simmons P, Pidgeon N 2008 "Constructing responsibilities for risk: negotiating citizen – state relationships" *Environment and Planning A* 40 1312 – 1330

Bickerstaff K, Walker G P 2002 "Risk, responsibility and blame: an analysis of vocabularies of motive in air-pollution(ing) discourses" *Environment and Planning A* 34 2175 – 2192

Blanchard-Boehm R D, Berry K A, Showalter P S 2001 "Should flood insurance be mandatory? Insights in the wake of the 1997 New Year's Day flood in Reno–Sparks, Nevada" *Applied Geography* 21 199 – 221

Brown J D, Damery S L 2002 "Managing Flood Risk in the UK. Towards an Integration of Social and Technical Perspectives" *Transactions of the Institute of British Geographer* 27 412 – 426

Burningham K, Fielding J, Thrush D 2008 "'It'll never happen to me': Understanding public awareness of local flood risk" *Disasters* 32 216 – 238

Cherubini P, Mazzocco K, Rumiati R 2003 "Rethinking the focusing effect in decision-making" *Acta Psychologica* 113 67 – 81

Del Missier F, Ferrante D, Costantini E 2007 "Focusing effects in predecisional information acquisition" *Acta Psychologica* 125 155 – 174

De Marchi B, Scolobig A, Delli Zotto G, Del Zotto M 2007 *Risk Construction and Social Vulnerability in an Italian Alpine Region*, FLOODsite Report Number T11-2006-08. ISIG: Gorizia.

Eden S E 1993 “Individual environmental responsibility and its role in public environmentalism” *Environment and Planning A* 25 1743 – 1758

FLOWS 2005 *Conference Report – external.* FLOWS third international conference

Fukuzono T, Sato T, Takeuchi Y, Takao K, Shimokawa S, Suzuki I, Zhai G, Terumoto G, Nagasaga T, Seo K, Ikeda, S. 2006. “Participatory Flood Risk Communication Support System (Pafrics)” In Eds S Ikeda, T Fukuzono, T Sato *A better integrated management of disaster risks: Toward resilient society to emerging disaster risks in mega-cities* (Tokyo, Japan TERRAPUB and NIED) pp 199 – 211

Giddens A 1990 *The Consequences of Modernity* (Polity Press, Cambridge)

Gladwin H, Peacock W G 1997 “Warning and evacuation: A night of hard choices” Eds W G Peacock, B H Morrow, H Gladwin *Hurricane Andrew: Ethnicity, Gender and the Sociology of Disasters* (London and New York: Routledge) pp 52 – 73

Harries T 2008 **“**Feeling secure or being secure? Why it can seem better not to protect yourself against a natural hazard” *Health, Risk and Society* 10 479 – 490

Hung-Chih H 2009 “The attitude towards flood insurance purchase when respondents' preferences are uncertain: a fuzzy approach” *Journal of Risk Research* 12 239 – 258

Johnson C L, Priest, SJ 2008 “Flood risk management in England: A changing landscape of risk responsibility” *Water Resources Development* 24 513 – 525

Johnson C L, Tunstall SM, Penning-Rowsell E C 2005 “Floods as catalysts for policy change: historical lessons from England and Wales” *Water Resources Development* 21 561 – 575

Keller C, Siegrist M, Gutscher H 2006 “The role of the affect and availability heuristics in risk communication” *Risk Analysis* 26 631 – 639

Keller K L, Staelin R 1987 “Effects of quality and quantity of information on decision effectiveness” *Journal of Consumer Research* 14 200 – 213

Kerr A 2003 “Rights and responsibilities in the new genetics era” *Science and Public Policy* 31 90 – 94.

Krasovskaia I, Gottschalk L, Sælthun N R, Berg H 2001 “Perception of the risk of flooding: the case of the 1995 flood in Norway” *Hydrological Sciences Journal* 46 855 – 868

Krewski D, Slovic P, Bartlett S, Flynn, J, Mertz C K, 1995 “Health risk perception in Canada I: Rating hazards, sources of information and responsibility for health protection” *Human and Ecological Risk Assessment: An International Journal* 1 117 – 132

Kunreuther H, Erwann O M-K 2009 *At war with the weather. Managing large-scale risks in a new era* (Boston, MIT Press)

Kunreuther H, Pauly M 2004 “Neglecting disaster: Why don’t people insure against large losses” *Journal of Risk and Uncertainty* 28 5 – 21

Levin I P, Gaeth, G J, Schreiber J, Lauriola M 2002 “A new look at framing effects: Distribution of effect sizes, individual differences, and independence of types of effects” *Organizational Behavior and Human Decision Processes* 88 411 – 429

Lion R, Meertens RM, Bot I 2002 “Priorities in information desire about unknown Risks” *Risk Analysis* 22 765 – 776

Lumbroso D, Twigger-Ross C, Orr P, Kashefi E, Walker G, Cotton J 2009 *Probabilistic flood warnings – Do eight out of then people prefer them?* Paper presented to the 44th Defra Flood and Coastal Management Conference Telford, UK

Maslow A H 1943 “A theory of human motivation” *Psychological Review* 50 370 – 396

McCarthy S S 2007 “Contextual influences on national level flood risk communication” *Environmental Hazards* 7 128 – 140

McCarthy SS, Tunstall S, Parker D, Faulkner H, Howe J 2007 Risk communication in emergency response to a simulated extreme flood *Environmental Hazards* 7 179 – 192

Murray-Johnson L, Witte K, Patel D, Orrego V, Zuckerman C, Maxfield A M, Thimons E D 2004 "Using the extended parallel process model to prevent noise-induced hearing loss among coal miners in Appalachia" *Health Education & Behavior*, 31 741 – 755

Næss LO, Bang G, Eriksen S, Vevatne J 2005 "Institutional adaptation to climate change: Flood response at the municipal level in Norway" *Global Environmental Change Part A*, 15, 125 – 138

Parker D J, Tunstall S M, McCarthy S 2007 "New insights into the benefits of flood warnings: Results from a household survey in England and Wales" *Environmental Hazards* **7** 193 – 210

Penning-Rowsell E, Johnson C, Tunstall S 2006 "'Signals' from pre-crisis discourse: Lessons from UK flooding for global policy change?" *Global Environmental Change* 16 323 – 339

Petts J 2005. "Health, responsibility and choice: contrasting negotiations of air pollution and immunisation information" *Environment and Planning A* 73 791 – 804

Pirolli P, Card S 1999 "Information foraging" *Psychological Review* 106 643 – 675

Pitt M 2008 *The Pitt Review. Learning lessons from the 2007 floods* London, Cabinet Office

Rose N 1999 *Powers of freedom: Reframing political thought* (Cambridge University Press, Cambridge)

Scolobig A, Broto V C, Zabala A 2008 "Integrating multiple perspectives in social multicriteria evaluation of flood-mitigation alternatives: the case of Malborghetto-Valbruna" *Environment and Planning C: Government and Policy* 26 1143 – 1161

Siegrist M 1997 "Communicating low risk magnitudes: Incidence rates expressed as frequency versus rates expressed as probability" *Risk Analysis* 17 507 – 510

Siegrist M, Gutscher H 2006 "Flooding risks: A comparison of lay people's perception and expert's assessments" *Risk Analysis* 26 971 – 979

Slovic P 1993 "Perceived risk, trust and democracy" *Risk Analysis* 13 675 – 682

Slovic P, Fischhoff B, Lichtenstein S 1978 “Accident probabilities and seat belt usage: A psychological perspective” *Accident, Analysis and Prevention* 10 281–285

Slovic P, Fischhoff B, Lichtenstein S 1982 “Why study risk perception?” *Risk Analysis* 2, 83 – 93

Slovic P, Monahan J, MacGregor D G 2000 “Violence risk assessment and risk communication: The effects of using actual cases, providing instruction, and employing probability versus frequency formats” *Law and Human Behavior* 24 271 – 296

Speller G 2005 *Improving community and citizen engagement in flood risk management decision making, delivery and flood response* R&D technical report SCO40033/SR3 (Defra and the Environment Agency, London)

Sperber D, Wilson D 1995 *Relevance: Communication and cognition*. (Blackwell Publishing, Oxford)

Stern N 2006 *Stern Review on the Economics of Climate Change* (HR Treasury, London)

Takao K, Motovoshi T, Sato T, Fukuzono T, Seo, K, Ikeda S 2004 “Factors determining residents’ preparedness for floods in modern megalopolises: The case of the Tokai flood disaster in Japan” *Journal of Risk Research* 12 1 – 13

Takao K 2006 “Residents’ perception about disaster prevention and action for risk mitigation: The case of the Tokai flood in 2000” Eds S Ikeda, T Fukuzono, T Sato *A better integrated management of disaster risks: Toward resilient society to emerging disaster risks in mega-cities* (Tokyo, Japan) TERRAPUB and NIED pp 135 – 151

Trettin L, Musham C 2000 “Is trust a realistic goal of environmental risk communication?” *Environment and Behavior* 31 310 – 326

Tunstall S M, Johnson C L Penning Rowsell E C 2004 "*Flood Hazard Management in England and Wales: From Land Drainage to Flood Risk Management*" World Congress on Natural Disaster Mitigation Report New Delhi, India

Tversky A, Kahneman D 1982 "Availability: A heuristic for judging frequency and probability" Eds D Kahneman, P Slovic, A Tversky *Judgment Under Uncertainty: Heuristics and Biases* (Cambridge University Press, Cambridge) pp 163 – 189

Venkatraman S, Aloysuis J A, Davis F D 2006 "Multiple prospect framing and decision behaviour: The mediational roles of perceived riskiness and perceived ambiguity" *Organizational Behaviour and Human Decision Processes* 101 59 – 73

Water UK 2008 *Lessons Learned from Summer Floods 2007* Phase 1 report - Emergency Response

Witte K 1992 "Putting the fear back into the appeals: The extended parallel process model" *Communication Monographs* 59 329 – 349

Figure 1: Mean scores of perception variables for groups of people who rate perceived challenges of domestic flood protection purchase as low, medium or high

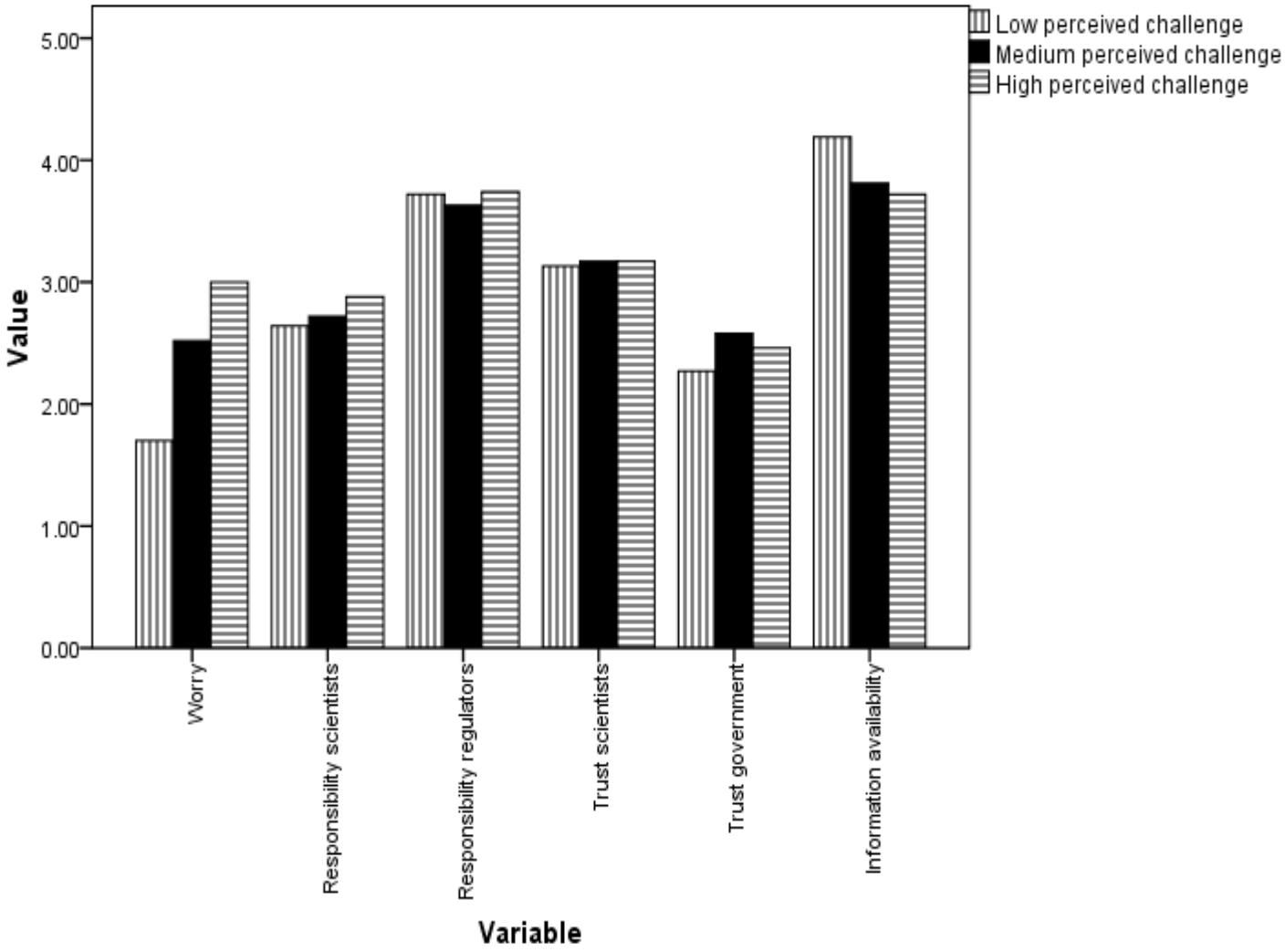

Figure 1: Mean scores of perception variables for people who have purchased domestic flood protection and those who have not