

# Understanding the influence of psychology and vicarious experience on property flood resilience choices

CARLY B. ROSE BSc (Hons)

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## ABSTRACT

There is an acknowledged need to improve the resilience of those at risk of flooding in the UK. The majority of the at-risk population do not actively adopt mitigation measures even when they have experienced multiple flood events. If uptake of resilience methods is not increased, the physical and financial impacts will continue to escalate, as will psychological harm, with wider implications for health care costs.

Previous studies largely focus upon explicating the barriers to resilient adaptation; a hitherto under-researched aspect is an understanding of the driving factors that can elicit active mitigation in the household sector, other than repeated inundation of the home. This research builds upon existing behavioural theories to develop a conceptual framework specific to the needs of the UK flood risk management context. The framework was explored via a survey of members of community flood groups; the topics covered included details of a wide range of flood mitigation measures adopted, together with the precise nature and extent of flood experiences. The survey instrument incorporated two psychometric tests measuring personality factors (self-efficacy and locus of control) which have been implicated in a range of hazard preparedness behaviours, but have not been subjected to formal assessment in this context previously in the UK.

The results yielded new insight on the link between preparedness behaviours, personality traits and different types of flood experience. In contrast to previous UK research, the majority of the respondents (92%) had taken one or more mitigation actions in addition to joining a flood group. Furthermore, a very high proportion of respondents in the sample had begun to take action when lacking direct flood experience (26%) or having had only vicarious (or other indirect forms of) flood exposure (36%). Respondents scored significantly higher than the general adult population for general self-efficacy (GSE) ( $p < 0.01$ ); furthermore, a highly significant positive correlation was found between GSE scores and the extent of mitigation behaviours adopted. These results suggest that any interventions which could be shown to increase the perception of self-efficacy in preparing for/dealing with flooding in members of the at-risk community (such as tailored community engagement processes) would now warrant consideration by the authorities tasked with enhancing resilience to flooding in the UK.

The original contribution to the body of knowledge made by this thesis includes unique insight into the relationship between psychological and situational factors affecting individuals and the extent of the flood mitigation they have undertaken. It has done so by developing an understanding of the characteristics of a hitherto under-researched minority, thereby shedding light on some of the driving factors with potential to be strengthened in the wider at-risk community. The findings will be of utility to the policymaker community in designing and targeting future interventions and/or campaigns to increase the uptake of flood resilience in the household sector. As one of the psychological factors identified can be measured quantitatively, this may provide a readily available means of monitoring and evaluating the effectiveness of different resilience interventions, via before-and-after testing of community members.

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I am indebted to my family and friends for their support and practical assistance; how they managed to suppress the urge to scream when every conversation included the 'f' word (flood) I shall never know.

I would also like to express my thanks to current and past personnel from both the National and Scottish Flood Fora, whose input in the early stages helped to set me on the right track. Finally, my gratitude goes to all the members of the community flood groups who gave up their time to participate in the survey.

I dedicate this work to the memory of my mother:

Edna Rose (née Carnall) ALAM (Hons).

## LIST OF ABBREVIATIONS

|         |   |
|---------|---|
| Defra   | Department for Environment, Food and Rural Affairs      |
| EA      | Environment Agency                                      |
| GSE     | General self-efficacy                                   |
| Loc     | Locus of control  |
| Loc-Ch  | Locus of control - chance                               |
| Loc-Int | Locus of control – internal                             |
| Loc-PO  | Locus of control – powerful others                      |
| MHLC    | Multidimensional Health Locus of Control                |
| MPPACC  | Model of private proactive adaptation to climate change |
| NFF     | National Flood Forum                                    |
| NRW     | Natural Resources Wales                                 |
| PADM    | Protective Action Decision Model                        |
| PBC     | Perceived behavioural control                           |
| PCoA    | Principal Co-ordinates Analysis                         |
| PMT     | Protection Motivation Theory                            |
| SE      | Self-efficacy   |
| SEPA    | Scottish Environment Protection Agency                  |
| SFF     | Scottish Flood Forum                                    |
| TPB     | Theory of planned behaviour                             |

## GLOSSARY

Affect (positive/negative) - emotion or desire, especially as influencing behaviour or action. (Oxford English Dictionary: meaning three) [Available at: <https://en.oxforddictionaries.com/definition/us/affect>]

Alleviation - the action or process of making suffering, deficiency, or a problem less severe. (Oxford English Dictionary) [Available at: <https://en.oxforddictionaries.com/definition/alleviation>]

Coping – “ ... *stress consists of three processes. Primary appraisal is the process of perceiving a threat to oneself. Secondary appraisal is the process of bringing to mind a potential response to the threat. Coping is the process of executing that response.*” (Lazarus, 1966, cited in Carver et al. 1989)

Efficacy (as used in PADM) - has the purely practical meaning of the resource requirements required for hazard adjustment.

Intangible impacts – the impacts of flooding, which are not easy to express in monetary terms, for instance, stress of flooding, worrying about future flooding. (Joseph, 2014)

Mitigation - the action of reducing the severity, seriousness, or painfulness of something. (Oxford English Dictionary) [Available at: <https://en.oxforddictionaries.com/definition/mitigation>]

Optimism – “ ...*hopefulness and confidence about the future or the success of something.*” (Oxford English Dictionary) [Available at: <https://en.oxforddictionaries.com/definition/optimism>]

Outcome expectation - “ ... a judgement of the likely consequence such performances will produce” AND “Outcome expectancies can take three major forms (Bandura 1986a). Within each form, the positive expectations serve as incentives, the negative ones as disincentives.” Bandura 1997 (p21)

Perceived self-efficacy – “ ... a judgment of one's ability to organise and execute given types of performances.” Bandura 1997 (p21)

Preparedness - the knowledge and capacities developed by governments, response and recovery organisations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters (UNISDR, 2016).

Property flood resilience – incorporates: resilience measures – these are measures, which are installed to inside a property to minimise the damage caused by floodwaters entering the building; and resistance measures - these are measures installed to keep flood water out of the property. (DCLG, 2009)

Psychometric test - a test designed to provide a quantitative analysis of a person's mental capacities or personality traits, typically as shown by responses to a standard series of questions or statements.

Residual risk - the risk which remains after all risk avoidance, reduction and mitigation measures have been implemented. (DCLG, 2009)

Resilience (general) - the capacity to recover quickly from difficulties; toughness; the ability of a substance or object to spring back into shape; elasticity. (Oxford English Dictionary) [Available at <https://en.oxforddictionaries.com/definition/resilience>]

Return period - the average length of time separating flood events of a similar magnitude: a 100-year flood will occur on average once in every 100 years. (MAFF 1999)

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# CHAPTER 1 - INTRODUCTION

## 1.1. Background to the research

Worldwide, attention is increasingly focussed upon assessing vulnerability to extreme events, improving upon recovery plans to deal with their aftermath and examining the ways in which adaptation to climate change might enhance resilience for the future (UN General Assembly, 2016; IPCC, 2018). There is an acknowledged need to improve the resilience of those at risk of flooding in the UK (Defra, 2008a; Defra, 2008b; Bonfield, 2016). Although some areas are already protected by flood alleviation schemes, there remains a 'residual risk': for example, any defensive walls may be overtopped by extreme flood depths. Households facing residual risk, as well as those in currently unprotected areas, can make use of some of the numerous property-level mitigation measures suitable for single, or small groups of buildings (Dhonau and Rose, 2018). Some of these are designed to exclude the water from buildings (also termed 'resistance' measures); others allow water in, but render the building more easily flood-repairable in the aftermath of inundation.

Research has, however, demonstrated that the majority of the at-risk population does not display adaptation behaviours until multiple flood events have been experienced (for example, Harries, 2013). Such findings are not adequately explained either by deficits in information provision or financial pressures and this is consistent with research in countries other than the UK, where a complex interplay of factors (including psychological variables) has been identified as influencing decisions around natural hazard preparedness (Paton *et al.*, 2000; Grothmann and Reusswig, 2006; McClure, 2006; Knocke and Kolivras, 2007). Although many of the *barriers* to adaptation have been examined in the UK (for example, Defra, 2008a; Parker *et al.*, 2009) the factors that may *drive* positive resilience behaviours remain under-researched. Identifying and, if possible, enhancing these driving factors would provide a valuable extension to the toolbox of techniques available to improve the current level of property level flood resilience.

## 1.2. Research justification

Increasing the uptake of household mitigation measures could be of advantage to considerable numbers of householders, whether situated in the floodplain, or at risk of surface water flooding. This is because the aftermath of flood events not only includes material damages but can also result in lasting mental health trauma (Lamond *et al.*, 2015). Such negative outcomes can, however, be mitigated if appropriate steps are taken such that homes can be occupied more swiftly after a flood event; for example:

*People who reported persistent flood related damage in their homes had higher odds of probable psychological morbidity. There are likely to be significant health gains from repairing properties as soon as possible ... (Jermacane et al., 2018).*

One method of enhancing the speed of repair is the use of a 'water entry strategy' in which floodwater is allowed to enter a building but the impact is minimised (by use of water-resistant materials and finishes) and rapid repair, drying and cleaning are facilitated (Lamond *et al.*, 2017). It would, therefore, be useful to understand the motivations and decision-making processes of those who have already adopted this, or other types of resilience approach. If additional factors involved in positive adaption behaviours can be identified, then a means of enhancing these factors in the at-risk population can also be sought, with the aim of improving beneficial economic and health outcomes.

The findings from this research will contribute to a better understanding of the actions of householders living with flood risk who have already taken action and will, therefore, be of interest to the flood risk management authorities at both national and local levels.

## 1.3. Aim of the study

The aim of this research was to examine the relationship between psychological and situational factors and positive flood mitigation behaviours in the UK at-risk population including those displaying 'anticipatory adaptation'.

#### 1.4. Research questions

To meet the stated aim, three research questions that need to be addressed by the study were formulated:

- To what extent does the nature (direct or indirect) of flood experiences correlate with the first adoption of flood resilience measures in at-risk areas?
- To what extent have governance issues (such as insurance costs and/or availability; government grant provision) influenced the patterns of measure adoption?
- Are socio-psychological factors associated with the extent of enacted flood resilience actions?

#### 1.5. Objectives of the study

To achieve the above aim, and answer the research questions, the following objectives were identified:

1. Examine flood resilience issues applicable to the domestic sector in the UK to contextualise the need for increased uptake of measures.
2. Undertake a critical review of psychological theory relating to risk and decision-making, at the household level, in order to develop an appreciation of the role of socio-psychological factors in relation to governance, experience and other variables contributing to hazard adaptation uptake.
3. Undertake a critical review of theories relating to behavioural change processes, particularly those designed for, or already used in, natural hazard preparedness contexts, with the aim of identifying those pertinent to the UK flood-risk population.
4. Develop an explanatory conceptual framework mapping out the relationship between psychological and situational factors, with particular reference to the influence of these variables upon positive flood mitigation behaviours in the UK at-risk population including those displaying 'anticipatory adaptation'.
5. Develop a methodology to enable data collection for empirical investigation of the conceptual framework.

6. Collect and analyse data to determine the contribution of psychological and other factors to positive flood mitigation behaviours.
7. Draw conclusions from the findings of the study and, on that basis, make recommendations for stakeholders (including policymaking bodies such as Defra and the Environment Agency) and for further research.

### 1.6. Research methodology

Research methodology is predicated upon the 'worldview assumptions' (or philosophy) adopted which, in turn informs the choice between the two main 'research paradigms': quantitative and qualitative (Creswell, 2003). As the variables are largely known, and an array of theories around hazard preparedness has already been developed, a quantitative research approach was adopted to gain understanding of a specific sub-section of the at-risk population in the UK.

Previous studies in this research area have tended to focus upon the factors posing barriers to flood mitigation; in contrast, this study sought to identify factors driving adaptation behaviours, such as resistance, resilience or other measures. The population of interest could not be accessed directly, however, as no comprehensive database of adapted households existed; the members of community flood groups were identified as including individuals most likely to have adopted mitigation measures, as such groups typically make information and advice on the subject readily accessible to their members.

The research design made use of an online questionnaire survey, as this was identified as most appropriate for gathering the type of data required from the potential respondent sector. The survey was distributed to flood groups across England, Wales and Scotland; Northern Ireland was not included, however, as it has a different approach to flooding issues from the rest of the UK, and equivalent groups have yet to be developed.

### 1.7. Limitations of the approach

Quantitative research methods are used to test, or verify, theories or explanations via statistical analysis (Creswell, 2003) and it is an explanatory model which is being

examined in this research. The chief drawback of the approach is that, although quantitative analysis can reveal which factors may be involved, and the extent of their interactions, it is not able to establish causation when performed as a cross-sectional (rather than longitudinal) design. In the absence of resources sufficient to perform a longitudinal study, this is (inevitably) a limiting aspect. A second limitation often cited (for example, Almeida *et al.*, 2017) is that the reliability of data collected via self-reported instruments such as questionnaires is dependent upon both the survey structure and the quality of the answers provided. Issues such as social desirability bias can affect the honesty (and, thus, accuracy) of responses, for example; poorly phrased questions can also yield unhelpful or misleading outputs. Both the latter issues have been addressed as far as is reasonably possible in this research. Finally, the population of interest (the minority who had already taken resilience actions) was known to be a small sub-section of those householders living with flood risk. A design based on random sampling would, therefore, have been inappropriate, but this means that the results are not (and were never intended to be) generalisable to the overall population at flood risk; instead, this research intentionally sought to illuminate the characteristics of this minority to identify drivers of, as opposed to barriers to, resilience adoption.

### 1.8. Expected contribution to knowledge

This research was designed to develop understanding of the relationship between psychological and situational factors affecting individuals and the extent of the flood mitigation they have undertaken. It has done so by providing unique insights into the characteristics of a hitherto under-researched minority (those who have already adopted resilience measures) thereby shedding some light on the driving factors that are lacking, or in need of strengthening, in the wider at-risk community.

Identification of these driving factors is likely to be of utility to the policymaker community in designing and targeting interventions/campaigns to increase the rate of household flood resilience. As the personality factors identified are amenable to quantitative measurement, they also have the potential to provide a means of monitoring and evaluating the effectiveness of different intervention types and/or

campaigns (for example, undertaking before-and-after testing of community members).

### 1.9. Thesis organisation

This thesis is organised such that it reflects the research objectives described in Section 1.5, hence Chapter 2 will address flood resilience issues in the UK; Chapters 3 and 4 covers the literature reviews (psychological, and behaviour change respectively). Chapter 5 describes the development of the conceptual framework, and Chapter 6 the research design and methodology selected to investigate this. Chapter 7 contains the data analysis and validation, and the thesis concludes with a discussion in Chapter 8 and the conclusions and recommendations derived from the research in Chapter 9.

### 1.10. Summary

A range of variables was identified from the literature as being positively associated with appropriate adaptation to natural hazards; these fell into three groups, namely flood experience, socio-economic factors and personality factors. The flood experience data collected in this study was not confined to 'dates of past floods': more searching questions on the details of both direct and indirect flood exposure was elicited. This enabled the chronological sequence of events to be established such that the likely 'triggers' for the different actions taken could be identified.

Community flood group members were shown to be an appropriate choice of population for this research, as the uptake of measures (of all kinds) far exceeded that found in previous UK studies. They did not prove to be a homogeneous group, however, as there was a wide variation in the majority of characteristics examined.

## CHAPTER 2 – FLOODING IN THE UK

### 2.1. Introduction

In this chapter the first objective identified in Chapter 1 is addressed. The context for the research will be examined, including climate change implications and changing policy aspects in the UK. This is followed by a consideration of resilience and coping strategies in the domestic sector as well as community resilience, and the use of community engagement. UK governance issues (insurance and government-funded grants) are then examined and the chapter concludes with a discussion of a key intangible aspect of flood events, namely the health and social impacts of flooding, which underpins the need for improvement in household resilience.

### 2.2 Research context

Floods in the UK can arise from a number of sources; a combination of gale force winds and high tides may give rise to coastal or estuarial flooding, whilst inland areas may be subject to fluvial flooding, affecting centres of population located on the flood plain of a river, or pluvial floods following exceptional rainfall events in susceptible areas. In the UK the responsibility for flooding from rivers and the sea fall largely within the remit of the Environment Agency (in England and Wales) or the Scottish Environment Protection Agency (in Scotland). For many years, management of fluvial and coastal flooding in the UK was dominated by the construction of hard-engineered flood alleviation schemes; these were typically government funded, providing the benefit/cost ratio met the criteria prescribed (MAFF, 1999).

Over the last two decades the UK has experienced a series of severe flood events, some of which have been widespread whilst others have been localised. Floods are not a new phenomenon, but both the frequency and severity of these events have focussed the attention of the UK government on the issue, particularly in the context of anticipated climate change outcomes (H M Government, 2017). The extreme flood events of recent years have also served to underline that the past is not a reliable guide to the future, as regards the design standard of flood alleviation schemes: extreme rainfall events may be increasing as indicated by both the original and updated Foresight Project reports (Evans *et al.*, 2004; Evans *et al.*, 2008).

The need to comply with the EU Floods Directive (2007), and the Climate Change Act (2008) have prompted the UK government to pursue a variety of strategic level approaches; these include assessing the vulnerability of the UK to extreme events, improving upon recovery plans to deal with their aftermath and examining the ways resilience may be enhanced in the future via a programme of adaptive capacity (Defra, 2009; Defra, 2014; Bonfield, 2016).

The element of uncertainty that inevitably accompanies any forecast, however, seems to be particularly problematic in the context of future flood risk. It can give rise to confusion among the public: for example, whether the authorities express the risk as 'a 1 in 100 chance' or a '1% probability' of occurring in any particular year, or any other suggested method, it seems there is always scope for some degree of misunderstanding (for example, Dale *et al.*, 2008); trust (or lack thereof) in the sources of forecasts can exacerbate this situation still further (Poortinga and Pidgeon, 2004). Decision-making in various risk environments has been the subject of much study, but continues to pose a complex problem, particularly in the context of constructing effective risk communications (Fischhoff, 1995). The issues around decision-making and risk will be considered in detail in Chapter 3.

In preparation for compliance with the EU Floods Directive due in 2007, the UK Government carried out a review of its long-term policy in this area resulting in the document 'Making Space for Water' (England only) (Defra, 2004) which articulates that floods cannot be prevented but flood risk can be managed. It further clarifies the need to target limited resources most effectively within the risk management framework in order to achieve sustainable outcomes. This change in policy approach, though understood and accepted at governance level does, however, represent a profound change in comparison with the paternalistic approach to 'flood defence' that existed for the preceding 50 years. In particular, it raises new issues for the people who live and work in at-risk areas: there is now an expectation that individuals will accept some responsibility for proactive protection of homes and businesses. This creates a degree of confusion regarding responsibility boundaries between at-risk residents and the policy-making community, however, as Mullins and Soetanto (2011) comment:

*“... householders may expect policy makers to do everything they can to prevent flooding and policy makers may expect householders to do everything they can to lessen the impact if it does flood.”*

Such perceptions may, therefore, constitute barriers to citizen participation in flood risk management that will need to be overcome.

If, however, it is accepted that a hazard cannot be prevented then the logical alternative is that resultant events, and their aftermath, should be dealt with in the most effective and efficient way possible; this, therefore, leads on to the concept of resilience.

## 2.2 The resilience concept and its application to flooding

The concept of resilience is utilised in many areas of research and has multiple meanings dependent upon context; Norris *et al.* (2008) list 21 known definitions across the fields of physics, ecology, sociology and psychology. An additional colloquial definition is ‘bounce-back-ability’, derived from the response of materials that bend, rather than break, under pressure. In human terms, therefore, a resilient community would not only be able to deal with the immediate impacts of flooding, but would also achieve optimal recovery from the event in the widest sense: this is described by Norris *et al.* (2008) as the attainment of ‘population wellness’. The parameters of recovery, in this instance, would include factors such as the population’s long-term mental health, as well as the physical and economic functioning of the society. In the UK, as required by the Civil Contingencies Act (2004) the resilience concept was embedded at all levels of governance, encompassing national (Department for Communities and Local Government, 2005); regional (Three Regions Climate Change Group, 2008); and city-specific (London Resilience Team, 2007; Greater London Authority, 2008).

## 2.3 Coping strategies

Coping, in the context of an individual dealing with stressful situations, has been defined as the process of executing a response to a perceived threat (Lazarus 1966 cited in Carver *et al.*, 1989). Different types of threat will elicit different potential responses (deciding between fight or flight, for example). Two broad categories have

been identified: *problem-focussed coping*, as the name implies involves a problem-solving approach, while *emotion-focussed coping* aims to reduce/manage the emotional distress cued by the situation (Lazarus 1980 cited in Carver *et al.*, 1989).

Flood coping strategies, therefore, include actions of a practical nature (including participation in flood warning schemes, and installing measures to keep water out of the home) as well as financial mechanisms (such as obtaining flood insurance cover), all of which comply with the definition of 'problem-focussed coping' above. They may also involve 'emotion-focussed' mechanisms, however, and these tend to be maladaptive strategies, such as denial that the risk exists, fatalism and the like. These two categories of response contributed to the development of 'Protection Motivation Theory' (Rogers, 1975) which will be discussed in detail in Chapter 3.

#### 2.4 Property level resilience

Property level flood mitigation can take three main forms: physical measures that exclude the water (as far as practicable) which is also termed flood resistance; alternatively, water is allowed to enter and flow through the property, having first taken steps reduced the amount of damage that it can cause (such as tiled flooring rather than fitted carpets); and finally, non-structural measures such as signing up to flood warning schemes, and moving valuable items and important documents to locations above the likely flood level, which are cost-free options (Dhonau and Rose, 2018).

Flood resistance measures involve the use of permanent or temporary barriers to protect openings such as doors, windows and airbricks; these are typically designed to hold back floodwaters up to 600mm deep, as some buildings can suffer structural damage at greater depths. There are also 'stand-alone' types of barrier designed to keep floodwater at some distance from the building. Floodwater can also enter buildings from the sewer system (via toilets or drains on the ground floor) and thus introducing an additional hazard in the form of faecal contamination; this is preventable by means of non-return valves (NRVs) and the use of devices known as toilet and shower 'bungs'. All of these measures can be retrofitted to existing homes at any time (Dhonau and Rose, 2018).

Flood resilience measures are designed to make the post-flood drying, cleaning and restoration stages as swift as possible, therefore permitting reoccupation of the home in the shortest possible time. Examples of this approach include re-positioning electrical sockets and meters above the likely flood level, and using building materials and finishes that can withstand, or more easily recover from flooding (for example, using lime-based plaster instead of standard gypsum on the lower sections of internal walls). These methods are generally most cost-effective when incorporated into the repair and restoration process following a flood event, although low-cost options have also been identified (Lamond *et al.*, 2017).

## 2.5 Community level resilience

Norris *et al.* (2008) reviewed the literature on community resilience to disasters, including earthquakes, floods and hurricanes, and suggested that resilience may usefully be viewed as a network of adaptive capacities. A network model of interaction, rather than a hierarchical framework, is perceived as possessing greater flexibility to respond to local needs. Individuals in disaster situations worldwide were found to turn to a variety of social support networks, ranging from family and friends to neighbours and co-workers; however, as noted by Green and Penning-Rowsell (2004) those who had limited social networks may, therefore, have found themselves disadvantaged in terms of practical and emotional support.

Resilience to floods can, therefore, encompass a wide variety of other measures: event preparedness (such as community flood education programmes); flood event management (emergency services capabilities for in-event evacuation; rescue of affected persons; effective liaison between the emergency services) and post-event recovery (local authority responsibilities as regards emergency accommodation provision and physical care in the short-term; health care provision in the longer-term). There are also risk reduction strategies embedded in planning regulations, designed to minimise the proliferation of new buildings in areas at risk from flooding<sup>1</sup>. These measures all operate at the social/municipal level, for the benefit of/on behalf of the household sector, rather than requiring direct decision-making

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<sup>1</sup> <https://www.gov.uk/government/collections/revised-national-planning-policy-framework>

by at-risk individuals. For this reason, these broader mechanisms will not be considered further here; however, it must be noted that the actions taken by individual resilient households will contribute to their community becoming more resilient overall.

## 2.6 Community engagement

In the post-event phase it has been noted that community groups may arise spontaneously to provide peer-to-peer support; these are described by Drabek and McEntire (2003) as 'emergent phenomena'. An example of this in the UK would be 'Communities Reunited', an initiative arising from a coalition of faith-based groups working with the city and county councils in the aftermath of the Carlisle flood of 2005 (HM Government Cabinet Office, 2005). Convery and Bailey (2008) evaluated the effectiveness of this approach and found that the information and practical help provided by a locally rooted, highly visible and accessible team was deemed by residents to be an 'invaluable' on-going support structure. Such spontaneously emerging groups may not, however, always interface so easily with the formal 'command and control' mechanisms operated by the emergency planning community and its partner organisations (for example, Cumbria Resilience Forum, 2008 p7). In the UK a number of independent local flood action groups combined to form the National Flood Forum in 2002, which subsequently became a registered charity, providing support and advice to flood survivors and those at risk of flooding, as well as representing their interests in discussion at central and local government levels (National Flood Forum, no date).

The Environment Agency (Henton, 2008) has acknowledged the importance of the social sciences in relation to its work on flood risk science in which issues around engaging with communities and building trust are described as 'vital'. Borrows (2007) highlights the need for a partnership approach between flood risk professionals and those at risk: communities should not be left in doubt as to whether their views have been listened to, accepted and understood, and such concerns can best be overcome where the professional organisation concerned becomes a trusted source, and where intermediaries are drawn from the local community itself. This type of approach can also help dispel the belief that flood protection is, or should be, the responsibility of

the Government, or local authorities, rather than householders (Brilly and Polic, 2005; Norwich Union, 2008).

The need for a fuller understanding of the issues involved, in order to achieve the desired outcomes, led to the publication of detailed guidance for the flood risk management community, such as Daly *et al.* (2015) This also aligns with the concept of 'community empowerment' in which involvement in the decision-making process enables a shift of 'ownership' of the problem, which can be a key issue in flood risk; the public may continue to believe that flood protection is, or should be, the responsibility of the Government, local authorities or other agencies, rather than householders (Brilly and Polic, 2005; Norwich Union, 2008). Dufty (2008) reports that many flood awareness raising campaigns in Australia had also been ineffective, but contrasts the adoption of earlier 'top down' approaches with a pilot study of a new flood education programme; the latter approach actively promoted community participation from the outset and has been found to have had considerable impact. This can, in part, be explained in terms of the population feeling that they 'owned' the problem, rather than being passive recipients of instructions from the authorities.

## 2.7 Governance issues - insurance and grants

Governance denotes the 'action or manner of governing' which, therefore, applies not only to central and local government bodies, but also to the way in which other organisations operate, such as the UK insurance industry. The interactions between policy and flood resilience are discussed in Section 3.3.2, but the impacts of insurance mechanisms, and the government-funded grants made available in recent years, will be dealt with in this section.

### 2.7.1 Household insurance and flooding in the UK

Insurance has been suggested as a suitable medium for raising awareness of flood risk, as well as a potential mechanism for incentivising resilience actions; however, it has been argued that the reverse situation currently applies (for example, O'Hare *et al.*, 2016). Where a household is covered by insurance, the residents will find their options are governed by the terms of the policy, not only as regards immediate issues

such as temporary alternative accommodation, but also the nature of the repairs which can (or cannot) be undertaken and this can militate against resilient adaptation.

The UK domestic and small business insurance regime tends to 'bundle' flood cover for both buildings and contents in with other risks (such as fire and theft) hence no separate decision to take out flood insurance normally has to be made by householders. Where the flood risks were deemed to be high by insurers, however, the relevant premiums and 'excess' amounts applicable to the flood cover elements of the policy have sometimes been increased to the point of becoming unaffordable (often, though not invariably, following a flood claim) as found by Harries (2010): 51% of flood victims surveyed (n=230) reported that their excesses were increased, the average amount being £4,700. The indemnity principle underlying insurance in the UK also requires that 'betterment' of property must be avoided during reinstatement work, which may act as a disincentive to adoption of mitigation measures (O'Hare *et al.*, 2016 p1183). This leads to an interestingly counter-intuitive outcome, as a failure to mitigate future damages is likely to lead to repeat claims where insurance does continue to be available.

Secondly, as from 2002 a series of agreements existed between the Association of British Insurers (ABI) and the government, which ensured flood cover continued to be available to many at-risk properties (Bennett and Edmonds, 2013). This included all properties (both residential and small business) at relatively low risk (defined as no worse than a 1.3%, or 1 in 75 annual probability of flooding); for those at higher risk, cover depended upon whether plans to reduce that risk within five years had been announced (such as a proposed flood alleviation scheme). Properties built after 1 January 2009 were excluded, however, the intention being to discourage new development in flood risk areas. While these agreements were in place, however, some householders experienced large increases in the premiums and/or excesses payable for continuation of cover as mentioned above. It is possible, therefore, that some of those who have adopted mitigation measures may have been motivated to do so by the desire to avoid such financial penalties.

The final agreement of the series formally expired on 30 June 2013 amid concerns that high risk households were often paying less than a fully 'risk-reflective' price, and benefiting from a cross-subsidy from other policyholders (Defra, 2013). The agreed replacement was a 're-insurance pool' model (Flood Re) covering residential properties only. Insurers can reinsure policies through the scheme only if they charge households a set price for the flood component of their insurance policy (thereby limiting the potential for price rises). If there is a flood claim on one of these policies, Flood Re reimburses the insurer for the amount paid to the policy-holder; other types of claim on the policy, such as fire or theft continue to be paid by the insurer as normal. The scheme is time-limited (expiring in 2039) as it is anticipated that the support and advice provided to affected households in the intervening years will enable them to take appropriate action to reduce their own flood risk (for example, by adopting property level resilience measures) (Flood Re, 2018).

In the aftermath of flooding, however, it has been noted that most insurers have declined to pay for resilience measures, as these are deemed to constitute 'betterment' of the property, contravening the 'like-for-like' principle enshrined in standard policies (Crichton, 2007). This can act as a considerable barrier to adoption of resilience: not only must the policy-holders fund the changes themselves, but also omitting to incorporate many of these measures during the post-flood reconstruction phase means that the potential cost-benefits are reduced. Although further consideration of this issue is beyond the scope of this thesis, several research projects have addressed different aspects of the matter (Lamond *et al.*, 2016a; Lamond *et al.*, 2016b; Lamond *et al.*, 2016c; Rose *et al.*, 2016; Lamond *et al.*, 2017; Rose *et al.*, 2017; Lamond and Rose, 2018; Lamond *et al.*, 2018).

In summary, the (pre 2016) UK insurance regime was not geared to incentivise resilience behaviours; where cover has become unaffordable, however, householders may well have been prompted to protect their homes and possessions as a measure of last resort. For this reason, any investigation into household flood resilience behaviours during this period will need to take such regulatory influences into account, by obtaining information on cost increases and/or withdrawal of cover. (It must be noted the regime did change, in relation to high risk properties, owing to

the introduction of the Flood Re scheme in April 2016. Although there is an in-built assumption that this will have positive impacts upon resilience uptake, questions have already been raised regarding the deliverability of this outcome (Surminski, 2017; Oakley, 2018).

#### 2.7.2 Government grants for resilience measures (England and Scotland)

A pilot study was conducted by Defra (2008c) in which government grants were made available for the installation of some types of property-level adaptation measures, through the medium of local authorities in parts of England. Of the 199 properties (both residential and commercial) that accepted grants 194 chose methods designed to keep the water out (known as flood-resistant, or 'water exclusion' solutions), with just 5 selecting a combination of methods that would also enable a property to recover more rapidly from inundation (termed at that time 'flood resilient' solutions, now more accurately described as a 'water entry' strategy) (Defra, 2008c). This finding is consistent with the concept of reducing anxiety as far as possible; for most people, keeping water out of the home if a flood occurs is the preferred choice, rather than accepting water ingress, even if this would hasten the recovery process. This pilot was, however, restricted to 'groups of homes' rather than single dwellings, and the use of water entry strategies alone were specifically excluded, for legal reasons (Defra, 2009). Another finding from the same project (Defra, 2008c) was that 41 of the original total of 240 eligible properties (17%) declined to take part. Among the reasons given were:

*"... concerns over potential loss of property value if visible flood resistance measures were installed (local estate agents expressed this view) even with effectively 100% funding. Others declined because of aesthetic concerns."*

This would suggest that a short-term benefit (several thousand pounds of government funding) was perceived as being less desirable than attempting to maintain long-term property values (assuming no further floods occurred) or maintaining the cosmetic appearance of the home. This is borne out by a survey on behalf of Norwich Union (2008) which found 46% of those affected by the summer 2007 floods chose not to make any changes to their property in the repair phase because they *"... wanted their home put back exactly as it was before"*. This is

consistent with the 'emotion-focussed' coping type discussed previously, as well as concept of 'ontological security': this preference represents a psychological need to return to and maintain 'normality'. Fitting any form of visible flood protection measures to the home would constitute an acknowledgement that normality may again be disrupted at a future time, and the choice made by the householder may be to 'decide not to act'. Psychological factors may thus outweigh the practical benefits that adaptation could bring: this topic will be considered more fully in Chapter 3 of this thesis.

The long-term impacts of flooding extend beyond tangible damages, as intangible effects such as mental health issues, including depression, anxiety and instances of post-traumatic stress disorder can arise, and this will be considered in the next section.

## 2.8 Health and social impacts of flooding

The impacts of flooding can go far beyond physical effects: one of the victims of the flooding in Carlisle in 2005 is quoted by Hendy (2006) as saying:

*"I wish I was dead"*

Problems with family and interpersonal relationships, social disruption, occupational and financial stress have all been found to follow in the wake of natural disaster situations. Convery and Bailey (2008) note the importance of informal support and local, post-flood information and support centres, providing a point of contact for both the emotional and practical problems arising from severe flood events. Although most survivors of disaster experience stress reactions within the normal range, a longitudinal study by Tapsell and Tunstall (2008) found a significant effect on the long-term mental health and well-being of some residents affected by the Easter 1998 flood event in the Banbury area. In some disaster scenarios such findings may be widespread, including the condition now known as post-traumatic stress disorder (PTSD).

This was first identified in the context of war-related stress reactions in the 1980's, as discussed in detail by Weathers (1995). Subsequently extended to other types of trauma, studies of the condition have included attempts to identify suitable

indicators of the individuals most likely to suffer severe symptoms; for example, it was found that depressive symptoms and diagnoses prior to major flooding contributed to increases in post-disaster distress (Ginexi *et al.*, 2000). Some groups of people are also more vulnerable to the condition, particularly the young for whom symptoms may include nightmares or social withdrawal (Russoniello *et al.* 2002; Sutton, 2008). Older adults are also a risk group, as demonstrated in a study by Phifer (1990): those aged 55-64 were at heightened risk partly because they displayed a reluctance to seek early medical intervention. Similar findings are noted by Carroll *et al.* (2009) in examining the aftermath of the Carlisle floods of 2005: residents with serious PTSD symptoms lasting over 12 months reported they believed their GP's 'would not be interested', or they feared they would be seen as hypochondriacs. Likewise DeSalvo *et al.* (2007) found over 70% of those experiencing PTSD symptoms following Hurricane Katrina in 2005 had not sought help from any healthcare professional.

In these instances, therefore, the affected individuals did not get appropriate help at the right time, which is essential for optimal clinical management of PTSD. Rhoads *et al.* (2007) undertook a pilot study in the use of cognitive behavioural therapy (CBT) for those adversely affected by Hurricane Katrina; subsequently, following the floods in Hull and East Yorkshire in the summer of 2007, the Humber Mental Health Trust provided early intervention (defined as being between one and six months following the incident) in the form of trauma-focussed CBT for individuals in the affected community (Sutton, 2008).

## 2.9 Summary

In this chapter the research context around the need to increase the uptake of household level flood resilience has been reviewed, and methods for making domestic properties more resilient to flooding have been introduced. The coping strategies employed by those at risk have been discussed, together with the concepts of community resilience and the use of community engagement. Governance issues specific to the UK have also been examined, as well as the risks of intangible damage to the health and social fabric of at-risk communities. The next chapter will explore

the role of psychology in the decision making processes people employ in risk environments.

## CHAPTER 3 - PSYCHOLOGY, DECISION-MAKING AND RISK

### 3.1. Introduction

In this chapter the second objective identified in Chapter 1 is addressed. The theoretical background to decision-making, with an emphasis upon risk situations, will be critically examined. The range of factors involved, both external and internal to the individual, which have been found to be of relevance will then be discussed, including the role of belief systems and social processes in hazard adaptation. The chapter concludes that a better understanding of the drivers of adaptive behaviours is needed, to complement the existing body of work on barriers to resilience adoption.

### 3.2 Preparedness and natural hazards

The dangers arising from natural hazards, including flooding and earthquakes, are undeniably real, whereas the risks (and the associated benefits of making preparations) are subject to the individual perceptions of those affected. In turn, both the perceptions held and the conclusions reached have been shown to be influenced by factors such as familiarity, controllability and level of knowledge regarding the risk (Slovic, 2007) as well as the wider social and political processes that 'frame' the particular issue (for example, Mullins and Soetanto, 2010; Brenkert-Smith *et al.*, 2013). Factors such as socio-cultural values, beliefs or superstitions may also exert effects on different sectors of the at-risk population (Smith, 1996). A cultural misapprehension was noted by Tapsell and Tunstall (2008) in relation to the Easter 1998 flood event in Banbury: some recent immigrants to the UK expressed surprise, as they had not expected to be flooded in a developed country.

How people make decisions about risk is a complex area, as demonstrated by the wide variation typically seen in at-risk populations (for example, Burton *et al.*, 1968; Baumann and Sims, 1978): some people may make extensive preparations in line with advice from relevant authorities, whilst others will take no action at all. The *barriers* that may be preventing the majority of those at risk from floods and other natural hazards from making appropriate adjustments have already been the subject of much research, and these will be discussed later in this chapter. The behaviour of

the minority, however, also merits attention: understanding their characteristics might shed light on the *drivers* for resilience behaviour, to complement the existing research on the barriers to adaptation. As noted by Paton *et al.* (2008a) the phenomena of ‘preparing’ and ‘not preparing’ for natural hazard risks should be regarded as separate processes. This will be discussed in more detail in the chapters that follow, but at this stage it should be noted that the behaviour of interest is that of the adapted minority, rather than the un-adapted majority, and this will form the focus of this investigation.

The development of theories underpinning our understanding of decision-making in general, and the decisions specific to risk environments will now be outlined.

### 3.2. The psychology of decision-making

Decision-making behaviours are subject to influences from two sources: firstly, processes external to the individual, which would include insurance mechanisms and grants (as discussed in Chapter 2) (Jackson, 2005) as well as the impacts of hazard experience and social factors, such as perceptions of what constitutes ‘normal’ behaviour; secondly, factors internal to the individual, including attitudes, emotions or beliefs. Additional complexities arise in the area of human behaviour under conditions of uncertainty, such as disaster preparedness. A brief overview of general decision-making theory will now be undertaken.

As described in Manktelow (2004) the study of thinking, including the way in which human beings make choices, grew initially out of the philosophy of the classical world; what we now term cognitive psychology did not develop until the second half of the 20<sup>th</sup> century. Early work on animals (for example, Skinner, 1948) articulated the principle of ‘reinforcement’ in learning whereby introduction of a *desirable* stimulus, such as food, can act as a positive reinforcement which increases the likelihood of the behaviour that immediately preceded it. The converse, negative reinforcement, occurs when the removal of an *undesirable* stimulus increases the likelihood of the behaviour recurring. (This contrasts with punishment, wherein a given stimulus has the effect of decreasing the occurrence of a particular behaviour). Applying this behaviourist view to humans drew a critical response, however, leading

to the rise of cognitive science, which incorporates the operation of internal mental processes, such as attitudes and beliefs: for example, social cognitive theory gave prominence to the concept of 'self-efficacy' wherein the stimulus-organism-response model was replaced by a person-behaviour-outcome model (Bandura, 1977).

Decision-making was, however, initially viewed as being a predominantly rational process, entailing the application of logic and reason in the absence of emotion (known as the analytic system/rational choice theory) as discussed by Elster (1996) and Darnton (2008). As consideration of all possible risks and benefits associated with a particular decision would be extremely time-consuming, however, it was suggested human beings commonly also employ mental short-cuts, based upon experience, to arrive at solutions swiftly (termed the experiential system); these short-cuts were termed 'heuristics' and a series of laboratory experiments by Tversky and Kahneman (1973) sought to demonstrate how these were applied. As an example, when asked to estimate the probability of an event occurring, a person might employ the 'availability heuristic' by making use of those associations that are most available, in that they can be brought to mind most readily. Aircraft crashes, although in fact comparatively rare occurrences, are easily brought to mind because they receive so much media exposure, and thus thought to be more common than they really are.

Not all investigators accepted the heuristics argument, however: Simon (1957) first proposed an alternative view, named 'bounded rationality'. The key principle of this was the concept of 'satisficing' (a term combining 'satisfy' and 'suffice') which was employed to describe a choice deemed to be satisfactory, rather than optimal. This approach was subsequently suggested as a possible explanation for the way in which people adjust to natural hazards (for example, Slovic *et al.*, 1974). This was further expanded (Gigerenzer and Goldstein, 1996) to suggest human beings make use of 'fast and frugal' algorithms to make probabilistic judgements; for instance, the memory is searched for cues to the problem and the first cue that is diagnostic will be adopted as the solution. As with heuristics, such a mechanism would provide a more time-efficient method of arriving at a solution, in other words acknowledging the cognitive limitations of human decision makers.

Another perspective is supplied by Zajonc (1980): psychologists initially believed emotional associations (termed 'affect' which, in this context, has a different meaning from normal English usage) contributed to decision-making only *after* the initial (cognitive) processing stage was complete; he then argues that the 'affective response' actually occurs rapidly and automatically, not only preceding any cognitive processing but also having a considerable influence on the judgements reached. A causal relationship between this 'affect heuristic' and decision-making was demonstrated by Finucane *et al.* (2000) in an experiment that manipulated the information provided to subjects before requiring them to make judgements evaluating the use of nuclear power or food preservatives. There is also some neurological evidence for the existence of such a mechanism: some brain-damaged individuals have been found to display impaired reasoning in the absence of the ability to experience feelings and emotions, even though other intellectual faculties were unaffected (Damasio, 1996).

Making decisions regarding clear and present dangers (such as fight versus flight in the face of an aggressor) requires swift appraisal and action. Where a threat exists, but may impact at an unknown future date, the decision-making process becomes more complex, as will now be discussed.

### 3.3. Decision-making in a risk environment

#### 3.3.1 Perception of risk

The way in which people perceive and respond to a variety of risk situations has been the subject of investigation from the early 1980's to the present day. In a study on the perception of 30 different (man-made) hazard types, ranging from nuclear power to home appliances, four contrasting groups of subjects were asked to rate all the activities on a list of characteristics hypothesised to be of relevance (Slovic *et al.*, 1981; Slovic *et al.*, 1982). The results indicated that these characteristics could be consistently grouped into two underlying factors:

- i) 'dread risk' (degree of controllability, dread, catastrophic potential, fatal consequences, and the inequitable distribution of risks and benefits);

- ii) 'unknown risk' (unknown, new, delayed manifestation of harm and unobservable consequences) (Slovic *et al.*, 1981; Slovic *et al.*, 1982).

To illustrate this concept, the approximate positions which four hazards would occupy on these axes are shown in Figure 3.1.

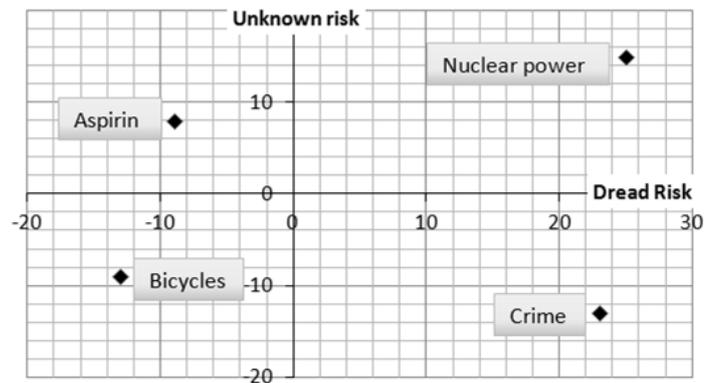


Figure 3.1 Location of hazards within a two factor space

(source – author)

In this representation, nuclear power scores high on both dimensions and so appears in the upper right quadrant; crime, though seen as familiar is also relatively uncontrollable and potentially fatal and so falls in the lower right quadrant. Aspirin and bicycles are perceived as 'not dreaded' risks, however the medicine's risks are perceived as less well known than those associated with the means of transport. Although natural hazard risks were not included in the original study (Slovic *et al.*, 1981; Slovic *et al.*, 1982), subsequent work employing the same approach found the 'dread risk' factor group to be of particular relevance: for example, Weinstein (1989) found strong correlations between 'dread' levels and previous flood experiences, while Terpstra *et al.* (2009) noted an increased likelihood of preparing for hurricanes when individuals engaged with institutions that communicated 'urgency and dread'.

The perception of 'controllability' of hazards is also of importance, as there are many documented instances where victims of flood events have (inappropriately) blamed 'the authorities' for failing to control water levels, or misunderstood the purposes of infrastructure: in the face of such misperceptions, urging an at-risk population to prepare for flood events might well be interpreted as an attempt to abrogate responsibility for institutional failings. Lave and Lave (1991) found that 80% of flood-

affected respondents asserted that the event had been 'man-made', because of a commonly held (but erroneous) belief that a hydro-electric installation upstream of the town was a flood-control structure and that this had 'failed'. This statistic does, however, raise the question of what characterised the remaining 20% of the survey respondents: for example, the population of the area in question is described as having an education level that is 'not high', with 77% having no qualifications beyond High School completion (p259) but whether there was any correlation between respondents' educational attainment and viewpoint on flood causation was not examined.

In order to improve the understanding of risk perception, the 'psychometric paradigm' was proposed (Slovic, 1987). This was a theoretical framework that assumed perceived risk was fundamentally subjective and defined by individuals in accord with the influence of psychological, social, institutional and cultural factors. Increasing evidence of the interactions between emotion and reason eventually led Slovic *et al.* (2004) to modify their theoretical, acknowledging that proper integration of *both* the 'cold' cognitive (risk-as-analysis) and 'hot' emotional (risk-as-feelings) modes of thought were required within decision-making around risks.

The impacts of the 'affect heuristic' discussed above have been demonstrated in the way people view natural hazard risk adjustments: for example, Siegrist and Gutscher (2008) found that people who had not been affected by a flood strongly underestimated the 'negative affect' actually associated with such events, in comparison with those who had experienced severe damage. Heller *et al.* (2005) found that the 'negative affect' attributed to seismic risk was associated with a lack of preparation; only after an earthquake had actually occurred, and denial of the risk became unsustainable, did such residents make preparations for subsequent seismic events.

In conditions of uncertainty the relationships between perceived risk, perceived benefit and risk acceptance are complex. In the context of technological advances, for example, it has been found that, where perceived benefits are deemed to be high, the associated risks will be perceived as low and *vice versa* (Finucane *et al.*, 2000). A psychological theory of relevance here is prospect theory (Kahneman and Tversky,

1979) which considers the importance of the ‘framing’ of problems; this considers whether the result of a gamble will be a gain, or a loss, relative to the reference point of the current state. The explanation for gambling behaviour is thus ascribed to tendency to ‘overweight’ the small probabilities of a gain, while a willingness to buy insurance depends upon the converse: the overweighting of the small probabilities of a loss occurring.

Expressing outcomes in terms of financial costs and benefits has resonances with the behaviour of residents in at-risk areas when they are considering investment in mitigation measures. A dilemma can be seen to exist between short-term expenditure (purchase of door barriers, for example), which can be construed as an immediate ‘loss’, when set against long-term potential savings (prevention of damage to household contents if a flood does occur) which constitutes a potential gain at an uncertain future date. In accordance with the rationality model, immediate and pressing needs might also be expected to be addressed in preference to longer-term needs, especially if the latter are uncertain, as is the case with estimated future flood risk.

### 3.3.2 Flood risk perception and response

For many years, both in the UK and elsewhere, flood risk management was characterised by a concentration on technical solutions for reducing flood risk; the public was often seen as irrational, with policy failures being attributed to public ignorance (Brown and Damery, 2002) or apathy (Association of British Insurers and National Flood Forum, 2004). Blake (1999) employs the term ‘information deficit model’ in relation to this dominant intellectual worldview, and highlights the shortcomings as symptomatic of a ‘value-action gap’.

Campaigns aiming to raise awareness, in the hope of encouraging preparation for flooding, were undertaken in the UK, prompted initially by the official report into the Easter 1998 floods in the English Midlands produced by Bye and Horner (1998). Research from around the world has, however, demonstrated that awareness of hazard risk does not engender protective action (Paton *et al.*, 2000; Gregg *et al.*, 2004; Takao *et al.*, 2004; Becker *et al.*, 2012). Both the Environment Agency and the Scottish Environmental Protection Agency (SEPA), subsequently adopted the

common slogan “*Flooding. You can't prevent it. You can prepare for it.*” and offered practical advice on appropriate preparation measures via their websites. Such attempts to elicit action via provision of information were also less successful than had been hoped, as subsequently acknowledged by Defra (2005a) (albeit in relation to the wider realm of behaviour-changes initiatives):

*“Information does not necessarily lead to increased awareness, and increased awareness does not necessarily lead to action. Information provision, whether through advertisements, leaflets or labelling, must be backed up by other approaches.”* (Demos & Green Alliance, cited in Defra, 2005a)

These ‘other approaches’ are designed to overcome a range of known barriers to adaptation and may be applied at different stages within the decision-making process. Harries (2007) suggests viewing risk response as a linear process where behavioural modifications may be attempted at a number of points within the sequence (Figure 3.2). A discussion of this process, stage by stage (becoming aware; considering action; and acting) follows below.

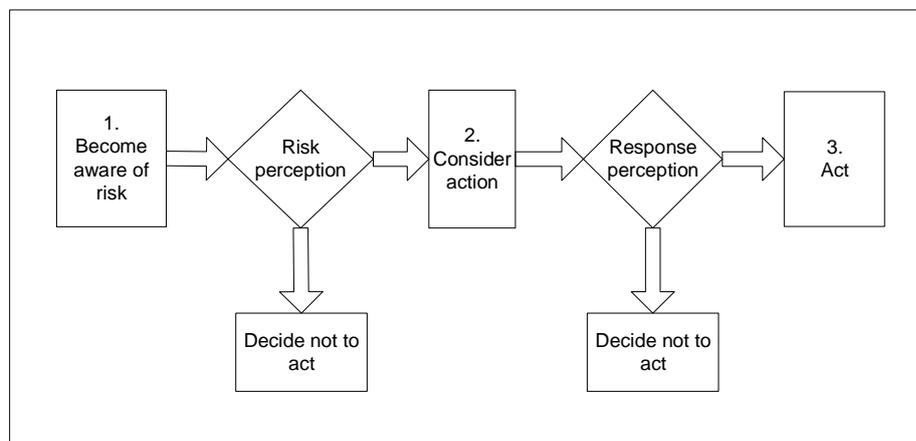


Figure 3.2 Representation of risk response as a linear process

*(after Harries, 2007) Used with permission of the author*

### 3.3.2.1 Become aware of (flood) risk

A ten-year campaign to inform the at-risk population of England and Wales commenced in 2001, incorporating mail-shots, billboard posters and media advertisements (at a cost of approximately £2m/year) (Bonner, 2006). The results of such initiatives are mixed, however: six years into the programme Harries (2007)

found that, while 60% of at-risk residents of England and Wales claimed to be aware they lived in a flood risk area, only 17% of the same population were aware of how to protect their homes against flooding.

The complexity of human information processing is not a topic well understood by policy-makers worldwide, however, as discussed by Kollmuss and Agyeman (2002) more knowledge does not lead to more enlightened behaviour, and provision of information alone, therefore, does not bring about behavioural change. Firstly, the information must be received and understood; secondly a decision has to be made in relation to that information. As shown in Figure 3.2 at each decision points there is a choice described as 'decide not to act'. An analogy might be that the adverse consequences of smoking have been known since the 1950's (Doll and Hill, 1954) but, despite being aware of this, some people still choose to continue to smoke tobacco. A lack of action may appear to be maladaptive but, in order to overcome this barrier, a deeper understanding is needed of the ways in which risks are perceived and decisions are taken.

The way individuals appraise risk information is a complex issue, not only because of the emotional and psychological factors referred to above but also because the potential hazards are normally described in probabilistic terms, such as 'a 1% chance of occurring in a given year', which may be difficult for some groups of people to grasp. Risks may be of high or low probability, thus an element of doubt applies (which can invite denial); the threat may be immediate or remote in time (inviting procrastination) and the consequences of an event may range from mildly inconvenient to catastrophic, which engenders confusion in the selection of appropriate responses. Where forecasts of natural hazards are provided to a wide range of recipients, it has been suggested (Doyle *et al.*, 2014) that a dual approach might be adopted, using both numeric and verbal descriptions/narratives to meet the varying needs of those at risk.

Acceptance of the existence of any risk can itself pose problems, as it threatens a fundamental human need to feel secure, a phenomenon that sociologists term 'ontological security'. A term first coined in the mental health sphere (Laing, 1960) it was subsequently adopted for use in other contexts, for example the security arising

from the development of trust between a child and its caretakers (Giddens, 1990) or the concept of the home as a secure base within a world that is threatening and uncontrollable (Dupuis and Thorns, 1998). Harries (2007) utilises the search for ontological (as opposed to physical) security as an explanation for some of the apparently illogical human behaviours exhibited in the face of natural hazards. He found that 61% of residents whose homes had been flooded, still did not take action to reduce possible damage in future flood events, hence personal experience of flooding does not necessarily bring about behavioural changes.

Psychology can also offer insights into the way messages need to be constructed, as well as how the message is conveyed. For instance, there is a need to guard against over-emphasising the 'fear factor' when communicating risk as this can prove counter-productive and trigger a denial response in individuals; Seymour (2007) employs an analogy with anti-smoking campaigns, in that an approach emphasising the choices available, rather than 'scary messages about death' had the greatest positive influence in persuading smokers to give up.

The interactions between policy-makers, at all levels, and the general public need to be guided by these same principles of incentivisation: the stage of 'considering action' will only be reached if the risk perception issues are addressed.

#### *3.3.3.2 Considering action*

Before being able to act in relation to the perceived risk the at-risk residents need to be able to access information on the strategies available and select those most appropriate to their individual situations. Promotion of appropriate adaptation measures takes place at a macro-level by seeking to act upon or influence householders as a group; response to these messages, however, is enacted at an individual household level and members of the public, as noted previously, are not a heterogeneous group. For example, following the 2007 summer floods, the Pitt Review (Pitt, 2008) recommended that members of the public should:

*"... increase their personal state of readiness and resilience to floods by following the Environment Agency's practical advice ..."*

Some of the suggestions made by the Agency, and equivalent bodies, require little or no financial outlay and were, therefore, accessible to a wide range of people; other options, such as the purchase of flood doors and air-brick covers, are necessarily income dependent. However, despite information on the subject being made widely available, the proportion of the at-risk population who have taken measures to protect their homes without having first experienced a flood event has been found to be extremely small: 6% in the case of the sample examined by Harries (2007); and only 9% had taken measures other than registering for warnings prior to a flood (Lamond *et al.*, 2009). One explanation could be that these people represent the only sector of society that is psychologically equipped to respond to exhortations to prepare from the authorities. Similarly small proportions are seen in preparation levels in respect of other cultures and other natural hazards: for example, only 8% purchased flood insurance before experiencing a flood in a US study (Baumann and Sims, 1978); and only 5-9% of respondents had adopted any loss reduction measures in an earthquake-risk area of California (Kunreuther, 2008). The similarity of these statistics would bear further examination in terms of the motivations driving such (successful) behavioural responses in these minorities and, in particular, the characteristics shared by the group of people who demonstrate such anticipatory adaptation.

Subsequent to a flood event, the effects of the reinstatement process itself on the affected householders is described graphically by Boobier (2008) as an 'emotional rollercoaster', as they navigate the unfamiliar (and often stressful) processes of dealing with insurers, loss adjusters and builders. Maladaptive coping strategies in this period, noted by Hendy (2006) may include a reliance on alcohol, nicotine or prescription medicines; Lamond *et al.* (2015) found up to 40% of flooded households had employed such methods in the five years following a flood event. Post-event strategies in the UK have been found to be influenced by the nature of household tenure (whether owner-occupiers or tenants); housing association tenants, for example, may find themselves cared for and re-housed by the landlord, whilst other households, if uninsured, could find themselves dependent upon emergency aid

provided by local authorities, charities or friends and family members (Werritty *et al.*, 2007).

#### 3.3.3.3 Acting to reduce risk

If it is accepted that many of the at-risk population practise anxiety reduction techniques, as described earlier (Section 2.7.2) this leads to an understanding that the way forward for adaptation strategies must address this issue if flood resilience is to be improved. There is increasing evidence that measures which can reduce the amount of time spent out of the home in the aftermath of flooding can help to reduce the incidence of mental health impacts (Lamond *et al.*, 2015; Jermacane *et al.*, 2018). Adoption of resilience measures can, therefore, enhance the recovery process of individuals, thereby promoting resilience within the affected community in the longer-term, as well as reducing the financial losses incurred.

Within these theoretical viewpoints, a wide range of specific factors has been invoked to explain the decisions people make regarding natural hazard risks, and these will now be examined, commencing with those arising external to the individual.

### 3.4 Factors affecting decisions about risks

#### 3.4.1 External - Hazard experience

*'Experience leads people to think about the risk more often, and with greater clarity.'*(Weinstein, 1989)

Past exposure to a given hazard might seem, intuitively, to provide an obvious driver for future mitigation actions, yet research shows this to be an overly simplistic expectation. Experience with volcanic hazards, for example, did not necessarily motivate individuals to make preparations for future crises of the same nature (Paton *et al.*, 2008b) whilst a study of evacuation behaviour during Hurricane Katrina found that the influence of friends and family members was more important than prior experience (Adeola, 2009). Having survived a major storm (hurricane or cyclone, depending upon the geographical location) was, however, a contributory factor in households having prepared evacuation plans (Horney *et al.*, 2008) emergency supply kits (such as bottled water and portable radios) (Sattler *et al.*, 2000; Horney

*et al.*, 2008) and practices such as deploying shutters on windows and doors (Tompkins *et al.*, 2009).

This somewhat mixed picture could suggest that hazard experience *per se* does not offer a consistent motivating factor; it has been suggested that, in part, the wide range of activities that can be subsumed under 'preparedness' have militated against the emergence of a coherent picture. A study that separated these activities into two groups, those linked to 'survival' (first aid kits, water and the like) and 'damage mitigation' (such as securing tall furniture to walls in seismic risk areas) found that the first group of actions were more commonly adopted than the second (Spittal *et al.*, 2008). Furthermore, hazard exposure can arise from two sources: direct interaction with the threat, or indirect interaction, such as vicarious experience (hearing vivid descriptions of others' experiences, or derived from media reports) (Lindell and Prater, 2002; Knocke and Kolivras, 2007). Becker *et al.* (2017) note four source types in relation to earthquake preparedness: direct, indirect, vicarious and life experiences (such as having suffered an accident). It is possible that the small minority of people reported as having taken anticipatory actions in the absence of any personal experience may, therefore, have been prompted by indirect experience types. Vicarious experience is also a factor identified as contributing to the cognitive processing of self-efficacy ('perception of the competency to act') (Bandura, 1977) which, in itself, has been implicated in some explanatory models of preparedness (Ajzen, 2002; Paton, 2003). This would suggest that development of a UK-specific flood preparedness framework should include exploration of both direct and indirect (particularly vicarious) types of experience.

The frequency of exposure has also been found to be of relevance for protective behaviour in the UK: when the number of experiences of household flooding rises above two or three, the frequency of mitigation behaviours is found to increase greatly (Harries, 2009). This may be due to insurance industry practices: UK householders have often found the repair and renovation costs for a first claim are likely to be met, but they may then face an increased premium and/or excess required in respect of any future flood claims (National Flood Forum, 2009). This is because a second claim would not simply be 'coincidence' from the insurers'

standpoint, but a confirmation that the property is at higher risk. If further flood incidents should occur, even those householders who have been vociferous in denying the existence of flood-risk in the past may come to the acceptance that their properties are indeed in risk areas, and investment in flood resistance or resilience measures may be required. The financial outlay involved in flood mitigation poses a well-recognised barrier to action, and this aspect will now be considered.

#### 3.4.2 External - Financial issues

Property-level mitigation measures suitable for single, or small groups, of properties have been available for a number of years in the UK. To boost homeowner confidence when purchasing such products, a BSI 'Kitemark' standard was established in 2003 covering many of the available measure types, and various guidance documents were also published on the matter to assist the public (for example, Crichton, 2003; Environment Agency and CIRIA, 2003). The range, and sophistication of such products has continued to develop (Dhonau and Rose, 2018) but the cost of such adaptations has frequently been identified as a barrier for many people, for example:

*"... over half of people living in areas of significant flood risk gave expense as a reason (for not adapting) ..."* (Defra, 2008a p21)

This appears to apply even though cost-benefit analyses have frequently demonstrated the long-term advantages of making properties resilient, as discussed by Lamond *et al.* (2018). The government grants made available in some areas in recent years (as discussed in section 2.5.2) therefore represent an attempt to address this area of concern. As noted by Harries (2009) however, prior to the grant schemes the cost of measures may have been of less concern to many homeowners than their own lack of confidence in choosing appropriate measures for their properties. Furthermore, insurance companies in the UK are largely reluctant to incorporate any reduction in respect of installed risk-reduction measures when calculating premiums, unlike those in Germany (Surminski and Thieken, 2017); this may form an additional financial disincentive to taking action.

### 3.4.3 External - Social influences

As social animals, human decision-making processes are inevitably influenced by the societies in which we live: there is the option to act as an individual, or to conform to a group's current social or cultural 'norm' of behaviour. A householder who chooses to buy/make/install flood resilient products to protect their own property can be seen to be prioritising their individual interests in the face of a potential threat. They may, however, find their actions attract opprobrium from neighbours, who believe 'advertising' there is a flooding problem in the area poses a more immediate threat in that it will reduce the saleability of fellow group members' homes (Garland, 2008). The ability to withstand social pressures such as this will vary between individuals, and indeed groups of people; thus, personality factors will be involved in the decisions made. Those individuals who are less susceptible to such pressures will feel less constrained to conform, and this aspect will be discussed further in Chapter 4.

Social influences of various kinds have been identified as impacting upon the decision-making process of individuals, and the implications for individual behaviours will now be examined.

#### 3.4.3.1 Social 'norming'

Individuals do not act in isolation, but in the broader context of social structures: Jackson (2005) summarises this, and its impact upon efforts to motivate sustainable behaviours as follows:

*"... factors such as personal motivation, collective practice, peer pressure, habit, subjective norm, and social context play a key role, both in influencing behaviour and in determining the success or failure of policy interventions to change it."*

Perceptions of what is, and is not, 'normal' behaviour affect the decision-making process as regards flood resilience. Harries (2008a) found that some interviewees were reluctant to adopt flood mitigation measures in case these reduced the visual conformity of their homes to (what they regarded as) an idealised norm. Shifts in established 'norms' can often be a protracted process, taking many years for reversal of old beliefs or acceptance of new ideas. Oakley (2018) notes that:

*"Changing social norms is likely to be the most effective way of shifting the burden of responsibility further towards households ... For example, **changing societal attitudes** towards wearing seat belts, drink driving and recycling are all areas where societal views have been changed over the last few decades (Oakley, 2018) (p51).*

There are exceptions to the time frame issue, however: Armitage and Talibudeen (2010) report that success in changing subjective norms was dependent upon the intervention mode: the active experimental manipulation group displayed immediate changes, but the control group, supplied with factual information alone did not.

In some instances, protective measures (even those that might appear to be self-evidently beneficial) are initially resisted, as was found in relation to household fire risk, burglary and seat-belt use: in some instances protective actions do not become accepted as 'normal' until some form of external pressure, such as legislation, obliges people to adopt them (Defra, 2008a). However, the use of 'exemplars' can help in accelerating such shifts; for example, Defra (2008a) also report that, in some of the villages surrounding the Nottinghamshire PLP pilot area, some interest had been shown in risk mitigation as a result of measures being applied in the pilot properties.

The adoption of mitigation measures by flood group members can, therefore, be seen as contributing to the necessary shift in wider society's perception of what is 'normal' for homes sited in flood-risk areas, in conjunction with the pilot studies referred to above:

*"The pilot scheme not only provided advice on what to buy; by contributing towards the costs of products it also, in effect, vouched for their effectiveness; and by introducing them on a large scale, **it made them seem more normal** ..." (Harries, 2009) (p36) (Author's emboldening).*

Another socially based concept of relevance here is that of 'social capital' which will now be discussed.

#### 3.4.3.2 Social Capital

Social capital can be defined as follows:

*'Social capital consists of the networks, norms, relationships, values and informal sanctions that shape the quantity and co-operative quality of a society's social interactions.'* (Halpern et al., 2004 p28)

By belonging to a group, bonds are said to be created that foster trust, solidarity, and cooperation among its members. Empirical evidence, found in a flood mitigation context in England and Wales, supports the concept that those who engage with their local communities express more intention to act (Lo and Chan, 2017). The suggested mechanism is that community engagement and other trusted social networks give rise to an accumulation of social capital which, in turn, enhances residents' motivation to prepare for adverse events, including climate change (Paton and Tedim, 2013; Lo and Chan, 2017). This finding underpins the potential importance of community-based flood groups as a method of increasing flood resilience in a particular locality, as membership of such a group impacts upon the outlook of the individuals involved.

#### 3.4.3.3 Social responsibility

Another concept of relevance here is responsibility: Paton (2003) cites a number of studies in which positive correlation was found between the degree to which personal responsibility is accepted and the level of preparedness behaviours. Individuals holding that viewpoint can have an effect on wider society, however, leading to the concept of 'social responsibility': this can be defined as:

*'... the relationships between the economic, environmental and social aspects of an organisation or group activities that endeavour to benefit society'* (ISO, 2004 as cited in Mullins and Soetanto, 2013).

Barnett *et al.* (2008), reporting on interactions between the Environment Agency and special interest groups (of all kinds) notes evidence the motivation for joining often includes altruistic concern for other community members. Individuals who choose to participate in a community-based flood group will also have an opportunity to expand their previously existing set of relationships to encompass representatives of

the policy-maker community, possibly for the first time (for example, local EA staff and emergency planners from the local authority). The resulting ability to reach common understandings of flood risk and mitigation issues, together with the scope for building trust between individual householders and risk management agencies, can influence and clarify the perception of the roles and responsibilities on both sides.

Having considered the external factors that can impact upon flood resilience behaviours, those arising from within the individual will now be examined.

#### 3.4.4 Internal - Feelings and emotions

Although emotional factors are known to influence decision-making, it cannot be assumed even a powerful emotion such as fear will elicit any predictable or 'rational' responses. Following the floods of summer 2007, for example, it was found 23% of the population (nationally) reported their fear of flooding had increased; the figure was higher in the areas directly affected at 43%, but nonetheless 95% of the at-risk householders reported they had not taken any action to protect themselves from a future event (Norwich Union, 2008). Bradford *et al.* (2012) conducted a pan-European study (n=1375) and found that 'worry' about flooding did not correlate with high preparedness level; furthermore, O'Neill and Nicholson-Cole (2009) found fear to be a largely ineffective tool for motivating constructive engagement or action, although employing fear-inducing representations of a threat (in this instance climate change) was effective in attracting an audience's attention to the issue. This has obvious implications for communication of warning campaigns across natural hazard scenarios, in that the negative emotional consequences must be envisaged as well as tangible losses. It has been amply demonstrated, however, that emotional content cannot be utilised within hazard communication in the hope it will act as a simple 'lever' to elicit action (for example, O'Neill and Nicholson-Cole, 2009; Chapman *et al.*, 2017).

Harries (2008a) suggests another type of emotional need: the desire to protect 'ontological security', which is the feeling of being secure (as opposed to actual physical security). This concept, as discussed by Dupuis and Thorns (1998) is rooted

in the unconscious mind and closely linked to an individual's self-identity. The outside world is thought to be perceived as threatening and uncontrollable in nature, but the home is, by contrast, seen as a place of safety. The threat of flooding would, therefore, constitute a violation of 'feeling safe' stemming as it does from an uncontrollable external force; denial that flood risk exists could, therefore, be interpreted as a means of upholding this sense of security (Brilly and Polic, 2005).

Another emotional factor of relevance here is that of optimism, which can be defined as '*hopefulness and confidence about the future or the success of something.*' It has, however, been found to take two forms in the context of decision-making: firstly, there may be a positive outlook, as just defined, but secondly (and more commonly) there is an *unrealistic* optimism typically expressed as 'oh, it won't happen to me', which cognitive psychologists recognise as the common trait of 'optimism bias' (Helweg-Larsen, 1999; Becker *et al.*, 2013). This outlook effectively transfers both the perceived risk, and the responsibility to act, onto fellow citizens and/or the authorities (Paton, 2018). It has been found that the majority of individuals regard themselves as less likely to suffer harm compared to others at risk from the same hazard, and this inhibits the adoption of protective behaviours (for example, Slovic *et al.*, 1981; McClure *et al.*, 2011; De Dominicis *et al.*, 2015). Genuine optimism, on the other hand, can be regarded as indicative of an individual's overall outlook on life which can be regarded as a 'belief system', as will now be discussed.

#### 3.4.5 Internal – Belief systems

Belief systems, in this context, comprise not only religious and spiritual worldviews but also secular outlooks such as fatalism. Beliefs can exert powerful influences on decision-making processes, not only in hazard adaptation contexts, but also in fields such as health, education and occupational psychology. Such beliefs may pose a barrier to action, even where awareness of hazard and knowledge of possible mitigation strategies both exist: for example, as discussed by Paton (2006) a fatalistic outlook can mean the destructive effects of hazards such as bush-fires may be seen as inevitable and insurmountable, rendering personal actions futile. This has links to the psychological phenomenon of 'learned helplessness' (Maier and Seligman, 1976 cited in Bandura, 1977; Abramson *et al.*, 1978) in which past experience of

(genuinely) uncontrollable events leads to the expectation that actions do not affect outcomes hence, even in situations where outcomes would be amenable to control, action is not taken. A similar psychological construct is that of 'locus of control' (Rotter, 1966) but this distinguishes between different types of control, being attributed to either internal, or external sources. Belief in a deity that controls one's life would be an example of 'external' control (Wallston *et al.*, 1999). The locus construct has been found to be of relevance in studies of hazard adaptation (for example, McClure *et al.*, 1999; Sattler *et al.*, 2000; Mishra *et al.*, 2009) and will, therefore, be further examined in greater detail in Section 4.2.

Beliefs can impinge upon people's perception of their own effectiveness in meeting challenges, as well as the perceived effectiveness of recommended solutions, and these can be termed 'efficacy beliefs'. If individuals feel they are personally 'not competent to act' in relation to a particular hazard they could be described as having 'low perceived self-efficacy'; if, however, they doubt the effectiveness of suggested mitigation measures, then this could be termed 'low perceived response efficacy' (Prentice-Dunn and Rogers, 1986). Both types of efficacy have been implicated in the way in which people respond to natural hazards (for example, Duval and Mulilis, 1999; Lindell and Whitney, 2000; Paton *et al.*, 2001) and the efficacy concept will, therefore, be examined in detail in Section 4.3. Although it may appear that possession of high self-efficacy could equate to having an optimistic outlook, Bandura's original concept (Bandura, 1977) is defined as a domain-specific trait, whereas dispositional optimism can be characterised as a generalised outlook; it has, however, been found to contribute to self-efficacy perception (Benight, 2004).

A more functionally oriented approach, wherein the styles of coping behaviour themselves are the focus of attention, has also been explored.

#### 3.4.6 Internal - Coping styles and processes

An early study of factors affecting behaviour in a disaster-preparedness context was conducted by Baumann and Sims (1978); in discussing their results they suggested a 'coping character type' to explain their findings. At one extreme, they identify 'copers', who needed little persuasion to adopt hazard mitigation techniques; at the other the 'non-copers', who tend to ignore or actively resist protective measures. In

practical terms, 'copers' were represented by 8% of the sample (n=144), who had not previously experienced damage from floods, but nevertheless purchased flood insurance.

Studies of coping styles grew in importance during the next decade, primarily in the field of stress response, and a number of measuring instruments were devised. Folkman and Lazarus (1980) developed the 'Ways of Coping Checklist', a 66 item questionnaire for which respondents were asked to identify the tactics they had made use of in relation to specific stressful life events, such as a medical treatment or an academic examination. Examples include: 'Turned to work or substitute activity to take my mind off things' or 'I got professional help'. By means of item sub-sets embedded within the checklist, coping processes such as distancing, self-controlling or escape/avoidance were identifiable. (It should be noted that this technique was not designed to ascertain coping styles or traits *per se*, but the category of tactics utilised in specific situations). Solomon *et al.* (1988) examined the relationships between coping (using a shortened version of the instrument), locus of control, social support and combat-related post-traumatic stress disorder in Israeli soldiers; significant relations between the factors were identified via cross-sectional analysis.

There are, therefore, both individually-situated and socially-based influences upon decision-making. These factors can also interact with each other in the formulation of resilience decisions, as will now be discussed.

#### 3.4.7 Interactions between individual and social influences

As Mullins and Soetanto (2011 p120 ) state:

*"Communities are made up of individuals, each of whom can have an effect upon their personal level of resilience to flooding, which in turn will have an effect upon their community resilience."*

Any community including greater numbers of people who adopt resilience measures will, therefore, be likely to benefit from increased overall resilience to adverse events (for example, those who recovered quickly would be then in a position to offer assistance to those who had not). As already discussed (in Section 2.1), it appears the majority remain confused by (or in active opposition to) the relatively recent shift in

'responsibility' attribution as regards flood resilience. This leads to consideration of another component of response, namely trust in the sources of information and warnings.

Parker *et al.* (2009), examining flood warning response in the UK, identified mistrust in authority as a factor inhibiting some sectors of society from heeding issued warnings. Lindell and Hwang (2008) also make reference to the issue of institutional trust, as potentially one of their 'missing factors' in measuring perceived personal risk. Paton *et al.* (2010b) note that, in all three countries within their study, the perceived quality of the relationship between at-risk populations and the relevant agencies influenced the meaning individuals attributed to information provided by the latter (for example, whether this relationship was perceived as empowering, or whether the source was deemed to be trustworthy or not). Trust was found to mediate the relationship between empowerment and intention, in a New Zealand seismic risk study (Paton *et al.*, 2010a). The degree to which a warning institution is trusted has a bearing on whether warnings will be believed and acted upon. Individuals may prefer to seek confirmation from more trusted sources such as friends, relatives or neighbours and thus disregard official alerts (Brown and Damery, 2002), whilst a lack of trust may be engendered by receiving false alarms, as illustrated by the following quote from Fielding *et al.* (2007):

*"...(I) got up to have a look obviously - well, what flood warning? There was no water in the road at all, not at any point..."*

As mentioned previously (Section 2.6) the Environment Agency (Henton, 2008) identified the need to build trust with flood-risk communities as a 'vital' component of its work to help overcome such issues.

### 3.5 Summary

This chapter has examined the limitations of rational choice theory and alternative models of choice, as well as exploring a range of factors involved in both social and individual aspects of decision making. Explanations of the barriers to adaptation have been found to be prevalent in research but there has been little exploration of the reasons for taking action (drivers of adaptation). When taken together with the lack

of understanding of the influence of some personality factors in the UK flood-risk context, and the contribution of indirect (as well as direct) flood experience to decision-making around adaptation, this constitutes a major research gap. It is, therefore, proposed that examination of the characteristics of those households that have already responded positively in terms of flood resilience behaviours may usefully inform the development of future mitigation initiatives. Consideration of the existing theoretical modelling concerning behavioural change will be discussed in the next chapter.

## CHAPTER 4 - BEHAVIOURAL THEORY

### 4.1 Introduction

In this chapter the third objective stated previously (section 1.5) will be addressed. The key concepts of 'locus of control' and 'self-efficacy', which are belief system factors pivotal to a number of theories, will first be introduced. A critical review of a range of behavioural change theories follows, with a particular focus upon those applicable natural hazard preparedness behaviour. The chapter concludes with a discussion of the applicability of these theories to the specific area of UK flood mitigation.

### 4.2 Changing behaviours

In the interests of increased resilience, more people will need to take appropriate steps, but this means existing behaviour patterns will need to change. Whether this is achieved via education, influence, persuasion, advertising or marketing, an understanding of behavioural theory is needed to aid comprehension of the way people respond to flood risk, as well as helping to guide future policy initiatives intended to bring about behavioural change.

Behavioural change is an important facet of human life and has been studied in a wide variety of settings, including health, education, employment and training. UK policymakers adopted this perspective relatively recently, in contexts such as promoting the environmentally responsible behaviours of recycling and sustainability, as discussed by Jackson (2005). An example of harnessing psychological principles to effect behavioural change and increase resilience is provided by the way flood warnings are now being provided in the UK.

Although a free telephone messaging system for at-risk properties had been available in England and Wales for over a decade, it was noted that only 41% of those eligible were registered for Floodline Warnings Direct service at the time of the summer 2007 flood events (Pitt, 2007). The take-up rate also varied across the regions; for instance, it was reported (Walsh, 2008) that only 2.7% of those eligible in the Sheffield area had signed-up for warnings a year after the 2007 extreme flood event. One of the factors contributing to the low take-up of the service nationally,

was found to be an 'urban myth' that insurance companies were able to find out who had registered and would withdraw insurance cover as a result (Know Your Flood Risk Campaign, 2011). (This also provides an example of the influence of trust in sources, in that unfounded rumours may appear more credible than the authorities in some circumstances).

To overcome these issues, the Pitt Review (2007) recommended the way in which the Flood Warning service is made available should be amended; this was subsequently endorsed by the Environment Food and Rural Affairs Committee (2008) p17:

*"There should ideally be an opt-out for receiving flood warnings from the Environment Agency in areas of high risk, rather than the current opt-in system."*

The initial pilot study on this option (Environment Agency, 2008b) found only 2% of people chose to opt-out of the service. By 2012, when almost 1.4 million people were included on the system, the opt-out rate was less than 0.1% (Cabinet Office, 2012). The psychological underpinning of this contrast in response has been described in terms of 'inaction inertia' by Tykocinski and Pittman (1998); the 'decision not to act' in this instance contributes to a positive resilience outcome, in other words, it acts a driver of the desired behaviour.

A number of theories and/or models of human behaviour have been suggested, all of which can be useful in enhancing our understanding of the complex processes involved. Models are, however, simplified versions of reality, as discussed by Chatterton (2011); and development of a single 'all-encompassing' model may be overambitious, as different contexts will dictate the adoption of different perspectives. Some concepts have been found to be of particular relevance in modelling disaster preparedness behaviours, and these will be introduced in the next two sections.

#### 4.2 Key concepts within behavioural change – 'Locus of control'

The 'Locus of control' construct is derived from Social Learning Theory (Rotter, 1966); the underlying premise is that individuals are believed to learn on the basis of their

past history of 'reinforcement' as discussed in the previous section. Where experience leads an individual to believe s/he is responsible for the outcomes of their actions, the person tends to develop an internal locus of control. If forces external to the individual are perceived to be responsible for outcomes, however, the learning process is likely to result in the development of an external locus of control. Owing to the ongoing impacts of life experience, however, an individual's LoC orientation is not static: it has been shown to be dynamic, responding to feedback from actual performance of tasks in longitudinal studies (Anderson, 1977; Bandura, 1977; Ajzen, 2002; Twenge *et al.*, 2004).

The concept was (initially) measured (Rotter, 1966) via a forced choice expression of belief in a list of paired statements, such as:

a. *Many of the unhappy things in people's lives are partly due to bad luck.*

vs

b. *People's misfortunes result from the mistakes they make.*

When tested with a population of university students in the USA, the resultant 'IE' scores were found to approximate a normal distribution curve (Appendix 1). Those scoring above the median were said to have an 'external locus' and those below an 'internal locus'.

This construct has been expanded and extended into a variety of environments, including health and educational studies, with context-specific questionnaires being developed and validated. The locus of control orientation provides a measure of cross-situational beliefs and, when used in studies of disaster preparedness, statistically significant correlations between behaviours and locus of control orientation have been found: for example, those with a more internal locus were more likely to judge that distinctive earthquake damage was preventable according to McClure *et al.* (1999); similarly Armaş and Avram (2009) found that people characterised by inner control have a significantly reduced general anxiety level regarding flood risk compared to those with external control. This, therefore, suggests that higher internality has the potential to act as a driver of positive behaviours in relation to natural hazards.

The original I/E scale was, however, a generalised expectancy measure and so does not readily lend itself to examination of specific behaviours in, for example, the field of health. This led to the creation of a number of sphere-specific scales, as well as further modifications to the methodology, as will now be discussed.

#### 4.2.1 Modified locus of control scales

The concept behind many health education programmes is to increase internality by encouraging patient responsibility for their own health care, as internals appear more likely to engage in positive health behaviours (Wallston and Wallston 1978). By developing health-specific versions of the locus of control measure, such programmes could, therefore, be evaluated, tailored and improved: one such example is the Multidimensional Health Locus of Control scale (hereafter MHLC). This incorporates an important modification to the original theory, in that locus of control is no longer viewed as a unidimensional construct: different types of external factor were identified, initially representing 'chance/fate' and 'powerful others'. The change of concept is illustrated in Figure 4.1. A third factor, the 'God locus', was added in response to feedback from

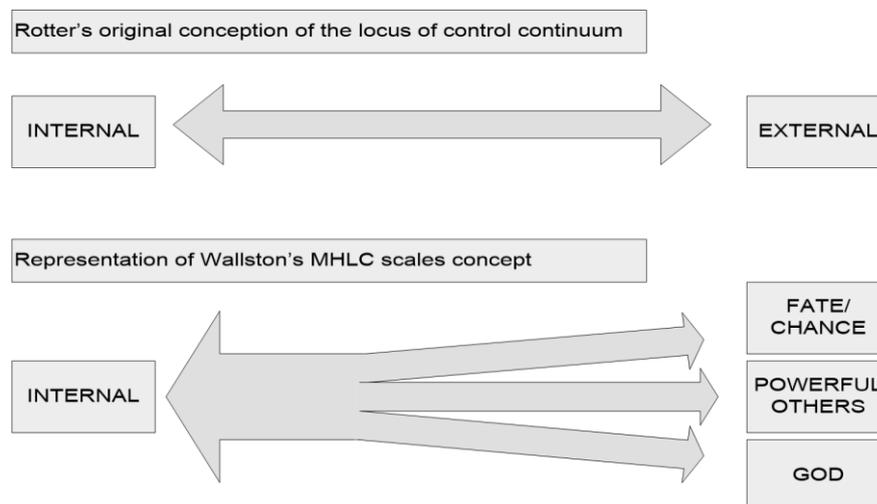


Figure 4.1 Illustration of the changes from unidimensional to multi-dimensional factors for locus of control

(author's own illustration)

subjects in the USA (Wallston *et al.*, 1999). This particular modification underlines the importance of considering what impacts cultural and/or faith-based values may have upon resilience behaviours in some at-risk populations (Bhatti, 2001).

The modified questionnaires not only comprised a combination of sub-scales, one for each dimension, but also employed Likert scales to elicit responses in a more nuanced fashion, rather than the forced choice method of the original I/E instrument. There is an extensive literature on the use of the MHLC approach, which has been found to be at least moderately reliable (with Cronbach alphas in the 0.60 - 0.75 range) and with test/retest stability coefficients between 0.60 and 0.70 (Wallston 2005).

Other health locus of control scales have been developed for use in specific conditions, for instance the 'Drinking Related Internal/External locus of control' scale for alcoholism studies (Yeh, 2008). In this instance, the questions are designed to assess the individual's perception of personal control in relation to alcohol, drinking behaviour and recovery; more external scores are related to, for example, the incidence of lapses of sobriety, whilst internal scores are linked to better outcomes following treatment.

Locus of control has also been widely used in other fields: Spector (1988) measured generalized control beliefs in work settings; while Coleman and DeLeire (2003) found having an internal locus of control contributed to the educational attainment of US teenagers. Oreg (2003) reports on the development of a 'Resistance to change' scale for use in the context of organisational change, with potential for use in personnel, training and marketing contexts. Landau (1995) found that the locus of control score was related to levels of depression and life-satisfaction in an Israeli population: subjects scoring high for internality tended less to depression and reported more satisfaction from life than the external subjects, regardless of their economic status. Overall the findings have indicated that, while the concept appears to have validity across cultures, the sense of control does not necessarily reflect real resources, but rather the ability to effectively mobilize resources in times of stress. This interpretation has practical relevance for disaster recovery programmes, in that those with an external locus as well as having low socio-economic status could

potentially be doubly disadvantaged. Internal locus of control has also been found to correlate with natural hazard preparedness behaviours (including flood risk) in a number of studies (Baumann and Sims, 1978; McClure *et al.*, 1999; Spittal *et al.*, 2008; Armaş and Avram, 2009; Mishra *et al.*, 2009).

The perception of internal and external control might well vary across different domains of a person's life, however, and Paulhus (1983) describes the development of a new measure named the 'Spheres of Control Scale' which includes some aspects of Bandura's self-efficacy theory (Bandura, 1977) in addition to the locus of control concept. This approach was utilised by Judge and Larsen (2001) in a work-related setting, and also by Spittal *et al.* (2006) in developing a scale specific to earthquake readiness.

To understand more fully the implications of this approach, Bandura's (1977) theory of perceived self-efficacy, and its relationship with locus of control, will now be discussed in more detail.

#### 4.3 Key concepts within behavioural change – 'Perceived self-efficacy'

The concept of self-efficacy was introduced in the course of developing the social cognitive theory as a departure from the behaviourist approach (Bandura 1977). He argued that a person's attitudes, abilities and cognitive skills combine to form a self-system, and this then influences the perception of situations, thus shaping our responses. Hence, although someone may believe a given course of action will produce the desired result, it is their belief in their own capabilities that affects judgement of whether they are capable of behaving in that way or not. Bandura argued that self-efficacy differs from locus of control, in that the latter is a measure of control over outcomes, and thus generalised; whereas, self-efficacy is a measure of behaviour-specific competence (see Figure 4.2).

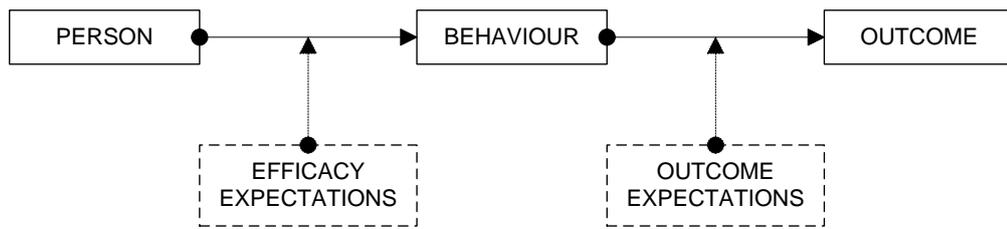


Figure 4.2 Diagram to show difference between efficacy and outcome expectations  
(after Bandura 1977) Used with permission of the publisher

Bandura believed self-efficacy beliefs begin to form in early childhood; thus, paralleling Rotter's (1966) reinforcement theories, these beliefs develop as a variety of tasks and situations are experienced. Growth of self-efficacy does, however, continue throughout adult life via the acquisition of new skills and understanding; however, relevant experiences may be vicarious as well as direct:

*"People do not rely on experienced mastery as the sole source of information concerning their level of self-efficacy. Many expectations are derived from vicarious experience. Seeing others perform threatening activities without adverse consequences can generate expectations in observers that they too will improve if they intensify and persist in their efforts."* (Bandura, 1977)(p 197) (This author's underscoring)

This forms a contrast with the theoretical viewpoint underpinning locus of control, as no 'reinforcement' will accompany imitative behaviour. In a natural hazard context, therefore, witnessing others successfully dealing with flood risk could potentially enhance self-efficacy. Bandura identified four sources of increased self-efficacy: mastery experience (performing a task successfully); social modelling (witnessing others performing a task successfully and imitating it); social persuasion (gaining verbal encouragement to counter self-doubt) and physiological responses (including the individual's emotional state and stress levels). In the latter case, learning to minimize stress and elevate mood will improve the individual's sense of self-efficacy.

The construct of self-efficacy has been utilised in a wide variety of settings, for example with relevance to human performance: Stajkovic and Luthans (1998) found

employees who perceived themselves as highly efficacious displayed a strong sense of commitment to their activities, and if these were well executed, produced successful outcomes, while those who perceived their self-efficacy to be weaker tended to lose confidence in their personal abilities and fail at set tasks. Thus, in a new situation, the individual will assess what prior experience is applicable (mastery) and also whether his/her personal abilities are conceived as sufficient to the task as perceived.

In a disaster resilience context, Paton *et al.* (2000) found a low self-efficacy score equated to a feeling of being 'not competent to act' and, thus, the risks (in this case volcanic hazard effects) were perceived as insurmountable. Lindell and Perry (2000), examining household adjustment to earthquake hazard, identified examples of all four of the determinants shown above: past hazard experience provided information about both vulnerability and resource requirements for adjustments; vicarious experience of hazard impacts was derived from the social context and persuasion was seen to operate in terms of the policy-making groups' provision of information and attempts to encourage adoption of adjustments. The psycho-physiological component, it was suggested, could apply by means of normative influences: people's beliefs about the action preferences of significant others in the community, can affect individuals by motivating imitative behaviours. Thus, the perceived views of opinion-makers could potentially promote, or deter, adjustment behaviours.

Gist and Mitchell (1992) examined the antecedents of efficacy judgements and how these might be changed (in employment situations, rather than health settings); they found that highly self-efficacious individuals will persevere even in the face of failure, thereby overcoming negative feedback inputs. This might help to explain why such individuals could still be prepared to try innovative solutions to a problem such as flooding, even if initial efforts (such as traditional sandbagging) had been tried and found wanting. Here again, the nature of a personality characteristic (high or low self-efficacy) can be seen to drive or inhibit (respectively) behaviours in relation to disaster preparedness.

Both the concepts of locus of control and self-efficacy have been employed as elements within models of human behaviour, which have informed behavioural change research, as will now be examined.

#### 4.4 Theories of change - Planned behaviour

The 'Theory of Planned Behaviour' (hereafter TPB) was originated by Ajzen (1991); as shown in Figure 4.3a intentions are influenced by attitudes, subjective (social) norms and perceived behavioural control (hereafter PBC). A subsequent modification (2002) is shown in Figure 4.3b which further clarified that self-efficacy and controllability are separate components that together comprise the higher-order concept of PBC.

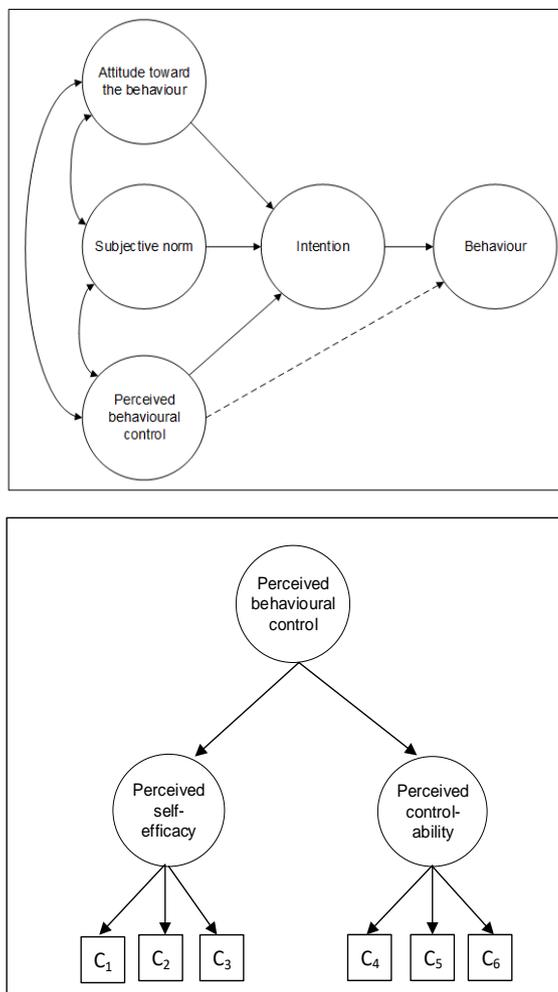


Figure 4.3 a) Theory of Planned Behaviour; and b) Hierarchical model to show relations among perceived self-efficacy, perceived controllability, and perceived behavioural control

(after Ajzen 1991 and 2002 respectively) Used with permission of the publishers

It should be noted that the 'subjective norm' component here is typically measured by asking people to rate the extent to which 'important others' would approve, or disapprove, of a given behaviour (Ajzen, 1991). This, therefore, has interesting parallels with the 'Powerful Others' type of external locus of control discussed previously. Ajzen (1987) also states that the relative weights of all three factors (shown in Figure 4.3a) are important determinants of intention, and, thus, enacted behaviours; furthermore, these relative weights may vary from one person to another. Thus, it might be expected that people who ascribe less weight to the potential disapproval of others would be likely to score low for 'LoC-Powerful Others' as they would be less susceptible to social pressures when forming intentions.

Armitage *et al.* (2002) report on studies in which the TPB variables, including PBC, were compared with the MHLC variables in the context of prediction of health behaviour change (for example binge drinking, or drink-driving). PBC was found to explain 21% variance, while the MHLC variables as a whole explained only 4% variance. Luszczynska and Schwartz (2005) use this as the basis for suggesting that PBC is of higher predictive value across such behaviours than the MHLC, but also note the latter's power would increase if the dimensions could be defined in an outcome-specific way.

This approach has many similarities to the integrative model originally developed by Fishbein and Cappella (2006) in bringing together the variables identified as being essential in predicting and understanding given behaviours. Fishbein and Cappella (2006) utilise this integrative model of behavioural theories in the context of developing communications designed to promote healthy behaviours, or to alter/prevent unhealthy behaviours (Fig 4.4).

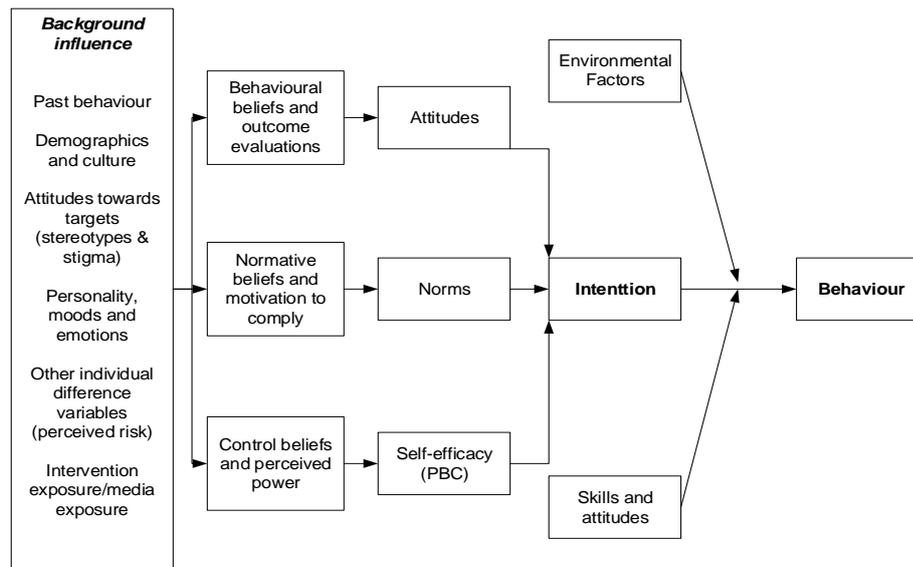


Figure 4.4: Integrative model (after Fishbein and Cappella 2006)

*Used with permission of the publisher*

Thus, background influences include both past behaviour, risk perception, cultural and social factors and exposure via the media, all of which contribute to the formation of intentions regarding behaviour via belief systems, attitudes and norms as well as self-efficacy. Intervening, however, between intention and the behaviour itself are both environmental factors and skills/abilities: a person may be unable to act on an intention if resources (financial or otherwise) are insufficient for the purpose, or if disadvantaged by physical or other disabilities.

In order to elicit desired behaviours consistent with this model, messages designed to change intentions would need to be based upon an understanding of the attitudes, perceived norms and self-efficacy that determine (thus driving, or acting as a barrier to, the enactment of) those intentions. Such knowledge does not, however, provide the key to changing those variables: this is dependent upon the preceding stages of behavioural, normative and control beliefs. Identifying these critical beliefs is, therefore, highly relevant to the policy-making bodies that design and deliver warning messages regarding natural, and other hazards, as well as health-promotion campaigns.

#### 4.5 Theories of change - Paton's social-cognitive model

A model specific to hazard preparedness behaviours was proposed by Paton (2003) and is founded in social cognitive theory, as shown in Figure 4.5. It incorporates a three-phase process, the first of which involves factors contributing to the motivation (or lack of same) to prepare; the second phase covers influences on how intentions are formed, and the final stage shows the additional factors which may moderate the inclination to act, thus dictating the final decision. It should be noted that the term 'outcome expectancy' (within intention formation) was described by Bandura (1997) as being an individual's judgement of the likely consequences of their actions; positive expectations serve as incentives, the negative ones as disincentives.

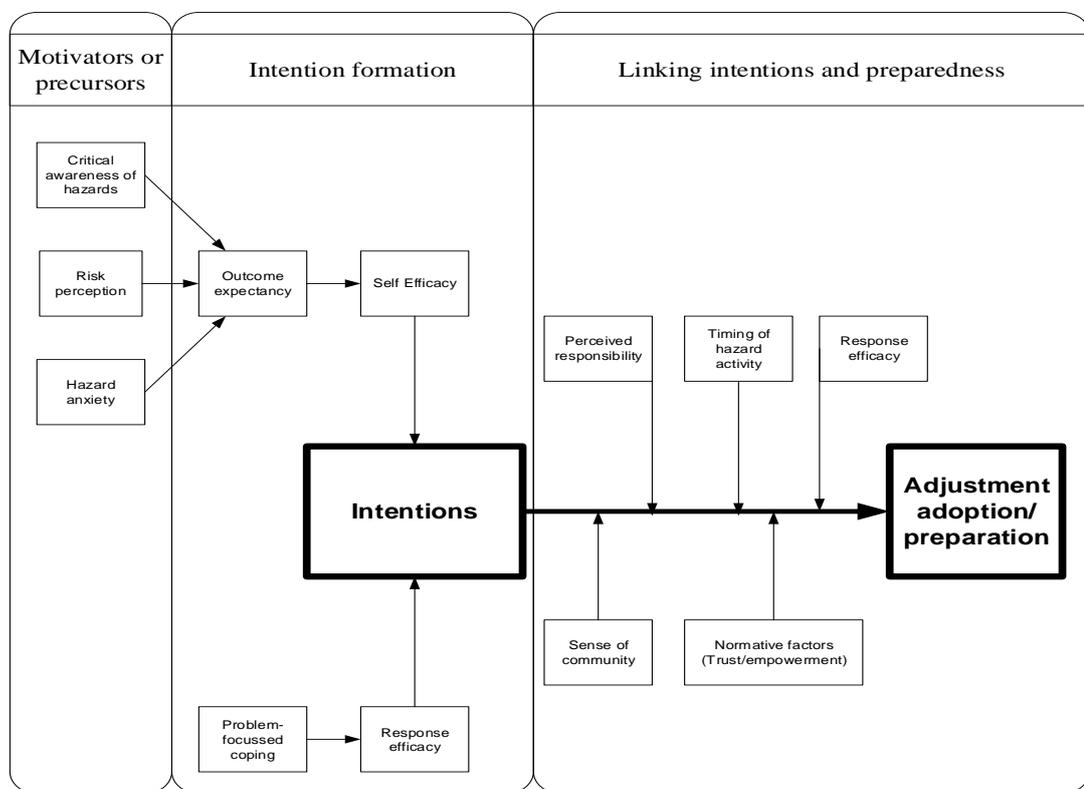


Figure 4.5 A social-cognitive model of disaster preparedness

(after Paton, 2003). Used with permission of the publisher

Later versions of the model mention fatalism and locus of control as examples of such expectancies (for example, Paton, 2006). The term 'response efficacy' (which appears in two phases here) different covers a very similar concept which relates to the perceived (as opposed to actual) effectiveness of the behaviour concerned. This model was subsequently modified, owing to issues arising from the 'critical

awareness' variable, as detailed in Paton *et al.* (2008a); self-efficacy has continued to feature as an element of 'coping appraisal' in subsequent investigations, however, for example (Paton *et al.*, 2015; Adhikari *et al.*, 2018).

#### 4.6 Theories of change - Generalised self-efficacy

Leganger and Kraft (2003) examined the links between socio-economic status and health behaviour (consumption of fruit and vegetables by women; n = 80). Their 'combined model' (shown in Figure 4.6) is the first to be reviewed in this thesis that employs the concept of 'generalised self-efficacy' (GSE), and there is an important distinction to note between GSE and SE. Bandura himself (1977, p194) acknowledged that some life experiences could lead to a more 'generalized' sense of efficacy, which could extend beyond the specific task in hand. Individuals who have had an array of successful experiences could, therefore, carry a 'global' expectancy of success into future novel situations; this led to the creation of a non-task-specific scale (Sherer *et al.*, 1982) which was then developed further by Schwarzer *et al.* (1995).

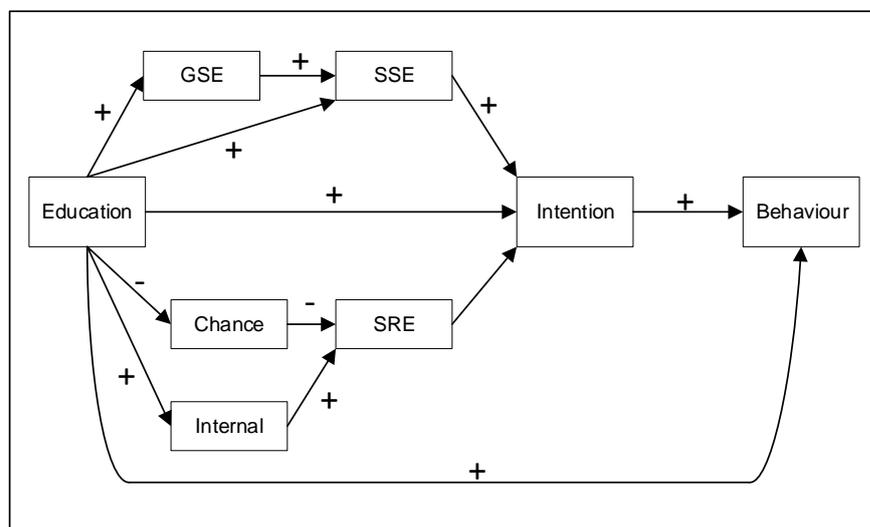


Figure 4.6 The hypothesised model

- effect of education upon fruit/vegetable consumption

(after Leganger and Kraft, 2003) Used with permission of the publisher.

**Legend:** GSE = general self-efficacy; Chance = chance health locus of control; Internal = internal health locus of control; SSE = specific self-efficacy; SRE = specific response efficacy.

Leganger and Kraft (2003) also utilised Schwarzer *et al.*'s (1995) GSE scale for their study, along with other control belief metrics, and found that higher self-efficacy and response efficacy control beliefs were the key variables mediating the education–intention/behaviour relationship, yet acting in opposite directions. Higher educational attainment was positively associated with a ‘global’ sense of efficacy which, in turn, positively influenced efficacy in relation to the specific domain of interest. A negative association was found to exist, however, between education and both LoC-chance and response efficacy, indicating that women having less education were more likely to attribute health outcomes to chance happenings. Both types of control construct were, therefore, of relevance but to different groups of people.

It can now be seen that a number of instruments, many of them largely originating within the field of health studies can, nevertheless, be utilised to examine behaviours in a variety of environments. This includes the fields of pro-environmental behaviour, disaster response and natural hazard preparedness and some of the most relevant studies in these areas will now be discussed.

#### 4.7 Theories of change - Pro-environmental behaviour

Kollmuss and Agyeman (2002) examined a variety of theoretical frameworks in an attempt to explain the ‘gap’ between the possession of environmental knowledge/awareness, and the display of pro-environmental behaviour, such as energy conservation measures. This was in the context of the identified need to increase responsible environmental behaviour (hereafter REB) by citizens of the USA and, indeed, other countries worldwide. They noted that the assumption that more knowledge will lead to more enlightened behaviour is overly simplistic, although many organisations persist in following this model. They concluded that the subject is of such complexity a single diagram cannot capture all relevant factors, but the single most important barrier to pro-environmental behaviour is overcoming old behaviour patterns.

One of the studies cited, Hines, Hungerford and Tomera (1987), consisted of a meta-analysis of previous studies in order to identify those variables which were most influential in motivating (or driving) individuals to take responsible environmental

action (the desired positive outcome). They concluded there were three major categories of variables influencing such behaviour, namely cognitive, psycho-social and demographic (or situational) factors and incorporated these into their proposed model of REB. The psycho-social group included a trait labelled by the researchers as 'locus of control'. It is made clear in the paper, however, that this term was employed to cover a factor of 'efficacy perception' (which describes an individual's effectiveness in a given situation), in addition to locus of control in the strict sense of the term (which is a measure of general control beliefs). (As this study covered research over the period 1971 to 1987, it is conceivable that some of the later source information may have been referring to Bandura's (1977) 'self-efficacy' concept). The corrected correlation coefficient reported as 0.365 (SD 0.121) for the relationship between 'locus of control' and REB must therefore be viewed in the light of this caveat; this is of particular importance as this factor was found to be the second strongest variable of all those identified.

The results also included a mean correlation between pro-environmental attitudes and pro-environmental behaviour of  $r = 0.38$ ; between locus of control/efficacy perception and pro-environmental behaviour of  $r = 0.37$  and between the 'felt moral obligation' to behave in a pro-environmental way and pro-environmental behaviour of  $r = 0.33$ . The conclusions include the observation that the personality components of their model are less readily influenced by educational efforts than the knowledge and skill elements; they recommended further research could usefully investigate factors leading to development of an internal locus of control, amongst other aspects.

#### 4.8 Theories of change - Diffusion of innovations theory

Rodrigues (2007) analysed the communication mechanisms, as well as the psychological and cognitive variables, operating in adoption of REB. Utilising the 'diffusion of innovations' theory of Rogers (1987) a distinction is made between the way information campaigns (constituting a 'mass communication' channel approach) are effective in generating knowledge of new ideas, but 'interpersonal channels' are more effective in influencing attitudes and behaviours towards those ideas. The use

of stakeholder engagement processes, for example, would be consistent with this 'interpersonal channel' approach.

Rogers (1987) also proposed five categories of adopters of innovation, according to the stage at which people engage with a given idea: the first tranche are termed 'innovators', who constitute 2.5% of the population and are characterised as risk tolerant, of high social class and possessing the financial resource to absorb failure. The next tranche (13.5%) is termed the 'early adopter' type and tend to be opinion leaders, again of high social class and with both greater financial resources, and higher education levels, than the later-adopting groups. Forming the remainder of the normal distribution are groups described as 'early majority'; 'late majority' and 'laggards'. People may, however, fall into different categories depending upon the type of innovation under examination. It is interesting to speculate how these categories might correlate with, for example, the respondents' locus of control scores and/or a 'coping styles' analysis. (Baumann and Sims (1978) found links between LoC score and coping styles: 60% of those scoring high for internal locus of control had purchased flood insurance; 43% of those whose scores were in the mid-range were also insured; but only 35% of the externally-oriented respondents were insured).

The concepts discussed above, in particular the different communication channels appropriate for influencing cognitive and psycho-social characteristics respectively, should be borne in mind as we now turn to the factors influencing natural hazard and climate change preparedness behaviours.

#### 4.9 Theories of change - Natural hazards and climate change preparedness

Mileti (1995) discusses personality factors pertaining to disaster warning responses, and notes consistent correlations between internal locus of control scores and behaviour; warnings need to be heard, believed, personalised and acted upon in order to be effective, and these behaviours are more likely to be found in internally, rather than externally, oriented people. The latter may, for example, perceive the warning to be 'someone else's problem', which will influence their decisions regarding what, if anything, to do about it. The conclusion includes a

recommendation that social psychology be incorporated into the design of warning systems, if these are to elicit the desired responses. Similarly, Tierney (2001) noted locus of control is correlated with warning compliance in the US, but also highlighted the considerations that need to apply in a multi-ethnic society: some groups of people display culture-specific distributions of internal/external locus scores, as well as in-group beliefs such as fatalism, or scepticism regarding science. Tierney (2001) also suggested a paradigm shift was required by the US agencies dealing with disaster warnings: from reactive, event-focussed procedures, to a pro-active and comprehensive approach, including the building of consensus views and integration of hazard management into the activities of grassroots community organisations. This would be consistent with the 'interpersonal communication' channel approach discussed in the previous section.

McClure *et al.* (1999), studying attitudes to earthquake damage in New Zealand, examined measures of locus of control and propensity to take risks in relation to preparation for earthquakes, and judgements about earthquake damage. This was in order to test which of the two constructs provided the stronger predictor of the two behaviours. Using two samples, students and non-student members of the public, it was found that a more internal locus was more likely to be associated with judgement that distinctive (as opposed to global) earthquake damage was preventable, in the student sample. Low risk-takers from both samples, however, were more likely to have made preparations for earthquakes; they concluded attitude to risk was a stronger predictor of behaviour in this instance. Sattler *et al.* (2000) investigating disaster preparedness relating to hurricanes in the US, found that age, prior experience of a hurricane and locus of control score were amongst the predictors of preparation behaviours (in other words, these factors acted as drivers of preparedness). They recommend future research should examine the role of perceived behavioural control and self-efficacy, as well as constraints to problem focused coping, such as resource availability and the strength of social support networks. Spittal *et al.* (2008) distinguish between two types of action in relation to earthquake preparation: damage mitigation actions, such as securing furniture to walls, and survival actions, such as storing water, food supplies or battery operated

radios. Of the many variables examined in this study, only home ownership and locus of control served as predictors of actions that mitigate damage.

A key characteristic of climate change adaptation is, however, the inherent uncertainty around the causes, and indeed for some individuals and groups, doubt as to the existence of the problem itself; this is in direct contrast to studies in the health sphere, where issues such as drink-driving, stress and disease diagnosis are self-evidently real. Blennow and Persson (2009) examined the roles of strength of belief in climate change itself, and strength of belief in personal adaptive capacity, in the context of adaptations to forestry management in Sweden. They identified a significant positive association between the first characteristic and adaptation actions, and a significant association between lack of such belief and motivation for not adapting. The key de-motivating factor was the perceived lack of adaptive capacity, linked to lack of knowledge, or understanding of how adaptation could be undertaken. Thus, the pre-requisites for positive adaptation were strong beliefs in the hazard itself, and the belief that, as an individual, a person has the power to do something about the hazard.

#### 4.10 Theories of change - Protection motivation theory

Some studies on the cognitive factors affecting adaptation to anthropogenic climate change have also been undertaken in recent years, challenging the dominant socio-economic and political models, which had typically focussed upon resource constraints as the primary determinants of adaptation behaviour, including Adeola (2003), and Smit and Wandel (2006). In contrast, Protection Motivation Theory (Floyd *et al.*, 2000) has been derived from the field of psychology and health behaviours, as were the constructs of locus of control and self-efficacy. Grothmann and Patt (2005) noted that PMT had (at the time) only been utilised in two previous works on hazard adaptation, one in an applied setting on earthquake preparedness (Mulilis and Lippa, 1990) the other being a theoretical paper by Krömker and Mosler (2000).

A socio-cognitive process model was developed (Fig 4.9) in which 'bottlenecks' in the decision-making process, that could lead to avoidant maladaptive responses are identified (Grothmann and Patt, 2005 p204). Grothmann and Patt (2005) tested the

explanatory power of the ‘model of private proactive adaptation to climate change’ (hereafter MPPACC) by means of two case studies, the first on adaptations to flood threat from the Rhine in Germany, the second on changing farming practices in response to rainfall prediction in Zimbabwe.

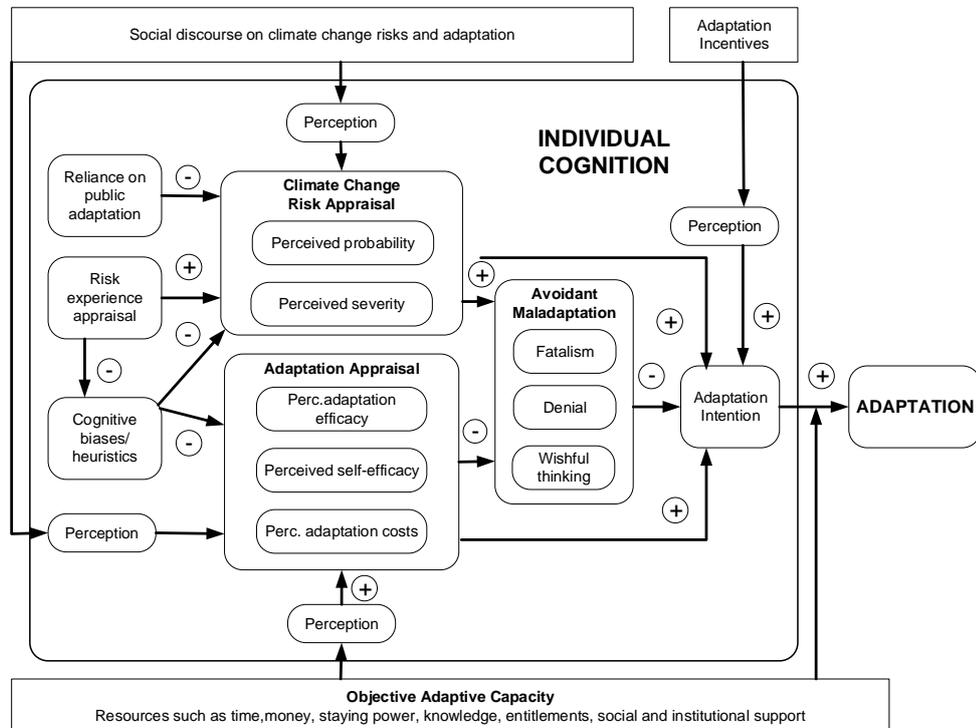


Figure 4.7 Process model of private proactive adaptation to climate change (MPPACC)

(after Grothmann and Patt 2005) Used with permission of the publisher

The findings were that this socio-cognitive model provided better statistical power than traditional socio-economic models in the first study; in the second a qualitative match between the model and behaviours was identified, together with attitudinal changes generated by participation in the study itself, which entailed repetitive analysis of decisions and role-playing activities. This latter finding could be a useful topic for further research; participation in the study might also be seen as a form of interpersonal communication, in line with the theory discussed above. It must be reiterated, however, that the MPPACC was explicitly formulated (Grothmann and Patt, 2005)(p203, footnote 2) to model maladaptive (non-protective) behaviour processes, rather than those actions resulting in positive adaptation. An attempt to explain the behaviours of the ‘anticipatory adapter’ group of householders at flood

risk (as discussed in chapter 3) would, therefore, require further modifications of this model, as the focus would be upon drivers of preparedness, as opposed to barriers to their adoption.

Further use of PMT has been documented, either as originally devised or in extended form: for example, Cismaru *et al.* (2011) review 11 climate change campaigns that employed some elements of the theory in attempts to construct persuasive messages. Dittrich *et al.* (2016) employed an adapted version to explore the impact of flood groups in Scotland on the adoption of four mitigation measures (insurance, flood warnings, sandbags and floodgates). Amongst homeowners who had already experienced flooding, it was shown that adaptation efficacy was positively influenced by joining such a group (in other words, membership acts as a driver of the desired behaviour).

#### 4.11 Key factors implicated in hazard adaptation

Similarities may be noted between the components of MPPACC as just discussed, and those appearing in the integrative model (discussed earlier), proposed by Fishbein and Cappella (2006), such as perceived risk and self-efficacy, in the context of health communications. There are also elements derived from decision-making theory (heuristics and biases), mal-adaptive coping styles (denial) and belief systems (fatalism, equivalent to a chance/luck locus). An additional component, of particular relevance to flood coping strategies, is 'reliance on public adaptation'; for example, where there is an expectation that public agencies will, or may, provide flood alleviation schemes, this could deter people from taking action themselves. Influences external to the individual are also shown as impinging on more than one stage in the process; for instance, social discourse affects both the perception of risk and the perception of adaptation options, thus paralleling the norms/attitudes influence on behaviour of Fishbein and Capella's (2006) model, as well as the interpersonal communication channel element of Rodrigues' (2007) argument.

None of the theories discussed, however, has been developed, or tested, in the context of flood risk mitigation in a UK population, and this indicates the existence of a research gap warranting further exploration. It is, therefore, suggested there is a

need for developing a model, specific to flood hazard adaptation in the UK, incorporating both the locus of control and self-efficacy concepts as potential explanatory factors. There is also an argument for identifying the drivers of preparedness behaviours (which may have the potential to be supported and strengthened) as opposed to the focus on overcoming barriers which has prevailed thus far.

#### 4.12 Summary

In this chapter, two key constructs that underpin major theories regarding behaviour change have been introduced, both of them capable of quantitative measurement. A range of theories of change, including models that have already been explored in connection with natural hazard response, were then critically examined. The chapter concluded by positing the need for a UK-specific model of behaviour change in relation to property level flood mitigation adoption.

# CHAPTER 5 – TOWARDS A CONCEPTUAL FRAMEWORK OF UK FLOOD-RISK POPULATION BEHAVIOUR

## 5.1 Introduction

In this chapter the fourth objective specified in section 1.5 will be addressed. Existing UK-specific research into flood mitigation behaviour in at-risk households will be critically reviewed, followed by an examination of key factors that act as drivers of behavioural change, as distinct from those inhibiting adaptation. The relationships between personality factors, social factors and situational factors are then explored in the flood adaptation context. The chapter concludes by presenting a conceptual framework predicated on explaining (as opposed to predicting) positive behavioural changes in the population of interest; this will be set in the context of UK flood risk management regime and be specifically guided by UK research. The developed framework will also identify the relationships already well established through existing UK research and the gaps still requiring empirical examination.

## 5.2 UK flood behaviours research

The Environment Agency is currently the lead organisation regarding flood risk in England and its sponsoring department is Defra (Department of Environment, Food and Rural Affairs); the start point for this section will be to examine the theoretical basis known to underlie Defra's changing policies as regards flood protection behaviours

Research was commissioned by Defra (2008b) which was specifically designed to improve the take-up of flood protection and resilience by both householders and businesses. The resultant consultation document (Defra, 2008a) acknowledged (Annex A, page 35) that a complex mix of barriers deters householders from adopting property-level protection and resilience measures, highlighting the following three:

- the impact of insurance on the financial benefit, for a householder, of taking protection and resilience measures;
- the perceived costliness of mitigation measures;

- the argument that the state has already reduced the risk sufficiently by implementing community level risk mitigation measures.

The issues around psycho-social constructs are also acknowledged, albeit briefly, the source cited being Harries (2008a):

*“These factors are complemented – and perhaps sometimes motivated – by a desire to avoid anxiety about flood risk and represent it as negligible or as someone else’s responsibility.”*

As shown (Figure 5.1) a model proposed in 2008 included the latter barrier, terming it ‘anxiety-avoidance and denial’, going on to link this (via ‘Be aware of flood risk’ as the journey stage) to ‘Reduce potential anxiety by promoting simple risk reduction measures’. The suggested policy option in relation to this type of barrier is ‘Provide information on mitigation measures’: the implication being that a psychological state, anxiety, might be mitigated by provision of information, which runs contrary to the evidence discussed previously (Section 3.3.2).

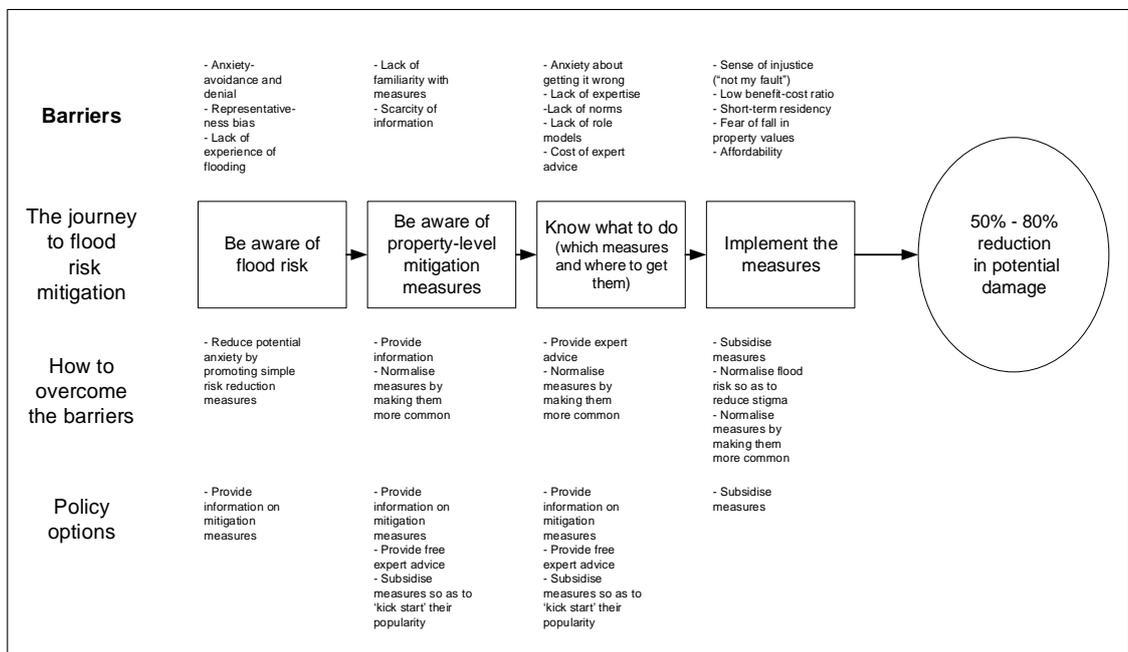


Figure 5.1 Factors that can prevent householders from taking property level protection and resilience measures

(after Defra 2008, 'Consultation on policy options for promoting property-level flood protection and resilience FD2607,(p11)© Crown copyright 2008

Another barrier, 'Lack of familiarity with measures' did, however, mention the need for normalisation of measure adoption in several places and also suggested a way of enhancing their 'popularity' via subsidies. It may be noted that a recurring policy option suggested, in addition to information provision, was to offer financial subsidies for measures: this approach is consistent with influencing an economic driver of residents' behaviour, this being one of Hines *et al.* (1987) 'situational factors'.

Both of these suggested policy areas have been pursued; firstly, specialist flood awareness officers were tasked with engaging with the residents of those flood risk areas known to be low in awareness (for example, Catalyst Stockton-on-Tees, 2018; Environment Agency (Wales), no date). Their remit was to provide one-to-one advice and information on the steps that can be taken before, during and after flood incidents; in behavioural model terms, this approach, whilst still seeking to influence cognitive factors as identified by Hines *et al.* (1987), does so by means more closely resembling the 'community participation' and 'empowerment' factors of Paton *et al.* (2008b). Secondly, the financial subsidy of mitigation measures was the subject of a pilot study from 2008 onwards, as already discussed in Section 2.7.2 (Defra, 2009). One of the stated aims of the latter initiative, however, was to review attitudes towards resistance and resilience measures, both before and after the project; no specific results of this appear in the executive summary on the scheme outcome, although the relative popularity of the two type of mitigation are provided:

*'...of the residential properties, 173 opted for resistance solutions and three chose a mix of resistance and resilience. The corresponding figures for the commercial properties were 21 and 1, respectively.'* (Defra and Goudie, 2009)

Awareness of the options had, however, increased even if the intention to pursue them was still absent:

*"... following the pilot project the interest of those surveyed in resilience solutions had increased to about 25% from less than 10%, but the local view was that there needed to be an external catalyst to escalate interest to action."*(Defra, 2008c)

The effects of the subsidy scheme on changing attitudes to flood-risk remains unclear. The published details of a subsequent workshop (Defra and Goudie, 2009) do, however, include brief details of types of concern still being expressed by at-risk householders:

- *Want my home to be comfortable and attractive* 26%
- *Not my responsibility* 19%
- *Worry about property values* 25%
- *Don't want to be reminded of the risk* 17%

The inclusion of three non-financial barriers highlighted the need for flood mitigation uptake to be viewed more explicitly as a behavioural change issue.

In order to expand the current understanding of flood risk behaviours in the UK, another relevant publication by Defra will now be discussed.

#### 5.2.1 Behaviour change approaches

In 2008, Defra commissioned an extensive review of behaviour change models, intended to address issues across a broad range of policy areas (Darnton, 2008) although flood-related challenges were not specifically addressed. Over 60 social-psychological behaviour change models were examined, largely from the academic literature, including the works of Ajzen (2002), Bamberg and Moser (2007), Bandura (1977), Kollmuss and Agyeman (2002), and Slovic (2007), (as covered in the preceding chapters), amongst many others. Furthermore, whilst acknowledging the two areas are closely related, Darnton (2008) draws a clear distinction between the use of models of behaviour *per se* (typically linear in form) and theories of change (typically circular feedback loops); the former seek to identify the factors underlying and influencing specific behaviours, while the latter are concerned with the identification of intervention techniques successful in changing behaviour, and thus appropriate for underpinning policy design and delivery. The work also advances a reason as to why changing behaviours poses such a challenge to policy makers: the sheer diversity of factors at play in social-psychological models.

Looking ahead to use of this information in policy development, Darnton (2008) makes the point that change is a process, not an event, and interventions must be designed to be flexible in relation to different audiences and contexts. The work

concludes (page 68) by advancing nine principles, designed to guide behaviour change practices across Defra, along with a listing of behavioural types matched to appropriate models and key factors; for example, 'voter turnout' and 'condom use' are both paired with the Theory of Planned Behaviour (TPB) (Ajzen, 1991), whilst 'coping (involving risk)' are linked to Protection Motivation Theory. Self-efficacy, as a factor affecting behaviours, is covered in some detail (pages 19-20 and others) both as a component of the 'planned behavioural control' factor, within the TPB (Ajzen, 2002), and also as part of Kollmuss and Agyeman's (2002) REB model. It is specifically cited as a key factor in the 'condom use' and 'giving up smoking' behaviour types, and also appears (page 61) in relation to Knott *et al.*'s (2008) 'Cultural Capital Framework'. Self-efficacy is acknowledged as being influenced by experience, not only personal, but also vicarious; as discussed in previous chapters, experience (of different kinds) is an aspect of interest in flood preparedness behaviours. As mentioned earlier, however, flood-related issues were not addressed within the report and, therefore, relevant models from the disaster preparedness literature were not included in the review. The absence of reference to the works of Grothman and Patt (2005) or Paton's extensive work from 2003 onwards (as discussed in Section 4.5) results in the omission of other potential applications of both the self-efficacy and locus of control concepts.

The theory of 'diffusion of innovations' (Rogers, 2003), and the associated change through social networks, was originally developed for the adoption of new products and technologies, rather than behaviours. Darnton (2008 p45) notes, however, that to promote pro-environmental behaviours, Defra was already starting to explore the related concept of 'mavens': these are people who act as 'information brokers, sharing and trading what they know' (Gladwell, 2000 cited in Dawnay and Shah, 2007). As the adoption of flood risk measure essentially requires changing behaviours *in conjunction with* product/technology acquisition (where relevant to a property), this would suggest a similar approach could also be applicable in this sphere.

Despite the readily available guidance on potential ways forward discussed above, and the policy initiatives that were subsequently explored, seven years later the uptake of property level mitigation continued to be low: a small scale survey in

Worcester found only 23% of homeowners (n = 39) had adopted any measures (Brown and Wedawatta, 2015). In 2015, Defra launched a research project to identify low-cost flood resilience repair measures (water entry strategy), which again focussed primarily on overcoming economic barriers to flood mitigation (Lamond *et al.*, 2017) but which also incorporated consideration of the behavioural change aspects, in particular acknowledging the challenges of normalising water-entry (as opposed to water exclusion) as a strategy for addressing flood risk. An explanatory model of the drivers of mitigation behaviours in the UK, some of which might be strengthened in order to improve flood resilience still, therefore, appears to pose a continuing gap in the research landscape.

Models incorporating behaviour change in natural hazard contexts will now be reviewed, with the aim of identifying which, if any, might be suitable for the UK flood risk population, together with identification of any modifications that may be warranted in the interests of achieving maximum explanatory power.

#### 5.2.2 Behaviour change modelling for flood preparedness

Although studies from the developed world will predominantly be discussed (Europe, Australasia and USA) as being the most readily comparable to the UK context, some pertinent results from the developing world are also cited, where relevant.

##### 5.2.2.1 Accounting for the effects of experience

A study from Germany (Kreibich *et al.*, 2011) examined private households' and businesses' flood preparedness, following two major events in the same area within a period of four years; the percentage of private households effectively protecting household contents, rose from 51% (in 2002) to 92% (in 2006), whilst the percentage effectively preventing water from entering buildings, increased from 16% (in 2002) to 59% (in 2006). This study is, however, based upon a learning model, rather than any of the behavioural change models, and the results are explained by the phenomenon of 'double loop' learning by the responsible authorities (Figure 5.2). The combination of direct experience, by residents and government alike, as well as intervention programmes, was seen to result in behavioural change between the two consecutive flood events.

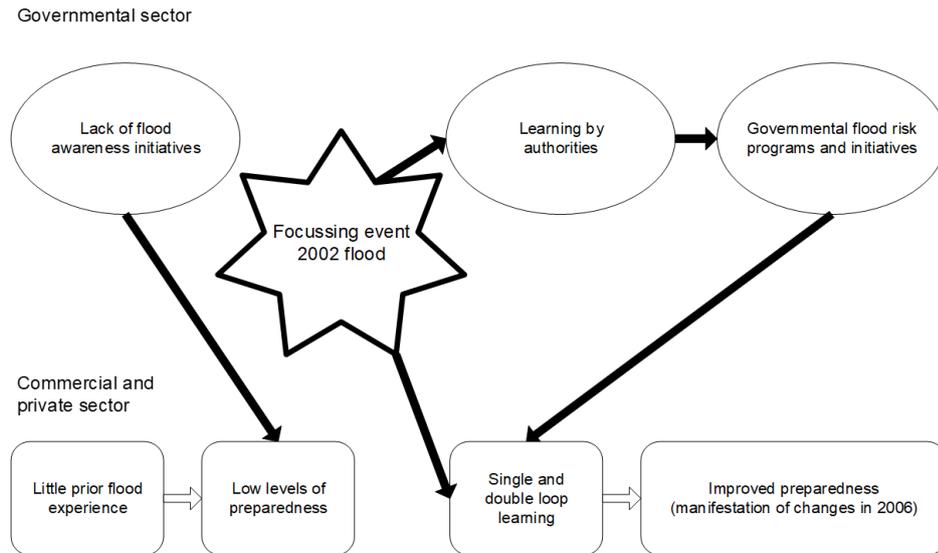


Figure 5.2 Changes due to the 2002 flood as a 'focussing event'

(after Kreibich *et al.*, 2011) Used with permission of the publisher

A potential mechanism for the effect of experience was also suggested by Begg *et al.* (2017), again in Germany, whereby experience changes the citizens' perception of 'response efficacy' (the belief that protective actions will be effective) and thus enhances acceptance of their responsibility for mitigating flood damages. Both the effect sizes and the explained variance were, however, reported as being rather small as regards appraisals of response efficacy, responsibility and participation (n=1380).

These figures form an interesting contrast to the available statistics for a UK 'at-risk' population: as reported by Harries (2008a), 6% of those with no experience of flooding (thus, approximating to the pre-2002 baseline in Kreibich, 2011) had taken any action to prepare for floods and reduce possible damage, whilst for those with flood experience (thus, resembling the pre-2006 situation) the figure rose to 39%. Although the success rates for the German residents far exceed those in the UK study, the effect of experience is clearly of importance in both instances. The theoretical basis of the latter work again pursues a model from a field other than behavioural change, as it finds these wanting in explanatory power, instead exploring the use of reward-based methods to bring about flood-related (and other) behavioural changes.

In terms of the mechanisms by which experience exerts this effect, Weinstein (1989) suggested past exposure leads people, not only to think about a particular risk, but to do so with greater clarity (p 47):

*'... attitude researchers have shown that thinking about an issue frequently has a tendency to increase the consistency between beliefs and behaviour. The vividness, concreteness, and certainty of thoughts originating in personal experience should also increase their impact on behaviour'. (Weinstein, 1989 p47)*

The second point is supported by Siegrist and Gutscher (2008), in a Swiss study as discussed in a previous chapter of this thesis: those without flood experience envisaged the consequences of a flood differently, the explanation being that they underestimated the 'negative affect' associated with property inundation. This characteristic of floodplain residents could, therefore, be seen to be in the realm of attitudes and beliefs, and thus related to personality factors, or it could form part of a rational assessment of cognitive skills and abilities, with a resultant over-estimation of their capabilities to deal with the hazard. An earlier study, however, by the same authors (Siegrist and Gutscher, 2006) included a short but important observation:

*" ... the experience factor was related to respondents' own experiences with flooding or those of neighbors." (this author's underscoring).*

This clearly suggests that vicarious experience gained from neighbours, who had themselves lived through such 'negative effect' events, is capable of modifying the perception of risk in those from unaffected households.

Lindell and Hwang (2008), in examining household response to hazards (including floods) in the USA, found that both hazard experience and perceived personal risk partially mediated the response behaviour. Terpstra (2009) offers an explanation for this, predicated on Lindell and Perry's (2000) 'Protective Action Decision Model' (PADM), which considered earthquake adjustments in a US population: 'dread' levels (feelings of fear/uneasiness in the face of risk) in a Netherlands population were found to be strongly affected by previous experience of flood hazard. The situation in the latter country, internationally known for its extensive flood defences is,

however, something of a special case: as the dike structures are built to design standards exceeding a 1 in 1250 year flood (Terpstra, 2009) the residents are, for the most part, protected against all but the most extreme events, which would be associated with catastrophic loss of life and property. Caution must, therefore, be exercised if seeking to extrapolate from the Netherlands findings to other countries such as the UK.

Finally, experience of various kinds form a key component of Bandura's (1977) self-efficacy concept, as discussed previously; the sources of information (in the widest sense) contributing to an individual's perception of their efficacy, in relation to a specific task, arise from four sources, as follows:

- performance accomplishments
- vicarious experience
- verbal persuasion
- physiological states

Without direct, personal experience of dealing with flood impacts, the first source is not available to many of those at flood risk; the second could, however, impact upon those whose relatives, friends, neighbours or co-workers experienced a flood, even though they themselves had not. The exhortation/persuasion approach is that most commonly provided by the authorities and which, in flood risk populations, has been found largely ineffective; the final source, however, involving emotional arousal (for example, symbolic exposure) could be seen as tapping into similar concepts as both the 'negative affect' and 'dread' explanations discussed above. The use of models incorporating self-efficacy, and closely related concepts, as explanatory factors in flood risk behaviours will now be examined in greater detail.

#### *5.2.2.2 Psychological factors*

Lindell and Hwang (2008), as discussed above, included the factor of 'perceived personal risk', as well as hazard experience, in their proposed causal path to adoption of hazard adjustments. Expressing some disappointment in the results obtained, they noted (p 551) that there were some 'important components of perceived personal risk' not measured in their study. As psychological characteristics of households ('receiver characteristics') had previously been incorporated in Lindell and Perry's

(2000) version of the (PADM), this suggests the contribution of such factors is important in the development of intentions to adopt hazard adjustments. Within PADM, however, it should be noted the term 'efficacy' is used to denote the purely practical meaning of the resource requirements required for hazard adjustment, NOT the individual's perception of 'self-efficacy' in dealing with a hazard, which will be discussed in the next section.

### 5.2.3 Self-efficacy

Increased self-efficacy, as a factor within Protection Motivation Theory (PMT), has been found to facilitate adaptive, rather than maladaptive coping behaviours in a disease prevention context (Floyd *et al.*, 2000) as discussed previously; it has also been identified as an important factor in wildfire protection behaviours in the USA (Martin *et al.*, 2007). The Model of Private Proactive Adaptation to Climate Change (MPPACC) of Grothmann and Patt (2005), as discussed previously, built upon the foundation of PMT to formulate a process model, specific to adaptation to climate change; subsequently, a model of flood adaptation behaviours in Germany, was developed (Grothmann and Reusswig, 2006), and perceived self-efficacy is included within the 'coping appraisal' group of factors within this model.

Bamberg and Moser's (2007) found perceived behavioural control (PBC) was one of three powerful predictors of intention, explaining on average 52% of the intention construct; as discussed in a previous chapter the PBC concept (Ajzen, 1991) has two components, perceived self-efficacy and perceived 'controllability' (belief systems linked to locus of control), hence the contribution that may be made by these factors separately is not identifiable in these studies. It is, however, worth considering the relationship between one particular form of self-efficacy and optimistic self-belief: Schwarzer *et al.* (1996) regard generalised self-efficacy (GSE) as being interchangeable with optimism, which offers the possibility of measuring an emotional driver of behaviour by quantitative means. It should be borne in mind that self-efficacy is (more usually) a measure of task-specific performance beliefs, whereas locus of control describes an individual's generalised belief system, as will now be discussed.

#### 5.2.4 Locus of control

Baumann and Sims (1978), as discussed in the previous chapter, had found that internal-external locus of control was a factor significantly related to purchase of flood insurance: 60% of the internally-oriented respondents had purchased flood insurance, but only 35% of the externally-oriented had done so. More recently, Spittal *et al.* (2008) reported locus of control was a predictive variable for actions mitigating earthquake damage. Mishra *et al.* (2009) demonstrated that, whilst prior experience and knowledge of protective actions significantly facilitated hazard preparedness (including flood hazard), this relationship was mediated by locus of control orientation. Those with disaster experience and awareness were thus found to be less prepared if they had external, rather than internal, control orientation; this suggests other relevant factors can be weakened by the presence of this dispositional characteristic.

#### 5.2.5 Relationship between self-efficacy and locus of control

As mentioned previously, some authors have suggested that self-efficacy and internal locus of control may be different facets of the same 'core construct' (for example, Judge *et al.*, 2002). By contrast, Urbig and Monsen (2009) using a measure of 'General Self-efficacy' and a slightly shortened version of Levenson's IPC scale, found that locus of control and efficacy beliefs could be distinguished using factor analysis techniques.

#### 5.2.6 Fatalism

As discussed in a previous chapter, the MHLC scales of Wallston (2005) measured health-specific locus of control along three dimensions: internal, fate/chance and 'powerful others'. The second element, also termed 'chance/luck locus', represents an essentially fatalistic worldview. Slovic (2007) considers fatalism as a belief that: '*...I have little control over risks (to my health)*', and this factor is also utilised by Grothmann and Patt (2005) as a component of 'avoidant maladaptation' within MPPACC (as mentioned above, and in previous chapters). Although the term 'external locus of control' is not employed in the latter study, the examples just cited demonstrate that the two concepts are very closely associated; it could, therefore,

be argued that the factors of perceived self-efficacy and externality are both represented within the MPPACC.

### 5.3 Beliefs, norms and attitudes

#### 5.3.1 Theoretical models

The 'Integrative model of behavioural prediction' was developed for use in risk communications within a health context (Fishbein and Cappella, 2006), as discussed previously. Behavioural intentions are here seen as arising from an individual's beliefs about performing a given behaviour; the underlying beliefs themselves may be inaccurate, biased, or irrational, but would provide a cognitive basis for the formation of intentions in a reasonable and consistent manner. If Fishbein and Cappella's (2006) model were to be applied to flood preparedness behaviours, the intention to adapt might, therefore, be informed by a range of beliefs, including the effects of norms and attitudes toward the adaptation behaviour itself. Where changes in the background influences occur (such as an additional experience of flooding, and the behaviours that accompanied this) alterations to the belief systems may result and, therefore, a different intention may be formed (for example, to prepare for future floods).

This is consistent with an element of the approach adopted by Defra (2008c) in creating the Pilot Projects on property flood resilience measures, which was intended to generate a 'demonstration effect'; the subsequent review concluded that:

*" ... by kick-starting the **normalisation** and popularisation of commercially available flood protection products, the pilot has made it **more likely** that they will be used by other individuals and communities in the future."* (Harries, 2009) (p41). (This author's emboldening).

This is also supported by the argument advanced by Oakley (2018) (discussed in Section 3.4.3.1) that interventions designed to change subjective norms might be effective in changing behaviour, unlike risk communications and fear appeals.

Many of the variables implicated in flood preparedness are included in this model, including experience (in the form of past behaviour), demographics and personality factors (control beliefs and self-efficacy/PBC). It also has the advantage that the

impacts of vicarious flood experiences, such as those employed in some community engagement initiatives, might be represented by the component 'intervention/media exposure' within the list of influencing factors. The impact of issues which can intervene between intention and behaviour are shown here as 'environmental factors' (such as the lack of financial resource) and 'skills/attitudes' (which would include the physical ability to deploy flood protection equipment).

Within the summary to their study Fishbein and Cappella (2006) also highlight the usefulness of identifying critical beliefs in order to tailor communications appropriately; as the original study concerned health behaviours, the word 'healthy' here has been substituted by 'desirable' to illustrate extending its use to a natural hazard context:

*"...(they can) attempt to increase the strength of beliefs that will promote (desirable) behaviours, reduce the strength of beliefs that promote risky behaviours, or prime existent beliefs that support (desirable) behaviours (i.e., increase their accessibility) so that these beliefs will carry more weight as determinants of attitudes, norms, self-efficacy, and intentions."*(Fishbein and Cappella, 2006 pS14)

This model could, therefore, represent a 'snapshot' of the development of flood protection behaviours at a given point in time. As any expressed behaviours would have an effect upon future behaviour, this would suggest a feedback loop is required to illustrate the learning process.

## 5.4 Towards a conceptual framework specific to flood adaptation behaviours

### 5.4.1 Modelling natural hazard adaptation

In a subsequent modification to MPPACC, specifically related to flood protection behaviours, (Grothmann and Reusswig, 2006) perceived self-efficacy appears in the 'coping appraisal' factor grouping, whilst fatalism (and thus, as argued above, external locus) is an explanatory factor within the 'non-protective responses' group (Figure 5.8). Furthermore, this model includes a new factor, not present in MPPACC, termed 'threat experience appraisal'; this seeks to measure the severity of threat

experiences *that have already occurred*, and is thus distinct from the ‘threat appraisal’ group of factors, all of which relate to *hypothetical future threats*. Thus, it is argued, that it is the appraisal of prior experience of a given threat that accounts for some people taking precautionary action.

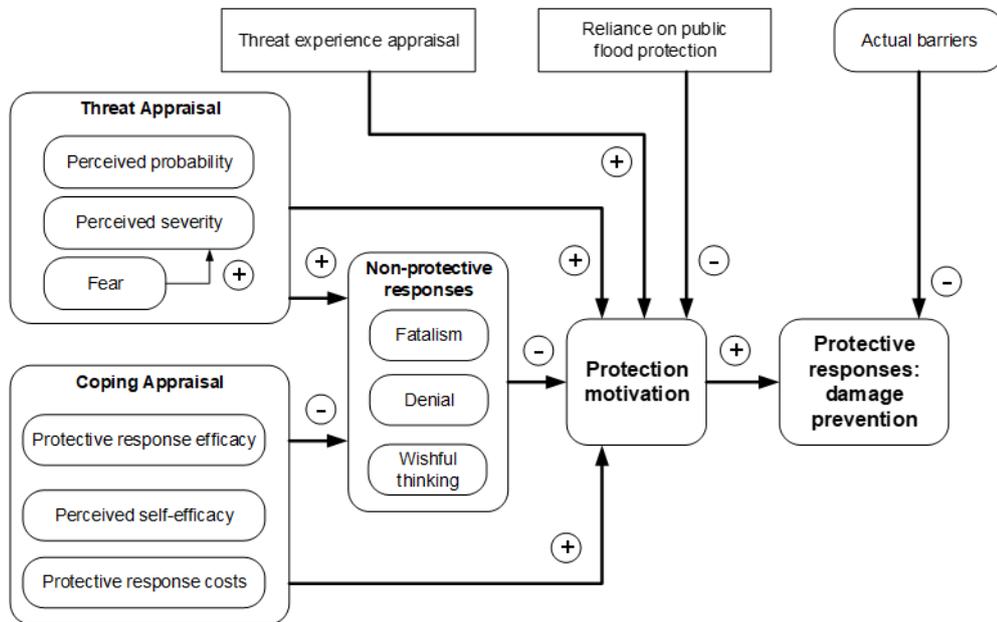


Figure 5.3 Explanatory factors for precautionary damage prevention by residents in flood-prone areas

(after Grothmann and Reusswig 2006) Used with permission of the publisher

This model, therefore, incorporates the two key psychological factors discussed above, as well as the experience issue looked at previously. Bearing in mind that Grothmann and Reusswig were, however, investigating behaviour in German flood-risk residents, caution is necessary before this model can be applied to an equivalent UK population.

#### 5.4.2 Cultural issues

Cultural differences, particularly norms and values, have been found to impact upon some types of decision-making and risk perception, for example in evacuation behaviour patterns (Xueqin *et al.*, 2007). Paton *et al.* (2010b) established some cross-cultural similarities in natural hazard mitigation behaviours (across New Zealand, Indonesia and Japan), insofar as personal beliefs and intentions were mediated by community and institutional factors in all three locations. Using the ‘Individualism’

dimension<sup>2</sup> from the published Hofstede scoring system (Hofstede, no date) Paton *et al.* (2010b) found that subjects from the country defined as the most culturally individualistic of the three (New Zealand, score 79), demonstrated direct links between individual beliefs and risk management choices; Japanese society, by contrast, (score 46) is characterised by mutual social obligation and co-operation, and in these subjects individual beliefs were merely implicated in collective processes. For comparison purposes, the relevant Hofstede individualism score for Germany is 67, whilst the UK score is 89 (a difference of 22). Although not as sharp a contrast as that seen between the scores of Japan and New Zealand (33), this measure does suggest an important difference in this (broadly defined) cultural attribute of the two nations in question.

Different countries may also display contrasting institutional approaches to flood risk management; as discussed above, the Netherlands is a specialised case in that their defence systems are typically built to exceptionally high standards, with some coastal protection being around 1 in 10,000 year design standard (Terpstra, 2009). In the light of this regime, instituted since the catastrophic event of 1953, the Dutch public is largely protected from what would, otherwise, be more frequent low-level flood events; direct and vicarious flood hazard experiences will, therefore, be comparatively rare within the majority of that population. It can therefore be seen that a Dutch model would not be easily adapted for use within the UK flood risk population. This raises an issue regarding the behaviours of residents in multi-cultural areas of the UK; people with a variety of contrasting cultural values, living within the same geographical area, may potentially respond differently, despite exposure to the same educational campaigns and warning mechanisms. It might, therefore, be prudent to capture relevant demographic information on belief systems within a proposed UK model.

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<sup>2</sup> “**Individualism** ... on the one side versus its opposite, collectivism, that is the degree to which individuals are integrated into groups. On the individualist side we find societies in which the ties between individuals are loose: everyone is expected to look after him/herself and his/her immediate family. On the collectivist side, we find societies in which people from birth onwards are integrated into strong, cohesive in-groups, often extended families (with uncles, aunts and grandparents) which continue protecting them in exchange for unquestioning loyalty.)” Hofstede, no date.

### 5.4.3 Modelled behaviour and the UK

All the foregoing models (as discussed here and in previous chapters) leave something to be desired, when considering the behaviours of flood-risk communities in the UK. The three most pertinent, in the context of formulating a new model predicated on the drivers of positive flood adaptation behaviours (as opposed to those models focusing upon the barriers to adaptation) are discussed below.

#### 5.4.3.1 Grothmann and Reusswig (2006)

This is a highly appropriate model, as it deals specifically with flood hazard, albeit with the caveats already stated regarding potential cultural differences. As this also includes the concept of ‘threat experience appraisal’, it also has the advantage that the effects of different degrees of exposure to flood hazard can be examined in context; this is known to be of relevance in the UK flood-risk community, as discussed by Harries (2008b). The latter notes that those flooded *more than once* were 3.4 times more likely to prepare for future floods than those never flooded at all; those with only a *single experience* of flooding were only 1.3 times more likely to prepare. The Grothmann and Reusswig model does, however, indicate that the ‘non-protective responses’ group of traits (including ‘fatalism’) mediates the relationship between coping appraisal (including self-efficacy) and protection motivation. If, as suggested previously, ‘fatalism’ is equated to ‘external locus of control’, then this would imply self-efficacy (a task-specific concept) is modified by locus of control (a generalised control concept), which could be seen as counter-intuitive and thus worthy of closer inspection.

#### 5.4.3.2 Paton (2003)

This social-cognitive model has been tested in several hazard preparation environments, including tsunami risk (Paton *et al.*, 2008b); bushfires (Paton *et al.*, 2006) and seismic risk (Paton *et al.*, 2010a). The types of flooding most commonly affecting the UK have not been explored through this lens, however. The model does, however, include the ‘trust’ concept, (as a mediating factor in the formation of intentions to prepare) as well as perceived responsibility: neither of these factors feature in the Grothmann and Reusswig model outlined previously (section 5.3.3.1), nor in the model which follows below.

#### 5.4.3.3 Fishbein and Cappella (2006)

The consideration of belief systems can help to identify key intervention opportunities to modify behaviours in a beneficial way: this would be of relevance in seeking to promote adaptation to flood risk. The integrative model proposed by Fishbein and Cappella (2006) focuses on the behavioural change process, albeit as a 'snapshot' of behaviour at a given point in time. As any expressed behaviours would, however, have an impact upon future behaviour, this would suggest a feedback loop would need to be incorporated in any new model of the flood adaptation behaviours to take such learning processes into account.

Finally, the flood insurance regime applying to the UK must be borne in mind; the so-called 'moral hazard' of relying upon recompense from insurance policies (where held) can potentially act as a barrier to individual preparation behaviours, when flood insurance is 'bundled in' with general property insurance as discussed by Lamond and Penning-Rowell (2014). Conversely, the recent introduction of grant-aided resilience schemes in limited areas following specific flood events is likely to have driven wider adoption of measures (in the limited geographical areas concerned). There could be a number of reasons for this, however, in terms of the 'drivers' that have operated: firstly, it may have created the perception that the government was 'sharing responsibility' for resilience adaptation (justice/fairness issues resolved); secondly, where cost perceptions were preventing uptake, these had been addressed (financial barrier removed or reduced); or thirdly, perceived governmental 'approval' of resilience measures improved the perception of their reliability (response efficacy perceptions improved). It would, therefore, be prudent to include questions of study participants regarding any grant-aid received, to illuminate this issue.

As already discussed, factors such as the thoughts, feelings and opinions of those who are at flood risk are also relevant to the decisions made; however, although some studies have suggested that disaster preparedness is positively associated with the feeling of 'worry' about a risk (for example, Miceli *et al.*, 2008; Terpstra, 2009) the creation of resilience interventions intentionally founded upon would not only be unlikely to succeed, but would also be unacceptable from an ethical standpoint (Hastings *et al.*, 2004; Pagneux *et al.*, 2011). Both internal LoC and high SE have been

found to be strongly associated with positive coping abilities (Benight, 2004) but external LoC is related positively to avoidant coping behaviours (Scott *et al.*, 2010).

### 5.5A conceptual framework for the behaviour of the UK flood risk population:

A comparison was made between the variables appearing in the three models considered above (Table 5.1). Investigation of the correlations between factors must, however, focus upon a limited number of variables (Breakwell, 2007). The final selection should, therefore, consist of those the literature indicates are most likely to drive/enable positive mitigation behaviours in the UK at-risk population (as opposed to those already identified as likely to form barriers to adoption, or having greater significance in other cultures).

*Table 5.1 Comparison of factors identified as related to positive adaptation appearing in the three models critiqued*

*(Key at foot of table)*

| <i>Group</i>        | <i>Variables</i>   | <i>Model 1<sup>1</sup></i> | <i>Model 2<sup>2</sup></i> | <i>Model 3<sup>3</sup></i> | <i>Conceptual framework for the UK (positive mitigation adoption)</i> |
|---------------------|--|----------------------------|----------------------------|----------------------------|---|
| Personality factors | Self-efficacy  | ✓                          | ✓                          | ✓                          | ✓   |
|                     | Control beliefs (including response efficacy/outcome expectancy) | ✓                          | ✓                          | ✓                          | ✓   |
| Flood experience    | Experience - direct  | ✓                          |                            | ✓                          | ✓   |
|                     | Experience - indirect  |                            |                            | ✓                          | ✓   |
|                     | Insurance effects  |                            |                            |                            | ✓   |

|                        |  |   |   |   |     |
|------------------------|--|---|---|---|-----|
| Socio-economic factors | Financial resources (socio-economic status/income/occupation/tenure) | ✓ |   | ✓ | ✓   |
|                        | Demographics (age, gender, education).                               |   |   | ✓ | ✓   |
|                        | Sense of community   |   | ✓ |   |     |
|                        | Trust  |   | ✓ |   |     |
|                        | Empowerment  |   | ✓ |   |     |
| Intention              | Intention formation (interim stage only)                             |   | ✓ | ✓ | (✓) |
| Other                  | Other resources (time/physical ability)                              | ✓ |   | ✓ | X   |
|                        | Acceptance of responsibility   | ✓ | ✓ | ✓ | X   |
|                        | Risk perception  |   | ✓ | ✓ |     |
|                        | Thoughts/emotions: Optimism  |   |   |   | (✓) |
|                        | Coping behaviours  |   | ✓ |   |     |
|                        | Timing of hazard   |   | ✓ |   |     |
|                        |  |   |   |   |     |

Key: <sup>1</sup> (Grothmann and Reusswig, 2006); <sup>2</sup> (Paton, 2003); <sup>3</sup> (Fishbein and Cappella, 2006)

In the resulting conceptual framework (Figure 5.4), processes that are most strongly supported by the literature as exerting positive effects are shown as solid lines; the suggested feedback process is represented by a broken line (as a longitudinal study would be required to explore this temporal aspect). A combination of factor groups affects the decision process undertaken by an individual, resulting in the formation of an intention to act positively: these include personality factors, flood experiences

and socio-economic factors. An intention is not necessarily carried out, however, as there are factors which may favour or impede the action intended. Socio-economic factors, for example, may affect intention formation directly or indirectly (mediated by the personality factor group); they may also affect the translation of an intention into actual protective behaviours (for example, where the terms of a lease forbid a tenant from making desired physical alterations to protect a property). The nature and extent of an individual’s flood experience can also, potentially, have impacts at more than one stage of the decision-making process.

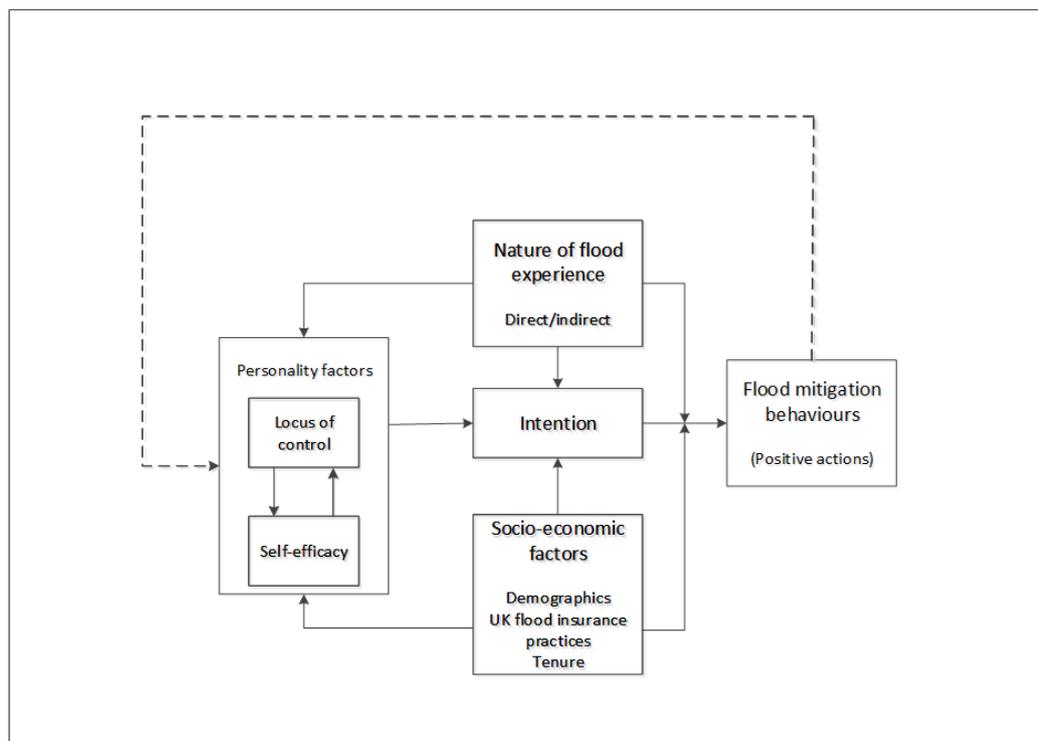


Figure 5.4 Conceptual framework of factors contributing to positive flood mitigation behaviours in the UK at-risk population.

(Source – author)

Note 1. Solid lines indicate previously documented linkages; dotted line represents potential feedback loop between successive floods.

Note 2. Flood mitigation behaviours will range from (voluntary) registration with flood warning service (where available), through cost-free options, such as moving valuables to high shelves, to adoption of resistant and/or resilient measures requiring financial outlay at the household level.

### 5.5.1 Linkages to be examined

The literature suggests that factors favouring anticipatory adaptation (mitigation behaviours expressed in the absence of direct flood experience) would include an internal LoC and/or a high GSE score (within the personality factor group), as well as adequate financial (and other) resources (within the socio-economic group) permitting an intent to mitigate to be carried through into action. Where individuals have had some experience of flooding, any subsequent failure to take protective actions may be due to a complex interaction of the relevant factors: for example, even where socio-economic status would permit investment in flood protection products, those who have an external locus (personality factor group) are likely to be prone to the social pressures that are known to exist (Garland, 2008) not to 'advertise' the flood risk applying to the locality by installing visible flood-gates, thereby preventing the translation of the initial intention into action.

A wide variety of possible protective actions are available to UK households, but it should be borne in mind that the current practice of 'bundling in' flood cover with buildings and contents insurance policies means a separate decision process on this matter is not usually required. Where households are not insured against flood damage there may be a variety of reasons for this: policies covering contents may have never been purchased owing to financial hardship, even though buildings insurance is mandatory for mortgagees; cover may have been withdrawn, or made unaffordable, following flood damage claims, or a reappraisal of risk; the buildings themselves may be insured by the lessor, not the lessee. In the absence of insurance cover, some people may have chosen to adopt mitigation measures as being the only avenue remaining to them in order to reduce future flood damages. Exploration of this issue is, therefore, one of the unique contributions this framework makes to the understanding of flood coping behaviours in the UK.

The framework also incorporates a feedback loop, in order to account for learning processes over time: measures initially adopted may prove to be ineffective in practice, such as the use of traditional sandbags (Dhonau, 2009). An individual's experience with ineffective mitigation measures may contribute to changes in intention: a more positive intention might be formed (to protect the home more

effectively in future, assuming socio-economic factors permit); conversely, such a negative experience could reinforce the fatalistic outlook of externally oriented individuals, discouraging them from making any further attempts at preparedness in the future, hence exploring the timing of successive decisions regarding different measure types may cast light on this issue.

Experience is also known to influence the individual's perception of SE and their locus of control, as neither of these psychological constructs is immutable: these beliefs are informed by both direct and indirect experience, and so may change over time (Bandura, 1977; Ajzen, 2002). This provides the potential to strengthen positive beliefs, as has been employed in the health sphere (Bandura, 1990); interventions such as community engagement programmes can be designed to enable and empower members of the at-risk population. As both LoC and SE can be measured quantitatively, this also suggests scope for monitoring the success (or otherwise) of such interventions via before-and-after testing; the policy-maker community may find such a metric helpful in identifying the most cost-effective intervention options.

Finally, it will be noted that, although the (dispositional) optimism factor is not explicitly included in the framework, the equivalent effects are deemed to be represented by the self-efficacy construct, in line with the view of Benight and Bandura (Benight, 2004) that dispositional optimism operates entirely through self-efficacy belief.

*5.5.1.1 Factors intentionally omitted (denoted by X  
in final column)*

Those who have already adopted any form of mitigation measures have, in effect, shown themselves to have accepted responsibility for taking protective actions (in contrast to those who abrogate all responsibility to 'the authorities', for example). Establishing when acceptance occurred, however, poses a challenge: it may be the person's overall outlook on life (as might be expected for very high Internals) or a viewpoint eventually (and reluctantly) adopted due to changing circumstances (for example, when campaigning for municipal flood defences had met with refusal). Similarly, the existence of non-financial resources (time/physical ability) can also be

deemed to apply in those who have already adopted measures; in some cases, however, this might only have been made possible with support from others (for example, reliance on a friend or neighbour to deploy a heavy door barrier). To fully explore either of these aspects would require a more in-depth investigation than the resources available for this study permits, but they are matters that would warrant attention by future researchers.

Of particular interest is identification of the factors influencing those individuals lacking any direct flood experience ('anticipatory adapters')

### 5.6 Summary

This chapter has examined existing UK based policy-development and academic research, and also demonstrated there are clear gaps in understanding which are in need of further empirical exploration. The theoretical relationships depicted within the conceptual framework developed seek to explain how positive flood adaptation behaviours might arise in the UK flood risk population, including the minority of 'anticipatory adapters'. The framework maps out the anticipated relationships between personality and situational factors, including the possible effects of government grants and insurance issues.

## CHAPTER 6 - RESEARCH DESIGN AND METHODOLOGY

### 6.1 Introduction

This chapter addresses the fifth objective stated in section 1.5. The theoretical background to research approaches is first examined, leading on to arguments justifying the choices made for this particular enquiry, including selection of the specific research methods and sampling strategy employed for data collection. The detailed research design for empirical investigation of the conceptual framework developed in the preceding chapter is then presented, and the chapter concludes with discussion of the data analysis techniques to be employed.

### 6.2 Research approach

Creswell (2003) defines 'research design' as follows:

*“... plans and the procedures for research, spanning the decisions from broad assumptions to detailed methods of data collection and analysis.”*

The function of research is to collect evidence, in order to address the specific research question(s) that have been posed (such as testing an existing theory, or developing a new one). This, in turn, requires collection of relevant evidence which will permit appropriate conclusions to be drawn. It is, therefore, not merely a logistical problem, but rather a logical process (Yin, 2013). De Vaus (2001) concurs, emphasising that the term research design refers to the structure of an enquiry, and evidence collected should have the potential to identify which of a number of explanations is the most compelling, or to disprove an extant theory (rather than seeking that which is consistent with a particular viewpoint). The term 'methodology' can be employed to describe the elements on which the choice of research methods is predicated: a strategy, plan of action, process, or design (Crotty, 1998).

When planning research, a series of interlinked decisions must be made. The overarching approach is predicated upon the 'worldview assumptions' (or philosophy) adopted which, in turn informs the choice between the two main 'research paradigms': quantitative (encompassing traditional, positivist and experimental worldviews) and qualitative (characterised by constructivist,

naturalistic or interpretive worldviews) (Creswell, 2003). Other pertinent factors would include the nature of the research problem itself and the expected audience(s) for the study outputs: for example, as regards the adaptation behaviours of the UK flood-risk population, an important audience would be the policy-making community, for whom an improved understanding of the drivers and barriers could be of benefit in formulating cost-effective future interventions to improve flood resilience (Defra, 2005b).

At the procedural level, the choice of an appropriate stratagem rests between quantitative (in which numerical data are collected); qualitative (which focuses on collection of non-numerical data, such as descriptions of behaviours, attitudes or beliefs); and 'mixed methods' strategies, for which both types of data are required. Finally, the specific techniques, procedures or 'tools' to be used for data collection, analysis, and interpretation must also be selected; these may be termed the 'research methods' (Creswell, 2003). In choosing whether to adopt the qualitative or the quantitative approach or indeed, a combination of the two, it is necessary to consider a number of factors, as will now be discussed.

The research aim, as stated in Section 1.3, is as follows:

*The aim of this research was to examine the relationship between psychological and situational factors and positive flood mitigation behaviours in the UK at-risk population including those displaying 'anticipatory adaptation'.*

The subject matter here is, therefore, the measurable relationship between flood protection behaviours expressed and an array of factors exerting influence upon an individual's decision-making processes in arriving at that choice. This seeks to explain the behaviour patterns of the minority within the UK flood-risk population who actively choose to protect their homes, as opposed to the majority examined by previous research who eschew protective behaviours. The research therefore falls within the broad fields of psychology and sociology, in which two broad methodological approaches are recognised: the 'nomothetic' and 'idiographic' methods (Hayes, 2000; McLeod, 2007). The nomothetic method focuses on

generalisations, or laws (such as cause-and-effect mechanisms) and typically employs quantitative techniques (such as experiments, correlation, and psychometric testing). The idiographic method, by contrast, focuses upon the unique, examining individual cases or events by means of qualitative methods (including case studies, informal interviews, or unstructured observation) (Hayes, 2000; McLeod, 2007). As the present research question concerns the measurable behaviour patterns of a particular group of people, this would situate the inquiry within a nomothetic approach, for which quantitative methods would be appropriate. Furthermore, the problem area has also been subject to previous research (albeit in other cultures for the most part), such that the likely array of variables has already been identified as have some of the relationships between these, and a number of theories to explain the findings; this contrasts with those topics forming a novel research area in which variables would first need to be identified by qualitative means. This is reflected in the research questions, regarding the extent to which relationships exist (as opposed to identifying where relationships might occur). The direction and scale of such relationships, therefore, form the focus of the investigation.

Although the conceptual framework includes two 'personality factors', which may appear to be more consistent with the ideographic method, both these variables are commonly assessed by means of psychometric tests, each yielding a numeric score: the 'Locus of Control' scale (Rotter, 1966) and the 'General Self Efficacy' scale (Schwarzer and Jerusalem, no date). Furthermore, the standard 'personality inventories' used to assess these factors are widely used and are of proven reliability, and this will be discussed in more detail in Section 6.4.1.

All the foregoing considerations have led to the adoption of a quantitative research approach for this study.

### 6.3 Research method choice

Quantitative data collection methods include questionnaire surveys, structured interviews, or observation checklists; the resulting data may be in the form of nominal ordinal, interval or scaling variables from which measurements, scales, counts, frequencies, rates, percentages etc may be derived. These are then subjected

to various forms of statistical analysis to explore population characteristics or patterns within and across variables. Data collection methods are therefore chosen in order to provide appropriate data with which to examine the characteristics and relationships of interest as represented by the research questions. In order to address the first stated research question, the data to be collected in this study will, therefore, include not only number of flood experiences, but also the years in which these occurred, and the nature of the experience (direct or indirect). To test for the presence of a relationship between flood experiences and flood mitigation adoption, data on both the timing and nature of the various measures undertaken will be collected. The second research question seeks to establish any effects of the flood insurance regime on mitigation adoption: even a single claim can lead to the imposition of large excesses and/or insurance premiums (for example, as reported in National Flood Forum, 2009). This can impact upon the perceived balance between overall costs and benefits of mitigation adoption, hence the study will collect data on the dates of any such marked differences in insurance charges. The third and final question seeks evidence for any association between specific socio-psychological factors (as identified in the literature review chapters) and the extent to which flood mitigation is undertaken. The study will include the standard format 'Appraisal inventories' by which these factors are measured, each of which yields a single numerical score. The conceptual framework developed in Chapter 5 of this thesis acts as a determinant of the other data to be collected: demographic details, including indicators of socio-economic status, educational attainment, gender and age will also be requested. As the population of interest is a subset of the at-risk community nationally, and no secondary datasets capable of furnishing this information exist, there is a need for primary collection as part of the survey.

### 6.3.1 Choice of design

The nature of the subject under study precludes the use of a controlled experimental design: although the outcome of some hazardous events may, on occasion, be treated as 'natural experiments', the variable of flood experience cannot normally be controlled or manipulated, for both practical and ethical reasons. Likewise, the personality factors involved are facets arising from the individual's life and

experience up to the point of assessment. A longitudinal study was also deemed inappropriate for this research: devising and administering interventions to change protection uptake rates are both expensive and time-consuming (although this would be a desirable approach for subsequent research in this area). A quasi-longitudinal approach was, however, adopted as data could be collected regarding the years in which specific adaptation actions had first been undertaken, along with the years of any flood event(s) experienced (and whether these experiences had been direct or indirect in nature). This latter category was included to enable a more detailed investigation of the ways in which different types of flood exposure act as drivers of (or 'triggers' for) preparedness behaviours, compared to previous studies in this area.

Correlations between many of the variables in the conceptual framework have already been identified in populations at risk from natural hazards in other cultures; however, those relating to flood risk have not yet been studied in detail. Correlational research is an approach particularly useful when dealing with variables that are not amenable to experimental manipulation (Pawlik and Rosenzwei, 2000). By collecting data from (or accessing records of) a specified population, it is possible to study the relationships among the individual scores on the (unmanipulated) variables of interest. (This contrasts with the experimental approach, in which the average performance of groups are being compared).

A correlational approach may be adopted in the field of medical diagnosis: an historic example is the research on the role of smoking in lung cancer (Medical Research Council, 1957). Having identified a disease or disorder of interest, any behaviours that vary with it are sought; however, whilst a relationship between two variables may appear to exist, this could actually be attributable to covariance in response to a third variable (continuing the previous example, if stress causes cancer and stress also causes people to smoke). The quasi-longitudinal aspect of the present study, discussed above, is intended to limit the potential for spurious relationships of this kind. Correlational methods can, however, aid in the elimination of some variables from an array of possibilities, where the absence of a relationship is identified.

It is also difficult to infer cause-and-effect when interpreting correlational data; the convention adopted is to refer to 'predictor' (rather than independent) and 'criterion' (rather than dependent) variables (Martin and Roberts, 2010). In the present study, the adoption of flood mitigation measures is the 'criterion' variable, and flood experience is one of a number of (potential) predictor variables.

There are a number of survey methods available, each with advantages and disadvantages and the choice made will now be examined.

### 6.3.2 Choice of survey method

The methods available include: interviews (face to face, or by telephone); self-administered postal survey; and (of increasing importance in recent years) self-administered internet survey (ESRC, 2007). There are also variations within methods, such as computer-assisted personal interviewing (De Vaus, 2001). In considering which method is the most appropriate for a particular study, a number of factors need to be considered.

'Social desirability bias' is the tendency for respondents to answer questions in a manner that they believe will be viewed favourably by others, potentially leading to over-reporting of desirable/'good' behaviours, or under-reporting of undesirable/'bad' behaviours. Questions regarding the usage of tobacco/alcohol/similar substances are obvious examples, but responses that might be perceived as denoting 'low prestige' are also prone to this effect (Oppenheim, 1992). The LoC IPC scales used in this study have been specifically designed to minimise such risks (Levenson, 1981). Face-to-face questioning has been found more likely to trigger such behaviour (for example, the style of clothing worn by the interviewer can be instrumental in this); postal/anonymous self-completed questionnaires are less prone to the issue (Oppenheim, 1992).

The length of time required for a respondent to complete any survey process is of importance, if participant fatigue is to be avoided, and consideration must be given to the varying needs of different groups of people (such as the elderly, or those with differing levels of educational attainment) (Fowler, 2002). The length of a questionnaire has been found to interact with the degree of interest the respondents

have in the topic under consideration: a relatively long questionnaire on a subject that is of intrinsic interest can, therefore, be completed successfully (Oppenheim, 1992; Environment Agency, 2008a). A related matter is the need to 'skip' over sections of a survey inapplicable to some respondents; although relatively simple to achieve in face-to-face, telephone and internet-based surveys, this can entail complex routing instructions in paper-based survey methods (ESRC, 2007). This can increase the risks of sections being omitted (leading to incomplete data therefore being collected); respondents may also abandon surveys that become too difficult to follow (further reducing the response rate).

Other constraints upon method selection include the resources available, particularly as regards the financial cost, and the total time required, to survey the appropriate number of participants. Interview methods are the most resource intensive, followed by postal questionnaires (with both printing and postage costs to be considered) (Dillman *et al.*, 2007). Internet surveys are the least demanding, in resource terms, but are by definition limited to use by individuals with access to/confidence in using a computer. The advantages comprise not only cost-effectiveness and ease of respondent participation, but also (in many cases) automated data collection, permitting direct export into analysis software formats, thereby presenting a further resource reduction.

The method chosen for conducting this study makes use of a self-administered on-line questionnaire (constructed using the 'Qualtrics' software package). The limitations of self-administered surveys include the well documented low response rate (for example, Oppenheim, 1992) and the potential bias due to self-selection of those who choose to respond (Fowler, 2002); there is also a heightened need to avoid ambiguity in both the questions themselves and the instructions for completing the instrument, as the respondents cannot ask for clarification. An advantage of on-line surveys, like postal questionnaires, is that they afford respondents the opportunity to respond in their homes, with the option to check receipts or other documents for data (in this instance, to identify the years on which different items of flood protection equipment was purchased, for example). This can enhance the accuracy of the data collected, when compared with respondents being required to recall facts

under the time pressures of face-to-face or telephone interview techniques and, perhaps, making guesses as a result (Fowler, 2002). The dates of flood events themselves are, however, highly salient to those whose homes have been affected, and as such, are likely to be easily recalled (Foddy, 1993).

Having made a decision on the survey method, it is also necessary to select an appropriate sample of the relevant population and this aspect will now be examined.

### 6.3.3 Choice of sampling method

Much of the research conducted on natural hazards protection, both in the UK and elsewhere, has sought to explain why people do not choose to protect their homes and property, despite living in areas designated as 'at risk'. The novel feature of this study is that it will focus on the factors influencing those who have adopted flood mitigation measures to some extent and, in particular, the small number of anticipatory adopters (who do so without having had flood experience), typically around 6% of the at-risk population (as described in the preceding literature review chapters).

In order to investigate the factors that correlate with active adoption of flood mitigation measures, it is necessary to survey those floodplain residents who have already undertaken such steps: however, no database of these people, or the properties involved, currently exists. It is clear from the literature that such behaviour is found in a minority of all the households known to be at risk: for example, Harries (2008b) found less than 20% of those who were aware of being at flood risk had taken protective action, typically those households which have experienced one or more floods in the past. A random sample of at-risk properties would not, therefore, be appropriate in this instance, if the investigation is to avoid mere confirmation of that which is already known. In this study, the intention is not to generalise from the findings to estimate wider population characteristics, but to explore possible reasons for the findings, consistent with the approach adopted by Ponto (2004) and this requires a purposive sampling strategy. The number of subjects required must be sufficient to yield adequate variability in the measures (to minimise extrapolation and interpolation of relationships where there are no data).

Targeting such a 'purposive sample' (De Vaus, 2001) does, however, require a means of identifying probable members of the relevant stratum of the at-risk population, and this will now be discussed.

#### 6.3.4 Selection of survey population (sampling frame)

In order to protect the home from flooding, a householder not only needs to form an intention to pursue this course of action (Harries, 2007), but must also obtain information and advice on the methods and products available for the purpose (Defra, 2008a) before a final decision to adopt is made. The information required includes: the level of flood risk applying to the specific property; cost; and suitability for the property concerned (including aesthetic considerations, compliance with listed building consent/restrictions applying in conservation areas). No comprehensive database of properties already flood-adapted existed at the time of this research, although an initiative to create one is now underway (BRE, no date). Authoritative advice and recommendations are available from organisations such as the National Flood Forum (hereafter NFF) which covers England and Wales (National Flood Forum, no date) and its Scottish counterpart (hereafter SFF) (Scottish Flood Forum); the Property Care Association (Flood Protection Group of the Property Care Association, no date); in the Homeowners' Guide to Flood Resilience (Dhonau and Rose, 2018) and from independent flood consultancies.

Although such resources can be readily identified via a web-search (by those with the benefit of internet access), both the NFF and SFF, typically in concert with local authorities, also organise 'flood fairs' and other community engagement activities in at-risk areas, to reach those residents directly. These include demonstrations of the range of products available for property-level protection, as well as offering personal advice, encouragement and support for those affected by flooding and its aftermath. The NFF and SFF are umbrella groups, representing and supporting over 270 affiliated community flood groups across the UK (National Flood Forum, 2013; Hendy, 2015) with an average membership of 12 per group, thus around 3000 individuals. The members of these local flood groups not only live in at-risk areas, with either direct or indirect experience of flooding, but are likely to have been exposed to one or more such community engagement initiatives and, therefore, have had opportunity to

access relevant information and advice. In addition, there are a number of flood groups in the UK who are not affiliated to either the NFF or SFF: for example, the 'Flooding on the levels action group' (FLAG) representing the communities flooded in Somerset during the winter of 2013/14 (FLAG, 2015) and similar groups identified via a web-search. The individuals within such groups will share some of the features of the Forum affiliated groups (including at-risk location and a degree of flood experience) but may not have been exposed to the same levels of information and advice typically available to the affiliated groups.

It is, therefore, argued that the individuals belonging to such community flood groups will occupy a stratum likely to yield a higher than average variance for protection behaviours (when compared with the vast majority of at-risk households which, as the preceding literature review chapters have demonstrated, display no mitigation behaviours at all). The intention is to invite all the members of such groups to participate in the research (thus around 3000 potential respondents) but, as no database of such individuals exists, this will be executed via the contact details for each group provided on their websites, together with appeals on groups' Facebook pages and Twitter accounts, where available. Although the reported response rate for web-based surveys can be low (ESRC, 2007), they can be comparable with postal surveys (around 30%) if the appropriate procedures are followed (Kaplowitz *et al.*, 2004). Population members will therefore receive notification of the survey launch (via an email sent direct to the group secretary, or other named contact) as well as notices appearing on relevant web-pages and social media pages, as will follow up reminders. Furthermore, respondents with a high degree of interest in the subject matter of surveys have been shown to be more likely to participate in, and return, survey instruments than those chosen at random (or example, Fowler, 2002).

#### 6.3.5 Limitations of the study

Although quantitative analysis can reveal which factors may be involved, and the extent of their interactions, it is not able to establish causation when performed as a cross-sectional (rather than longitudinal) design. In the absence of resources sufficient to perform a longitudinal study, this is (inevitably) a limiting aspect.

The proposed method is not intended to obtain a sample representative of the at-risk population nationally. It is, however, designed to yield a valid sample, in terms of the response variability. The survey instrument is only available in the English language, which could exclude any potential respondents who are not sufficiently fluent in the written form of that tongue. Internet based surveys may also exclude those who lack access to, or sufficient skill in using, a computer. However, the complexity of the question-routing (which will be discussed further below) could render a paper-based equivalent difficult for some groups of people to navigate. The method selected therefore represents a compromise between cost, accuracy and ensuring sufficient numbers for meaningful analysis, as advised by De Vaus (2001).

The design of a questionnaire survey is key to the successful use of the instrument, not only in terms of the questions themselves and the order in which these are presented, but also less obvious factors such as the choice between using individually stamped envelopes or those franked by machine for postal surveys (Dillman *et al.*, 2007). The design of the survey to be used in this investigation will now be discussed.

#### 6.4 Design of the survey instrument

Questions were designed based on the data requirements, while also making reasonable demands on the intended respondents. An iterative process of development involved consultation with key personnel from the NFF (both of whom had direct flood experience), who not only contributed to, for example, the range of categories likely to be needed within the mitigation measures sections, but also highlighted issues not articulated within the existing literature. For example, although flood events are known to be 'emotionally salient' (for example, McEwen, 2006; Kellens *et al.*, 2013) information from the consultees highlighted that not only the date, but also the time of day, of a flood may be retained for many years. The dates on which flood mitigation measures were installed, however, lack an emotional component and it could be difficult for survey respondents to recall the exact dates involved: for this reason, the survey refrains from asking for precise dates in either of the relevant sections. Further development included consultation with a professional researcher who had indirect flood experience, and the questionnaire was then subjected to rigorous testing (as described in Section 6.6).

Specific aspects of the design will now be examined.

#### 6.4.1 Question format

Questions may be asked in two forms: closed or open-ended. A closed question has a finite number of answers, typically presented in a 'tick box' format: such questions have the advantage of presenting an easier 'recognition' task, as opposed to a 'recall' task, to the survey respondents (Foddy, 1993). Improving the ease of response in this way is known to maximise return rates, an important consideration for postal questionnaires (Fowler, 2002).

Closed-ended questions are also relatively easy to deal with at the data-coding and analysis stages of a study, in contrast to open-ended questions which have an unlimited range of responses; an example would be: *'Can you say which flood warning methods you prefer and why?'* Such a question elicits textual responses that need to be read, understood and coded individually, a process that is resource-hungry and may require specialist training.

The method chosen for this study was closed questions, utilising tick-lists wherever possible; in some cases an option of 'Other' and 'Please specify' was included, as even the most comprehensive list of, say, flood protection measures, cannot be assumed to be exhaustive (Peterson, 2000). One of the purposes of advance testing and piloting of a questionnaire is to identify any additional categories that may be needed in the final version, in order to reduce the use of this option to the minimum, to facilitate later data handling (Oppenheim, 1992).

The exception to this principle was the use of the two 'off the shelf' psychometric tests: the standardised instrument for the IPC LoC scale (Levenson, 1973), which employs a 6-point Likert scale, and the 'Generalised Self Efficacy scale' (Schwarzer and Jerusalem, 1995) which utilises a 4-point Likert scale. (Discussed further in sections 6.4.2 and 6.4.3 below). Unlike metrics used in the physical sciences, where a 'standard error' of measurement is usually stated, the internal consistency of psychometric tests is routinely assessed by calculating a coefficient such as 'Cronbach's alpha' (Cronbach, 1951). This is widely accepted within psychology, social sciences, medical education and other fields as providing an estimate of the

internal reliability of the suite of questions comprising the test, or scale, concerned (for example, Tavakol and Dennick, 2011). It is only suitable for use with tests designed to measure unidimensional concepts.

#### 6.4.2 The IPC locus of control Scale

Rotter's (1966) original work indicated that scores on the I-E scale exhibited sufficient convergent and discriminant validity, together with satisfactory internal and test-retest reliability and the I-E scale has been used with a wide variety of populations since its inception. The 'IPC scale', as used in this study, is Levenson's refinement of Rotter's work (Levenson, 1981); the three separate dimensions measured within the IPC scale have been reported as having Cronbach's alpha between 0.50 and 0.73 (acceptable) (Wallston *et al.*, 1978). It has also been examined by Brosschot *et al.* (1994) reporting partial confirmation of reported findings of other authors concerning the validity of the scales, indicative of the usefulness and meaning of the IPC-scales. As the instrument has been standardised using a 6-point Likert scale, this method was retained in the present study, to avoid compromising these known characteristics.

The method for scoring the IPC self-assessment inventory is included as Appendix 12. Permission to use this instrument is not required, but Dr Levenson was notified that it was being employed, in accordance with the terms stated on her website.

#### 6.4.3 Generalised self-efficacy scale

The concept of generalised self-efficacy (GSE) (Schwarzer and Jerusalem, 1995) relates to the strength of an individual's belief in their ability to perform novel or difficult tasks, or cope with various forms of adversity, in the sense of global confidence (in contrast to Bandura's self-efficacy concept which is domain specific (Bandura, 1977)). The GSE scale is unidimensional and consists of ten items, each of which refers to successful coping; as an operative construct, this trait is related to subsequent behaviour and, therefore, is relevant to behaviour change settings, as well as clinical applications. Cronbach's alpha for the GSE scale has been reported in relation to samples from 25 nations: the results ranged from 0.76 (acceptable) to 0.90 (excellent), with the majority in the high 0.80s (good)(Scholz *et al.*, 2002). Criterion-related validity has been documented in numerous correlation studies

where positive coefficients were found with, for example, motivational traits, including need for achievement and conscientiousness (Imam, 2007). As the instrument has been standardised using a 4-point Likert scale, this method was retained in the present study, to avoid compromising these known characteristics.

The method for scoring the GSE self-assessment inventory is included as Appendix 13. Permission to use the instrument is not required, as stated in the terms stated on Professor Schwarzer's website.

#### 6.4.4 Other variables to be examined

The conceptual framework for this study comprises five groups of variables, of which four (personality factors; flood experience; socio-economic factors and flood protection behaviours) can be explored with relative ease, as all are amenable to quantitative measurement. In contrast, the fifth variable within the framework, intention, is a transitional stage within the individual's decision-making process (Ajzen, 1991) and can, therefore, only be explored by means of self-reports. Furthermore, as Oppenheim (1992) comments, statements of intent with regard to future actions may be valid at the time they are made, but can be poor predictors of actual behaviours at later dates. As the major thrust of this investigation was to examine the factors that have influenced behaviours already expressed (active adoption of flood mitigation) and, in accordance with the framework, such actions would have been preceded by the formation of positive intentions, then no purpose would be served by an attempt to measure this variable. In subsequent research focussing on failures to adapt it may, of course, be appropriate to include such measures. (The date on which positive adaptations were first made may occur after the date of a second or third flood event: correlation here would support the influence of the direct experience factor).

The variables to be measured were grouped within the questionnaire as follows:

- Flood mitigation

Number of measures adopted, in each of three categories (water exclusion strategies; water entry strategies; cost free strategies) with dates. Predominantly tick boxes.

- Flood experiences  
Number of floods and year of occurrence (0 floods; 1 flood; 2 or more floods); direct flood experience; indirect (local area affected); vicarious (people known to the respondent affected) with year(s) of occurrence, and flood sources (if known). Predominantly tick boxes.
- Personality factors (appraisal inventories)  
Two specific variables were measured by means of psychometric tests yielding numeric scores: locus of control, using Levenson's 24 question IPC scale; generalised self-efficacy, using Schwarzer's 10 question GSE scale: Likert scales.
- Socio-economic factors
  - Demographic factors (age group, gender, educational attainment and income; house type (house or flat and if the latter, ground/basement or above) and tenure (tenant/non-tenant). Tick boxes
  - UK flood insurance questions (any refusals/increased premiums or excesses) Text, to include date(s).

(See Appendix 2 for table showing all the data collected).

### 6.5 Sequence of questions within the survey instrument

The context and order in which questions appear in a survey can influence the answers given by respondents (Dillman *et al.*, 2007), in particular questions concerning attitudes. As noted by Peterson (2000), however, when using self-administered paper-based questionnaires, the researcher has no control over the order in which questions are actually answered, unlike on-line surveys (provided these have been correctly designed). Good practice (Oppenheim, 1992; Peterson, 2000) suggests questions on demographic data (such as age and gender) should be placed at the end of a questionnaire for two reasons: firstly, these questions are straightforward to answer and, therefore, most suited to the final phase when the respondent may be beginning to tire; secondly, there is a need to reassure the respondents that the survey is genuine, not some form of market research ploy, and placing the topical questions before personal details strengthens this.

Another example of good practice, is to avoid posing the 'core' questions too early in the process: in live interview contexts, this allows time for the interviewer to build a rapport with the subject (for example, Harries, 2007); in other types of survey the participant will have invested effort in completing the earlier sections and, therefore, be less likely to abandon the survey when more searching questions are encountered. Similarly, Dillman *et al.*, (2007) advise placing any 'sensitive or potentially objectionable' questions near the end of a questionnaire, to increase the likelihood that respondents will be fully engaged in the survey and, therefore, more amenable to answering such questions by that stage. A final good practice matter concerned the two psychometric inventories, which were presented in random order to avoid 'order effects' (Dillman *et al.*, 2007) (accomplished via automated facility within Qualtrics software package).

In the light of these considerations, the relatively simple section on flood protection measures already undertaken (7 questions, all in a tick-list format) will be presented first; next will be the slightly more complex sections relating to flood experience (17 questions, the majority in tick-list format); the personality variable items (which could be construed as sensitive matters) occupies the third section (34 questions in Likert scales); and the final section comprises brief demographic details (the majority in tick-list format).

## 6.6 Survey piloting

Questionnaire sections were initially trialled with a range of individuals, of varying ages, genders, occupations and educational backgrounds. For trialling purposes, the survey had two text boxes added at the end (one for leaving feedback, the second for entering the approximate time taken for completion). The responses were anonymised, consistent with the intended full survey protocol, but in some instances additional feedback was provided via email by respondents. Anyone who had already trialled an individual section was not asked to take the fully developed survey (to avoid compromising the overall response times due to familiarity).

### 6.6.1 Response times

As an example, the longest individual section (IPC Loc, 23 questions using Likert scale) took between 1 and 9 minutes to complete (including provision of feedback comments). For the full survey, the total times ranged between 5 and 20 minutes (including any time spent entering feedback comments). Although this is a relatively long period for a survey, for participants having an active interest in flooding issues (as evidenced by their membership of a local flood group) and thus with an increased likelihood of remaining engaged (as discussed above in Section 6.3.2) this was deemed to be an acceptable timing range.

### 6.6.2 Feedback and modifications

Some respondents commented (adversely) on the phrasing within the personality sections; however, as these are standardised psychometric tests, changes to the wording were not undertaken to avoid compromising their known parameters (including test/re-test reliability). One of the participants who trialled this section commented upon the 'intrusive' nature of some of the personality questions, as anticipated when the choice of question positioning was addressed. There was, therefore, a risk that some respondents would choose to abandon the survey on reaching that section; however, the survey software captures incomplete responses separately, hence the extent of such incidents can be examined as part of the analysis. Finally, where errors or omissions within the survey itself were identified, these were corrected on the master copy within the 'Qualtrics' software.

The final survey instrument, together with the invitation to participate, are included as Appendix 10 and Appendix 11 respectively.

## 6.7 Data Analysis

Data analysis procedures must be selected in accordance with the underlying assumptions governing each method; for example, multiple regression procedures are widely used in research in both social and natural sciences, and two of the fundamental underlying assumptions are that the relationships between the dependent and each of the independent variables are linear, but there should be no relationships between the independent variables (avoidance of multicollinearity).

These assumptions may not hold for the type of data to be collected in this study: for example, the LoC inventory employed provides scores for two different types of externality, which may well be related; there are also known associations between demographic variables such as educational attainment and income. Furthermore, the dependent variable (the extent of mitigation adoption) here is ordinal, but the assumption for multiple regression is that such data are either interval or ratio in nature.

Techniques such as multivariate regression, or MANOVA, are applied in situations involving multiple dependent (or criterion) variables, but the assumption here is that the variables are continuous (ie - any value is possible); this does not apply to any of the data to be collected in this study. A further assumption in such techniques is that variables are normally distributed; although both GSE and LoC scores approximate to a normal distribution across the general population, the sample to be used in this investigation is (intentionally) a small subset (members of flood groups) within a larger subset (those at flood risk) of the UK population. It cannot be anticipated that normality will apply under these circumstances, and this will further restrict the analysis techniques that will be appropriate.

#### 6.7.1 Methods selected

As normality for the majority of the variables within this sample cannot be assumed, the widely used parametric tests (such as Anderson-Darling, ANOVA, Pearson's Correlation Coefficient) are not appropriate for the majority of the analyses to be conducted. There is one instance, however, in which a t-test could legitimately be applied (comparing sample data with population data known to be approximately normally distributed) and this appears in section 7.2.4.1. For the remainder, the assumptions associated with were violated to an unacceptable degree (for example, the ordinal scale used for the dependent variable of 'MitScore', together with notable 'outliers' and doubts over the linearity of relationships precludes multiple regression approaches).

The Spearman's correlation coefficient is a non-parametric technique which does not assume normality in the data; it is also appropriate for ordinal, ratio and interval data, which are the types to be gathered. Tests to compare the sample means and

population means were also undertaken where appropriate and where population statistics are authoritatively documented.

Another technique, which is less commonly employed, is expected to be appropriate however: the 'multivariate factor analysis' approach. This has the advantage of reducing the parameters, by combining two or more variables into one single factor, thereby identifying any latent (hidden) dimensions that would not have been apparent from direct analysis. The multivariate technique of simultaneous r- and q-mode factor analysis will be used for interrogating the data. Both r- and q-mode factor analyses are based on eigenvector methods and can be performed separately. Essentially, r-mode factor analysis attempts to detect interrelations between parameters, whilst q-mode factor analysis attempts to find patterns, or groupings of samples, within their arrangement in 'multidimensional factor space' (Walden and Smith, 1995; Booth *et al.*, 2006). It should be noted that this technique is not a statistical procedure, but might better be termed a mathematical manipulation; as a consequence the results are not subjected to any significance testing (Millington, 2010).

The data analysis is performed using 'Minitab PC' (version17), following a procedure based upon that proposed by Walden and Smith (1995). The r-mode technique adopted for the analysis follows a 'principal component' approach to factor analysis and does not produce a 'true' factor solution (Davis, 1986). Given an original (standardised) data matrix of  $n$  samples by  $m$  variables, the data are first transformed into an  $m \times m$  *correlation matrix*. The way in which the data points are geometrically arranged in space, relative to each other, are defined by the eigenvalues and eigenvectors which are extracted from the matrix. The factors are then derived from scaled eigenvectors, whose lengths are proportional to the amount of total variance. The resulting factor matrix contains 'factor loadings' for each original variable on each of the new factors. Factor loading size is therefore related to the amount of variance contributed *by a variable* to a particular factor.

The *q-mode technique* follows a procedure similar to Principal Co-ordinates Analysis (PCoA) (Davis, 1986; Kovach, 1995). Starting from the same standardised data set of  $n$  samples and  $m$  variables, an  $n \times n$  *similarity matrix* is constructed, representing the

similarities between sample pairs, in terms of the way they respond to all variables. Factors are then extracted from the data (as for r-mode analysis) to produce a factor matrix of all sample factor loadings. In this case, however, the size of the resulting factor loading is related to the amount of variance contributed by *a sample* to a particular factor. The mathematical steps of the procedure are shown in Appendix 9.

#### 6.7.2 Example of r- and q- mode results

An example of the results produced by this technique are now considered, using an illustration of the outcome of analysis on a (hypothetical) multivariate dataset of twelve parameters, which were measured on five sample populations (AE) each containing different numbers of samples. Table 6.2 shows that factors 1 and 2 extracted from the analysis can be seen to explain around 55% and 19% of the total variance in the (hypothetical) parameters. (Attempts are made at identifying underlying causes in order to name each factor appropriately at a later stage of the process).

The parameter and sample loadings for these factors have then been used to generate the factor plot, with factor 1 on the X axis, and factor 2 on the Y axis. Any sample loadings that predominantly (or entirely) occupy one half, or one quadrant, of the plot are clearly influenced by the parameters whose end points are located within those same quadrants. The technique produces multiple graphical plots of this nature, allowing a complex dataset to be examined in detail for indications of the inter-relationships between variables.

*Table 6.1 Summary results from the factor analysis, showing the eigenvalues, total variance (%), cumulative eigenvalues, and cumulative total variance (%)*

| Factors | Eigenvalues | Total variance (%) | Cumulative eigenvalues | Cumulative total variance (%) |
|---------|-------------|--------------------|------------------------|-------------------------------|
| 1       | 6.595       | 54.955             | 6.595                  | 54.955                        |
| 2       | 2.321       | 19.338             | 8.915                  | 74.294                        |
| 3       | 0.959       | 7.992              | 9.874                  | 82.286                        |
| 4       | 0.834       | 6.950              | 10.708                 | 89.235                        |
| 5       | 0.463       | 3.857              | 11.171                 | 93.093                        |
| 6       | 0.358       | 2.981              | 11.529                 | 96.074                        |
| 7       | 0.192       | 1.600              | 11.721                 | 97.673                        |
| 8       | 0.126       | 1.051              | 11.847                 | 98.724                        |
| 9       | 0.068       | 0.568              | 11.915                 | 99.293                        |
| 10      | 0.052       | 0.434              | 11.967                 | 99.726                        |
| 11      | 0.020       | 0.166              | 11.987                 | 99.893                        |
| 12      | 0.013       | 0.107              | 12.000                 | 100.000                       |

## 6.8 Summary

This chapter has identified the research approach to be adopted, together with the research methods appropriate within that approach, such that the research questions could be addressed. The rationale leading to both the approach and methods adopted have been presented. The detailed research design for empirical investigation of the conceptual framework was then discussed, including the justification for the sampling strategy selected (to survey a subset of the UK flood-risk population, specifically those householders more likely to have already adopted some examples of flood mitigation). The chapter concluded with a consideration of the analysis procedures appropriate to the nature of the data to be collected.

## CHAPTER 7 – DATA ANALYSIS

### 7.1 Introduction

This chapter addresses the sixth objective stated in section 1.6. Firstly, the characteristics of the survey sample are presented; this is followed by examination of the nature of preventive actions taken, and calculation of a proxy variable (MitScore) representing this. The varying types of flood experience, and their relationships to the timing of preventive actions are then presented, along with the calculation of a proxy variable (TrigCat) representing the affective nature of those experiences. The results from analysis methods applied to examine relationships between the variables are then presented, concluding with a factor analysis procedure employed as a validation technique.

Unless otherwise stated, statistical analysis was performed using SPSS Statistics 24 software; in one instance MS Excel was also used, to perform a t-test which was appropriate for comparing sample data with population data known to be approximately normally distributed. Minitab version 17 was utilised for the validation exercise. As discussed in Section 6.7.1, it should be noted that normality for the majority of the variables within this sample cannot be assumed, hence the widely used parametric tests are not appropriate: non-parametric alternatives are, therefore, employed.

### 7.2 Characteristics of the survey sample

#### 7.2.1 Demographic data

Of the estimated 1,040 potential survey participants a total of 95 individuals had responded to the survey by the closing date, which represents a response rate of approximately 9.13%. This low result may, however, be due to using ‘gatekeeper’ intermediaries to distribute the invitations to participate (these being the secretaries/other specified contacts for local flood groups) where no Facebook or Twitter pages were available. (It could not be ascertained whether all requests had been forwarded to all group members, except where personal contact had been made by the designated contact).

Whilst lower than ideal for survey analysis, this result is not unusual for disaster research. However, a small response rate does not necessarily lead to a large response bias, neither does a higher rate guarantee a representative sample (Lamond, 2008). It does, however, limit the analyses possible in terms of the data points available. Although two-way and three-way interactions between variables may exist (for example, age/education/income factors) these cannot be examined in this instance.

Ninety-one participants had made use of the online version of the survey instrument, and a further four had completed the printed copies offered as an alternative (their responses being coded and entered into the data set by the researcher).

Demographic questions formed the final section of the questionnaire, in accordance with recommended good practice (Oppenheim, 1992; Peterson, 2000) but a large number of respondents had chosen to exit the survey without completing this information, for reasons which are unclear. *(However, one individual contacted the researcher to express their disquiet at being asked to disclose such 'personal' details, even though the survey instrument was entirely anonymous).* Remillard *et al.* (2014) do, however, cite evidence that some older adults with limited incomes may not have access to high-speed internet and/or up-to-date hardware/software, all of which could adversely affect their ability to complete on-line questionnaires.

Gender and age are amongst the demographic factors believed to affect risk perception in the literature, but the direction of influence is far from clear, as discussed in Wachinger *et al.* (2013). In this study, of those who did complete the gender field, 35 were male, 28 female and one had chosen the 'prefer not to say' option; males are, therefore, somewhat over-represented within those who provided demographic data (in comparison with population norms). The remainder had dropped out at, or before reaching, this section of the survey instrument.

As is often the case with questionnaire surveys (for example, Charles *et al.*, 2008; Lamond, 2008) the ages of the respondents were skewed towards the more senior categories, as shown in Figure 7.1.

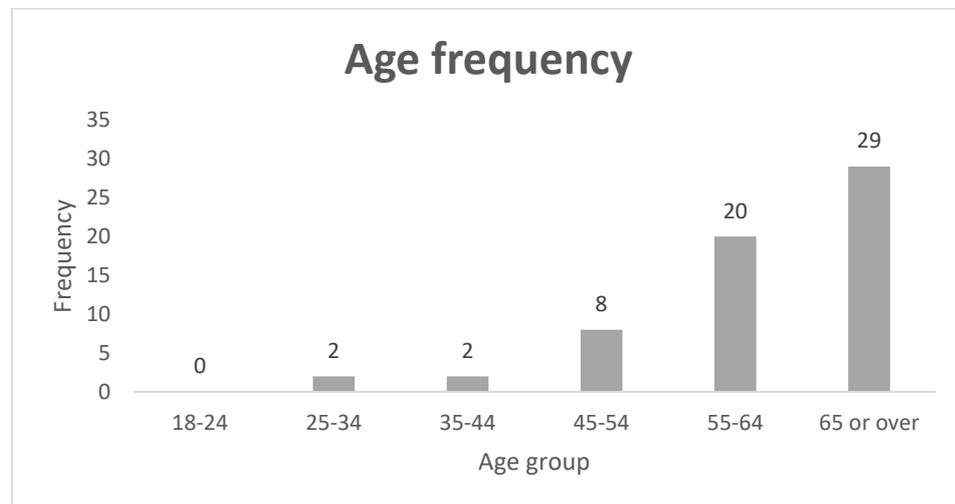


Figure 7.1 Distribution of age ranges of respondents

Nonetheless, of those providing data, 52.5% were below pensionable age (which may be linked to the use of a predominantly online, rather than printed, survey instrument).

The annual income bands were fairly evenly distributed (Figure 7.2). It must be noted, however, that 26.6% of respondents chose not to disclose income data; there are well-documented findings that a high number of respondents typically decline to answer questions of this nature (for example, Moore and Loomis, 2001; Allison, 2009) making it an example of 'missing not-at-random' data.

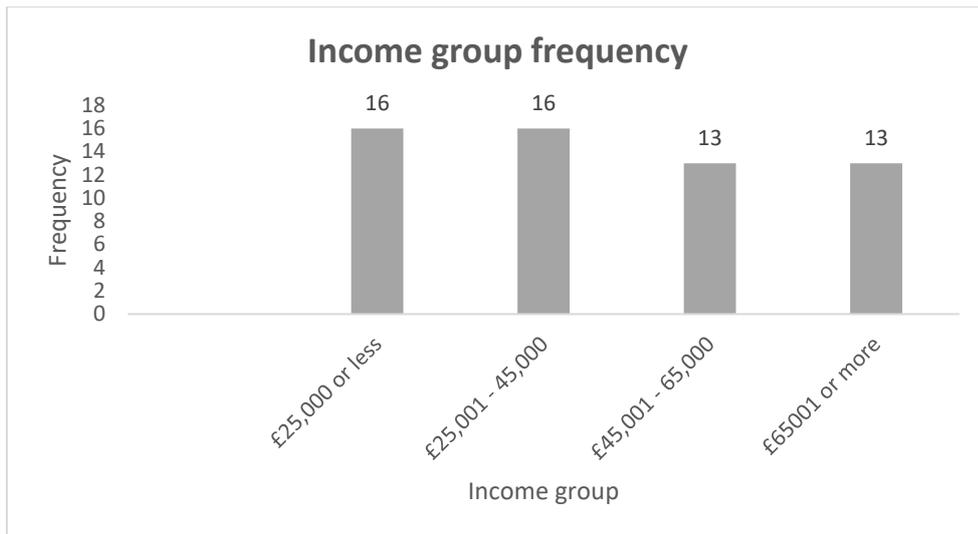


Figure 7.2 Distribution of income bands of respondents

The educational profile of the sample was notably dominated by the postgraduate/professional category (Figure 7.3).

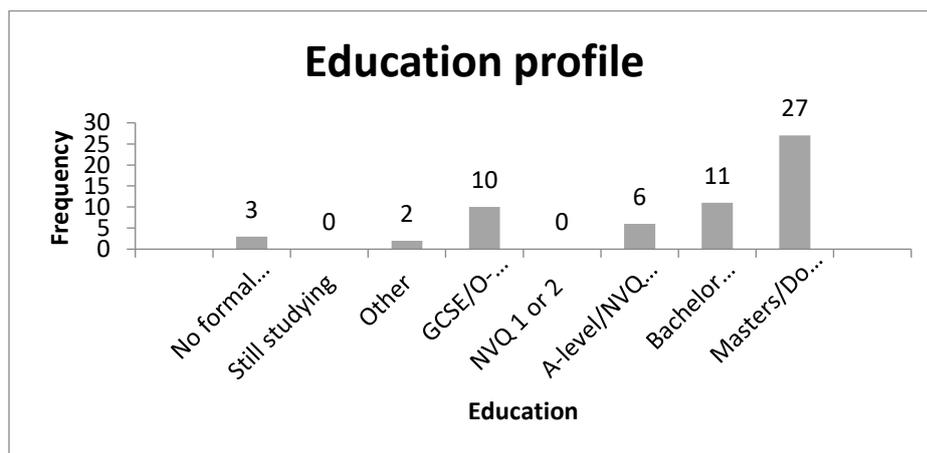


Figure 7.3 Distribution of educational level of respondents

All but one of the respondents providing information on the subject were homeowners (with or without mortgages) and the exception had chosen the 'Other, including accommodation tied to someone's job'; there were no tenants (private or public authority). The issues around obtaining flood survey responses from private and social tenants have been acknowledged previously: for example, Lamond reports 17% of responses were from tenants, in areas where national statistics indicated 31% of households were rented; an Irish study was unable to recruit any participants from an urban area which largely comprised rented accommodation (Fox-Rogers *et al.*, 2016).

### 7.2.2 Flood experiences

The respondents represented a wide variety of flood experiences: for example, the number of *direct* floods ranged from none to twelve, as shown in Figure 7.4 By definition, all the survey respondents had taken at least one 'action' in relation to flood mitigation (joining a flood group). However, only 33% of those with direct flood experience had lived through three or more such events; this means 67% had taken some kind of action at a lower level of hazard experience than previous studies have noted (Harries, 2007; Lamond, 2008). This provides a further example of the way in which flood group members differ from the majority of the flood-risk population.

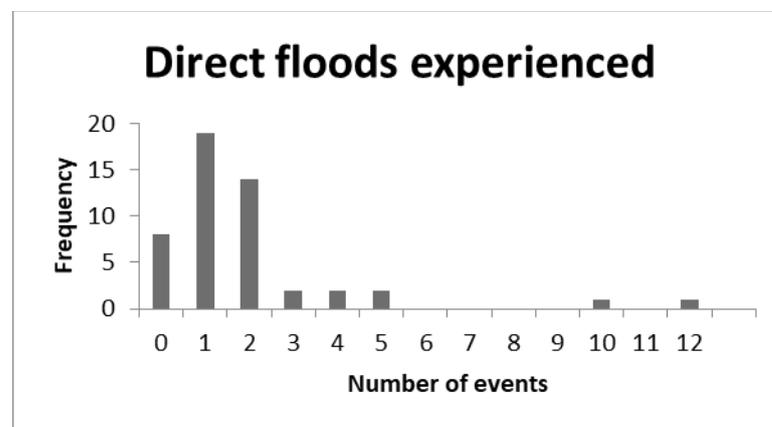


Figure 7.4 Number of direct floods ever experienced

The total number of floods of all types was also examined and the results are shown in Figure 7.5. (Note - where direct and indirect occurred in the same event these have only been counted once).

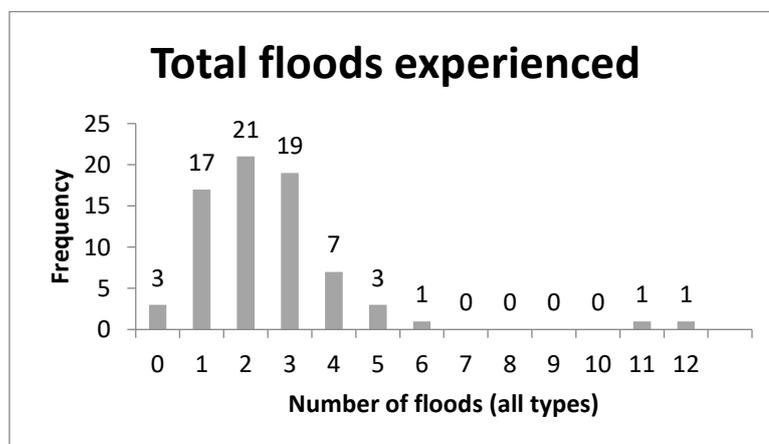


Figure 7.5 Number of floods of all types ever experienced

When indirect flood experiences (affecting areas outside the home, as well as events affecting people known to the respondents) are included, then 78% have experienced some form of flooding. This is of critical importance: a less nuanced definition of 'flood experience' would have categorised many of these respondents as 'not previously flooded'. For example, of those who had registered for flood warnings, 46% had either no flood experience or only indirect experiences prior to doing so, as shown in Figure 7.6.

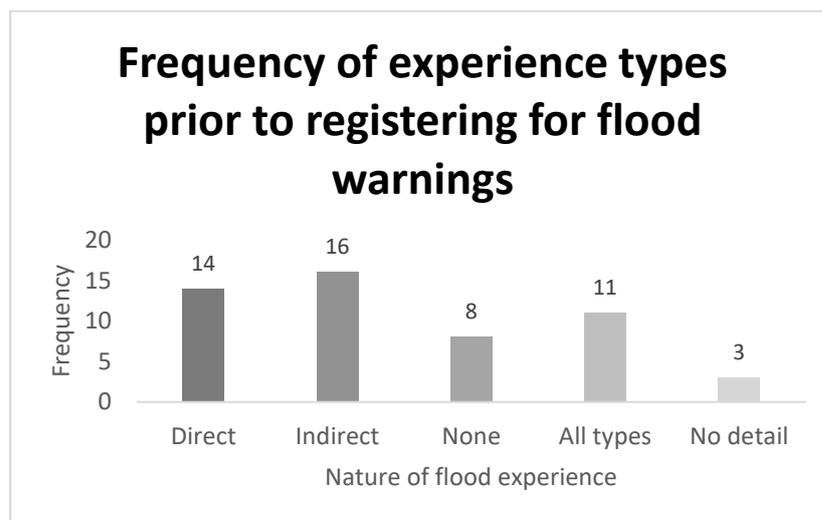


Figure 7.6 Frequency of flood experience type prior to registering for flood warning service

### 7.2.3 Geographic spread

The geographical location of respondents was examined. Although invitations to participate in the survey were sent to flood groups across England, Wales and Scotland, those respondents who included their post-code data were confined to England, with noticeable concentrations in the areas that had experienced severe flooding in the summer of 2007 (the lower Severn catchment) together with the winter floods of 2013/14 and 2015/16 (Cumbria), respectively. This does not mean that only those dwelling in England had taken part: the precise locations of all participants could not be ascertained, as 14% of the respondents (who completed the subsequent survey sections) had left the postcode field blank. Caution should, therefore, be exercised in extrapolating the results to the devolved government areas.

#### 7.2.4 Psychometric test profiles

The literature discussed in preceding chapters showed that scores on psychometric tests, including General Self Efficacy (Schwarzer, 1995) and Locus of Control (Levenson, 1973), have been associated with the tendency to prepare for, and adapt to natural hazards. Both of the standard inventory formats incorporated into the survey instrument in the present study were scored in accordance with their originators' guidelines in each case (Levenson, 1981; Schwarzer and Jerusalem, no date); for each respondent completing this section of the questionnaire a single GSE score, and a set of 3 scores for the IPC scale for locus of control, was produced.

##### 7.2.4.1 GSE

The GSE scores attained by the respondents completing this section were notable for the absence of scores lower than 23 (Figure 7.7), although the lowest possible score on this inventory is 10. The mean score was 31.84 (S.D. 3.94;  $n = 68$ ).

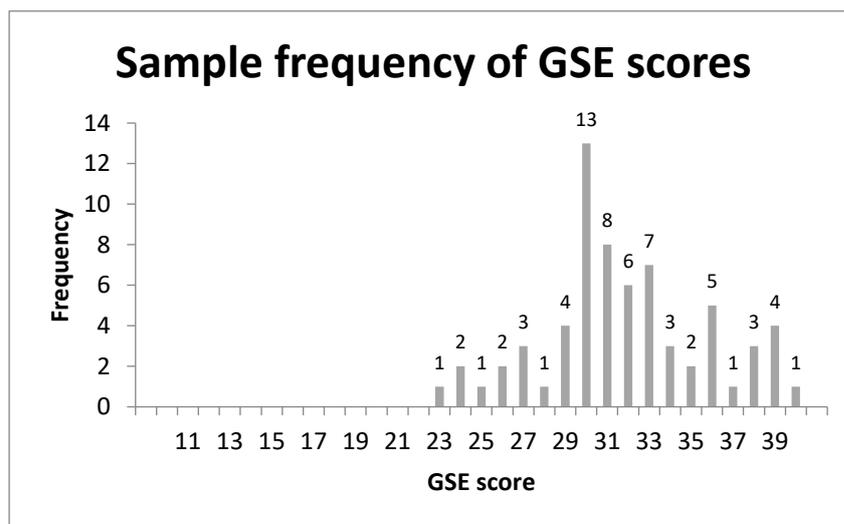


Figure 7.7 GSE scores in the sample

To contextualise this, the GSE scores for the populations of several countries (including Great Britain) were examined by Scholz *et al.* (2002) who found the GSE scale to be reliable, homogeneous, and unidimensional across 25 nations, and that:

*The frequency distribution of the self-efficacy sum scores of the total sample comes close to a normal distribution ( $M = 29.55$ ,  $SD = 5.32$ ,  $kurtosis = .38$ ,  $skewness = -.52$ ,  $N = 19,120$ ). (p248) (Data are available at: [http://userpage.fu-berlin.de/~qgesund/qesu\\_engl/world\\_zip.htm](http://userpage.fu-berlin.de/~qgesund/qesu_engl/world_zip.htm)).*

The data for randomly sampled GB adults was extracted, and the mean was calculated as 29.23 (SD 5.33; n= 219). The distribution is shown in Figure 7.8.

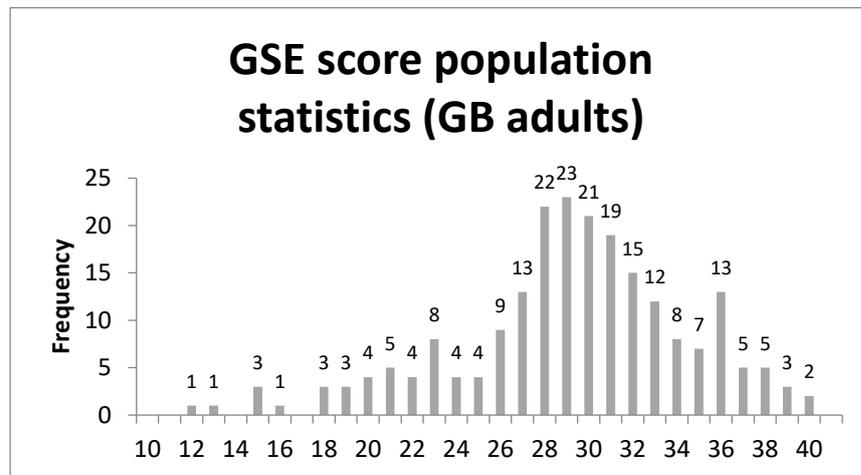


Figure 7.8 GSE scores distribution for GB adult population (n=219)

A t-test was performed comparing the GB adult statistics with the survey sample, the null hypothesis being that *'the sample mean is equal to the population mean'*. The result (2-tailed t test) was calculated as: p-value <0.01.

This result means that the null hypothesis should be rejected, hence this group of respondents differs from the general adult population.

#### 7.2.4.2 Locus of control

The means for the sample on the three sub-scales are as follows:

LoC-Internal – 33.30

LoC-Powerful Others – 16.22

LoC-Chance – 18.22

The relationships between dimensions are, therefore, consistent with findings (within Western countries) from previous studies, as discussed by Levenson (1981):

*... for most samples, scores on the Internal Scale are consistently higher than those on the Powerful Others or Chance Scales. Such a finding is as expected, for two reasons: (a) For most Western societies belief in personal control is a given cultural perception, and (b) a certain degree of personal means-end connection is basic to survival and coping in the world.*

Unlike the GSE test, there are no (publicly available and reliable) UK population statistics for Levenson’s test; whilst there is such data from the USA, the cultural differences identified by Hofstede (no date) and which were discussed in Section 5.4.2, mean that direct comparisons (and thus t-tests) would be inappropriate (Appendix 3). However, as highlighted in Table 7.1, it is noteworthy that the UK sample mean for LoC-PO is somewhat lower than that for LoC-Ch, unlike the USA data (Levenson, 1981), which has very similar means on both externality dimensions.

Table 7.1 Adult LoC scores for USA population (1981) and UK sample (2016)

|                              | Internality |      | Powerful Others |      | Chance |      |
|------------------------------|-------------|------|-----------------|------|--------|------|
|                              | mean        | SD   | mean            | SD   | mean   | SD   |
| USA data <sup>1</sup>        | 36.99       | 6.38 | 18.13           | 9.60 | 18.43  | 8.62 |
| Sample data, UK <sup>2</sup> | 33.30       | 6.01 | 16.22           | 7.37 | 18.22  | 7.28 |

<sup>1</sup> Levenson, 1981 (n = 860); <sup>2</sup> sample UK 2016 (n=67)

For a full table of descriptive statistics for all variables, see Appendix 4; a full set of frequency charts is also included as Appendix 5.

### 7.3 Proxy variables

#### 7.3.1 Mitigating actions taken

Lists of possible actions were presented in three groupings: water exclusion (resistance) measures; water entry (resilience) measures; and ‘other’ (largely cost free) actions, such as signing up to receive flood warnings, or moving valuables to higher locations (these actions being in line with the Environment Agency’s broad definition of ‘taking action’, as used in their Flood Awareness Campaign Tracking Survey (Ipsos MORI, 2008)). Where any additional measures were entered in the text field ‘Other, please give details’, these were then assigned to the most appropriate of the three groupings above before further analysis was undertaken.

One of the listed measures under ‘other’ was ‘Joining a flood group’; under the terms of the consent procedure, all participants were *required* to be members of such a group in order to participate (the question was designed to elicit the date of joining, for comparison with the dates of flood events). By removing this ‘action’ the total number of mitigation actions actually taken *in addition* to such membership could be ascertained and this is shown in Figure 7.9. Of the respondents who had completed all the flood section of the survey 92% were found to have undertaken between one and fifteen additional mitigation actions.

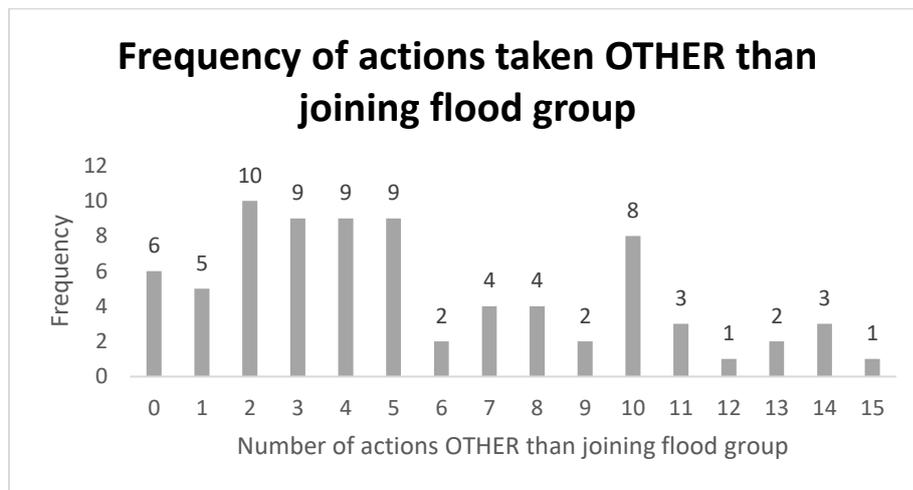


Figure 7.9 Frequency of total mitigation-actions taken in addition to joining a flood group

The commonest type of measures were those in the ‘other’ category, with a mean of 3.29 measures per respondent and a wide degree of variability (SD = 2.36). As anticipated from the literature, water exclusion (resistance) measures were more common than water entry adaptations (resilience) measures (mean 1.21 and SD=1.69; mean 0.82 and SD=1.47, respectively). The mean of the total number of measures (all three categories) was 5.32 (SD=4.51).

Refining the approach somewhat, the first actions taken in each of the three categories were then identified (based on the earliest dates provided); the frequency of the choices made is shown in Figures 7.10, 7.11 and 7.12.

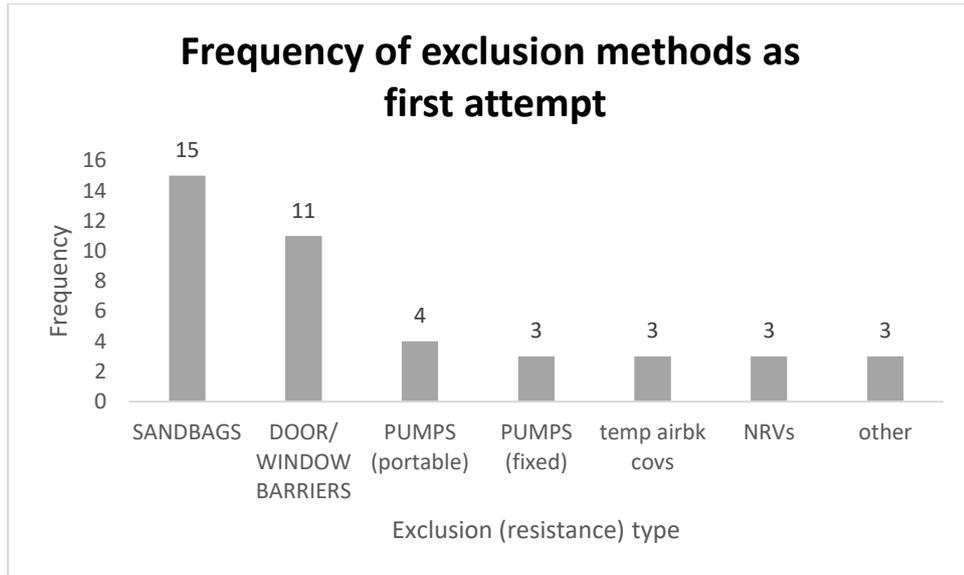


Figure 7.10 Earliest action taken - frequency of choosing different water exclusion methods

The commonest resistance method was the sandbag, which is consistent with the findings in a Scottish study (Dittrich *et al.*, 2016). In some instances in the present research, however, sandbags were used in conjunction with other methods (for example, door barriers) so may have been intended to deflect water-borne debris, rather than as an exclusion method *per se*.

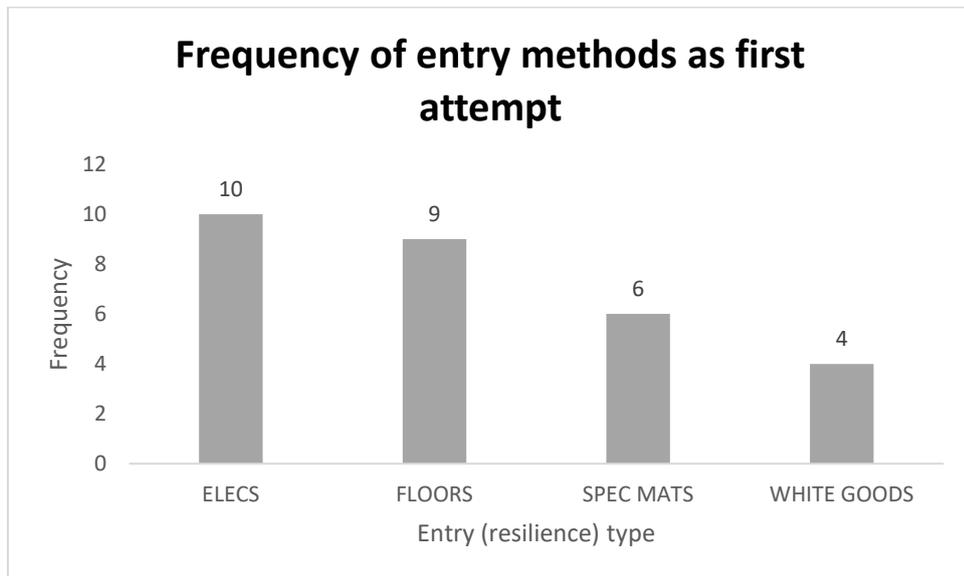


Figure 7.11 Earliest action taken - frequency of choosing different water entry methods

The commonest method here was 'Electrical sockets/ fuse-boxes/ meters moved higher up on walls', which has been found to be a low-cost or near cost-neutral

option when flood reinstatement is taking place (Lamond *et al.*, 2018). Similarly, the measure *'Replaced flooring materials with water-resistant ones'* could have been undertaken as part of a reinstatement process, rather than as an explicitly resilient approach.

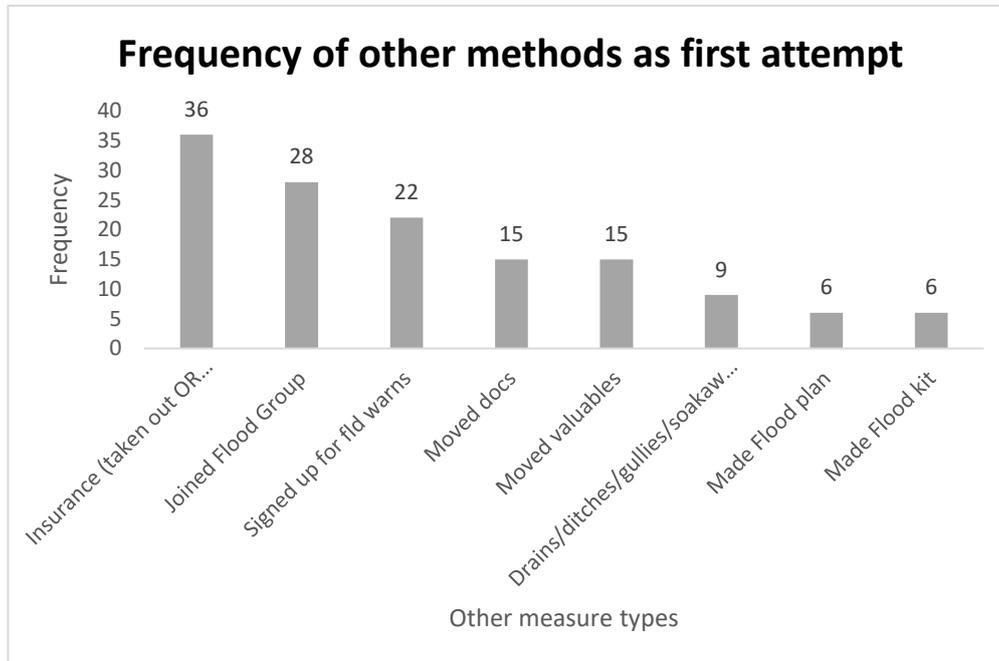


Figure 7.12 Earliest action taken - frequency of choosing other methods

Whilst the commonest measure in the 'other' category related to insurance, it is possible that the UK practice of 'bundling' flood cover in with general building policies has increased the response rate here: the dates stated in some cases seem likely to reflect the commencement of mortgage-related buildings policies, rather than any flood-specific policies. It should also be borne in mind that the creation of local flood groups and flood warning provision will be date-specific: neither option can be taken until it becomes available in the area concerned.

### 7.3.2 Flood mitigation weighting procedure

As the financial costs between (and, in some cases, within) the three main categories differ widely, a weighting process was then undertaken. This was based upon the indicative cost bands (for application to a single dwelling) used in the 'Know Your Flood Risk' campaign's *'Householders' guide to flood resilience'* (6<sup>th</sup> edition, 2018); the relevant summary shown in Table 7.2.

Table 7.2 Summary costing bands from 'Know Your Flood Risk' guide

| <b>Cost range</b> | <b>Band</b> |
|-------------------|-------------|
| <£100             | Low         |
| £100 - £750       | Low-medium  |
| £750 - £1500      | Medium      |
| £1500 - £5000     | Medium-high |
| >£5000            | High        |
| >£10000           | Very high   |

(after Dhonau *et al.* 2018, p21) Used with permission of the author

For each measure taken by a respondent, the mid-point of the bands above was used as a proxy measure of the cost/effort/time involved (with the value of each action within the 'Low' band deemed to be £50, even where cost-free) and a total value of the 'investments' made by each individual then calculated. This forms the 'mitigation score' (hereafter MitScore) used in further analyses: for example, if an individual had taken all seven actions in the 'Other' category (regardless of date) but nothing else, this would yield a MitScore of £350. All the categories used are shown in Table 7.3. There was an open-ended question regarding any measures taken that were not already listed within the survey instrument: the upper limit of the total MitScore was, in effect, infinity. (The calculations are included in Appendix 6).

Table 7.3 MitScores assigned to each cost range

| <b>Cost range</b> | <b>MitScore generated</b> |
|-------------------|---------------------------|
| <or=1K            | 1                         |
| 1001 to 5000      | 2                         |
| 5001 to 10000     | 3                         |
| 10001 to 15000    | 4                         |
| 15001 to 20000    | 5                         |
| 20001 to 25000    | 6                         |
| 25001 to 30000    | 7                         |
| >30K              | 8                         |

The distribution of total scores is shown in Figure 7.13.

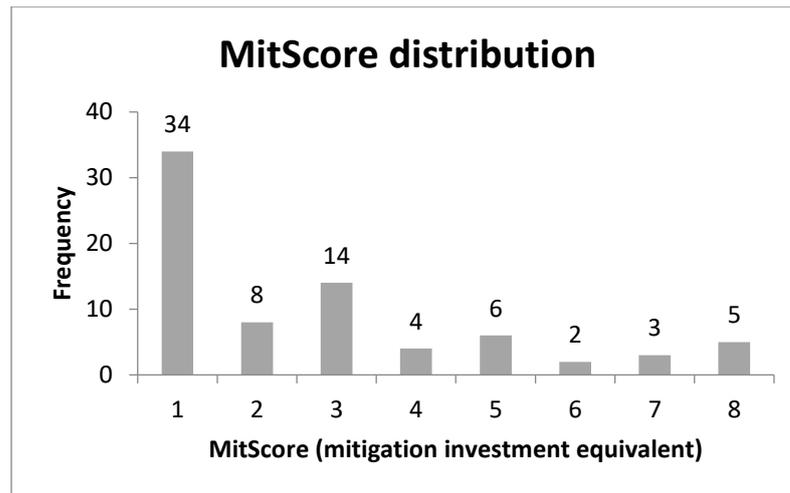


Figure 7.13 Percentage of respondents with the same MitScore

Although 45% of the respondents had scores of 1 (an investment equivalent of <£1000), the remaining 55% exceeded this, with a peak around the £5-10k category. This finding represents a marked contrast with the levels of mitigation activity reported in the UK flood-risk population previously: for example, Thurston *et al.* (2008) found only 33% had taken any steps of this kind.

### 7.3.3 Drivers of positive actions – flood experience

As discussed in Chapter 3, the definitions of ‘experienced’ and ‘non-experienced’ in a flood context can be open to interpretation: for example, a (superficially) straightforward category ‘*Not been flooded before*’ (as used by the EA, quoted in Thrush *et al.* (2005) contrasts with the more specific ‘*... affected by flooding in your current residence*’. The difference is heightened when the latter is further subdivided into ‘*... homes had been damaged by floods*’ as opposed to ‘*flood waters reach their property, but without damage*’ (as used by the ‘UR-Flood’ strand of the CRUE Funding Initiative (2011)).

Respondents were asked for the years in which different types of flood experience had occurred, under three main headings: direct (floodwater in *rooms actually lived in*); indirect – flooding affected *garages/outbuildings/gardens* or the *ground floor* of multi-storey buildings; indirect – flooding affected ‘*people you know*’. Consistent with the findings of many previous studies, there is a positive relationship between the number of direct flood events experienced and the overall level of investment in flood mitigation (consistent with experience acting as a driver of preparedness),

likewise the total number of floods of all types (direct and indirect). The existence of two 'extreme outliers', (as shown in Figure 7.14) where 10 direct floods were noted (by respondent 32; MitScore 3) and 12 (by respondent 91; MitScore 8) may, however, affect any underlying trends.

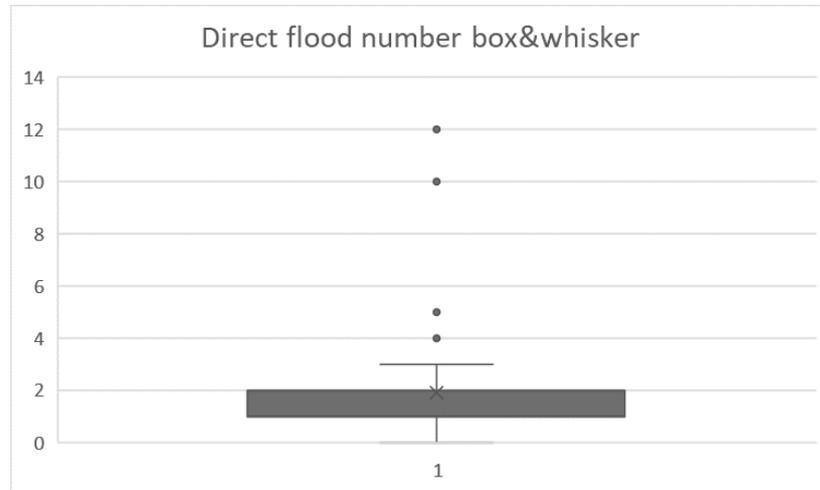


Figure 7.14 'Box and whisker' plot showing number of direct floods experienced

The year in which each respondent had first taken action in any of the flood-type categories was identified (manually) so that a comparison could be made between this information and the dates of any flood experiences and other (potentially) relevant occurrences. Where the earliest action dates provided were found to precede earliest flood experience dates stated, those individuals conformed to the 'anticipatory adapters' group (as discussed in the preceding chapters).

The potential drivers or 'trigger events' which preceded positive action were examined (manually) and were found to fall into the four categories (Table 7.4) which were then numbered in increasing emotional 'affect' order (the trigger type associated with the most impact, direct flooding of the home, has the highest score)<sup>3</sup>.

---

<sup>3</sup> As the Government Grants (discussed in section 7.3.5) were only available to properties that had already been damaged by (direct) flooding it was decided not to regard this as a separate trigger category: only 5 respondents fell into the group concerned (first mitigation action around same date as grant received/applied for). The 'TrigCat' definitions were therefore predicated on the 'affect' associated with the experience itself.

Table 7.4 Statistics for 'trigger types'

| Trigger type             | 'TrigCat' label | Frequency of adapters | Percentage adapters |
|--------------------------|-----------------|-----------------------|---------------------|
| no triggers identifiable | 1               | 19                    | 26.39               |
| other triggers           | 2               | 13                    | 18.06               |
| vicarious (people)       | 3               | 13                    | 18.06               |
| direct (inside home)     | 4               | 27                    | 37.50               |
|                          |                 | 72                    | 100.00              |

The distribution of trigger categories shows the Direct flood group is the largest, but the 'no identifiable trigger' group is second largest (these being the *assumed* 'anticipatory adapters' who appear to have taken action in the absence of direct or indirect experience, or pressure from insurers).

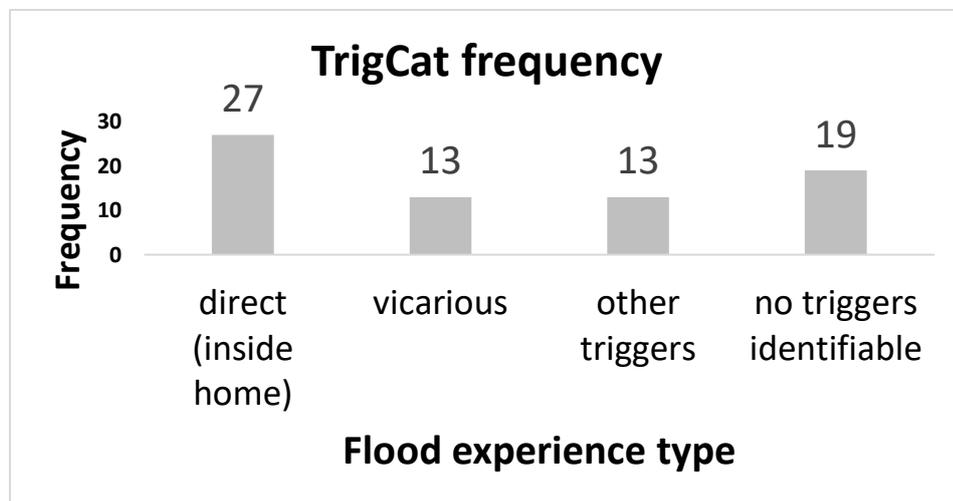


Figure 7.15 Chart showing frequency of different trigger types.

As shown in Table 7.4, the assumed 'anticipatory adapters' in this sample (based upon the date of first mitigation action) constitute 26.39% of the respondents (trigger category 1); a less nuanced definition of 'experience' would, however, have placed both the 'indirectly flooded' respondents in the same category as those with

no flood experience (meaning 62% would appear to have taken at least one mitigation actions in the absence of flood exposure).

#### 7.3.4 Relationships between mitigation actions and psychometric data

Literature suggested that both GSE and internality locus scores would be more strongly associated with preparedness behaviours (MitScore) than scores on either of the two Externality dimensions. Neither factor was found to have a strong linear relationship with MitScore however, as shown by the scatter plots shown in Figures 7.16 and 7.17.

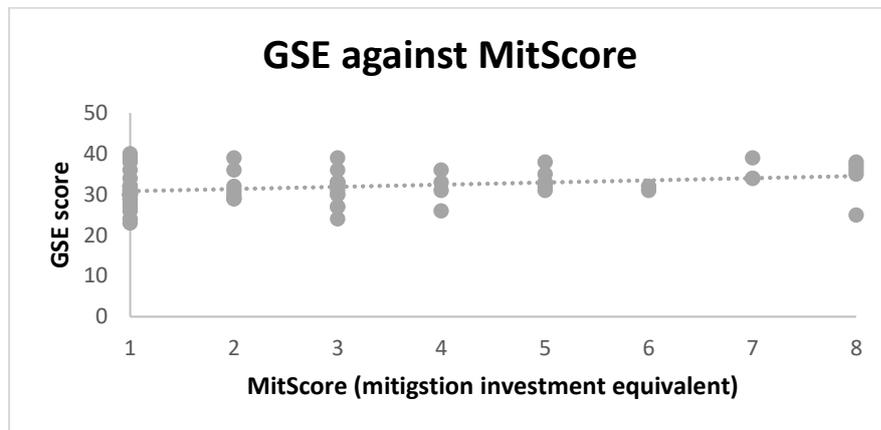


Figure 7.16 Scatter diagram – GSE against MitScore

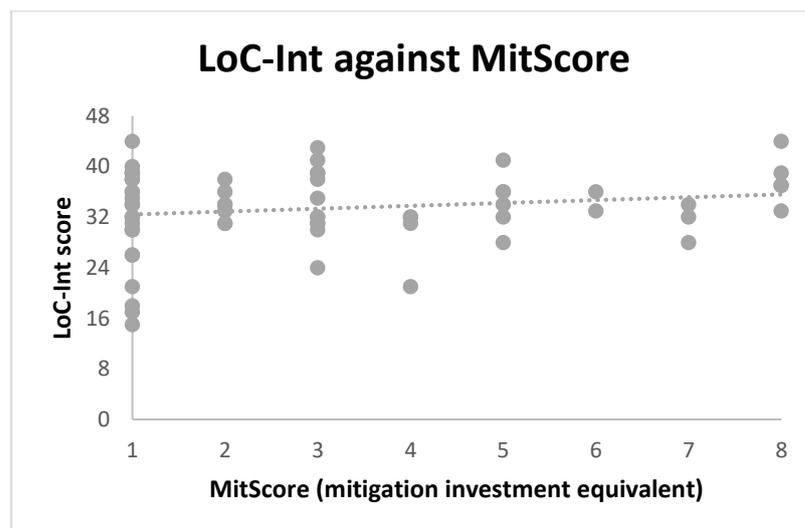


Figure 7.17 Scatter diagram – LoC-Int against MitScore

There is, however, some indication of a linear relationship (albeit weak) between internality and self-efficacy, as shown in Figure 7.18.

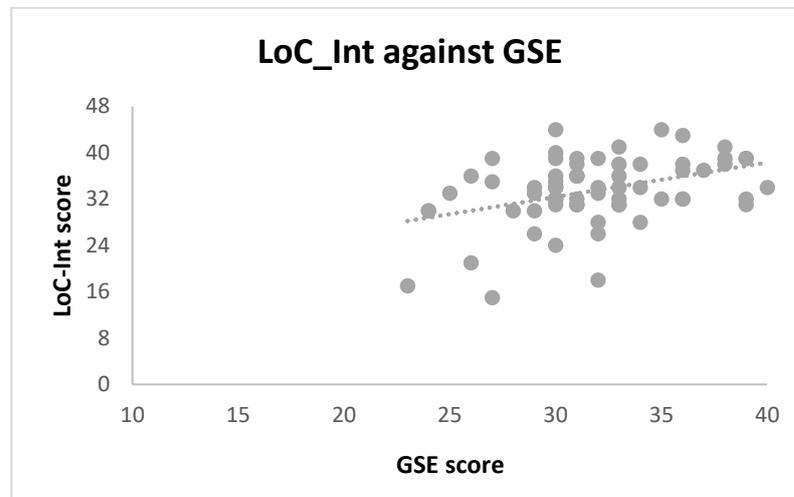


Figure 7.18 Scatter diagram – LoC-Int against GSE

As discussed in preceding chapters, the complexity of human behaviour in relation to flood preparedness was not anticipated to produce clear-cut linear relationships with any single variable: correlations between all the variables will now be examined followed by further analysis of the data employing more complex techniques.

#### 7.3.5 Governance issues – grants and insurance

Of the 86 households that had taken mitigation actions of any kind, 20 had received (or were still awaiting the outcome of applications for) government grants for property level measures. In six instances, resistance solutions alone were chosen, but twelve households (60%) opted for a mix of resistance and resilience solutions (known as an 'integrated strategy'). This means floodwater is excluded during lower level events, but ingress is accepted in more extreme floods (usually to prevent structural damage occurring). The remainder were still awaiting the outcome of funding applications at the time of participation, and the type of measures involved was not stated in every case.

In four cases, insufficient detail had been provided to assess the chronological sequence; for the rest, in five instances some physical adaptations to the property had already been undertaken prior to grant date, and (where details were provided) the additional funding had typically been used for measures known to be relatively

expensive such as basement-tanking, or resilient kitchens. The remaining eleven properties, however, had made use of the grants to take action in a new category: for example, to fund additional resistance products plus first-time adoption of resilience measures. In five cases the date of first action (in any category) was the same as, or in the year immediately after, the date of the grant receipt or grant application, suggesting the grants were indeed acting as a financial driver of behaviour. The data relating to this section is included in Appendix 7. In only one case was it possible to identify mitigation activity specifically linked to an insurance issue; however, the details given revealed this followed an unusual instance of underground flooding caused by a fractured water main, and therefore this line of enquiry could not be pursued any further in the present study.

Having reviewed the data collected, the relationships between all variables will now be explored.

## 7.4 Correlation testing

### 7.4.1 Normality of data set

The data include a large proportion of non-normally distributed variables. Parametric tests such as t-tests and ANOVAs are inappropriate for non-normal distributions, hence non-parametric tests (such as Spearman's Rho) were the most appropriate methods for further analysis. A full set of 'box and whisker' plots is included in Appendix 8.

#### *7.4.1.1 Spearman's Rank order correlation*

Scatter plots in the previous section indicated there are only weak linear relationships between Loc-Internality, GSE and the MitScore. The Spearman's rank-order correlation is the nonparametric equivalent of the Pearson product-moment correlation. It is used to determine whether there is a monotonic (rather than a linear) relationship between two continuous, ordinal or ratio variables; the test examines the full set of variables in pairs, and the table of results is shown on pages 142-144.

There are 15 significant correlations in all, as shown below:

Positive Correlations x 4 – sig at 0.01

GSE and income; GSE and MitScore; Loc-Int and GSE; Loc-Ch and Loc-PO.

Negative Correlations x 4 – sig at 0.01

Income and age; Loc-Ch and income; Loc-PO and GSE; Loc-Ch and GSE.

Positive Correlations x 4 – sig at 0.05

MitScore and TrigCat; Loc-Ch and gender; Education and income;

Loc-Int and Education.

Negative Correlations x 3 – sig at 0.05:

Income and TrigCat; GSE and gender; Loc-Int and gender.

#### *7.4.1.2 Interpretation*

Making use of Cohen's standard (Cohen, 1992) to evaluate the correlation coefficient to determine the strength of the relationship, or the effect size. Correlation coefficients between 0.10 and 0.29 are said to represent a small association; those between 0.30 and 0.49 a medium association; and coefficients of 0.50 and above represent a large association or relationship. The largest association identified within these data is that between LoC-Chance and LoC-PO (+0.654); as both these variables measure (different aspects of) externality beliefs, this is not unexpected. There is a medium positive association between GSE and Income (0.429) and a medium negative association between Age and Income (-0.487).

The findings of key relevance to the conceptual framework (Chapter 5), again classified in accordance with Cohen's Standard (Section 7.4.1.3) are as follows:

- a) The medium positive association between GSE and MitScore (+0.358) indicates those respondents perceiving themselves as more self-efficacious are also those investing greater sums in flood mitigation measures over time.
- b) The small positive association between MitScore and TrigCat (+0.236) shows those making greater investment in mitigation over time also tend to be those with higher affect initial flood experiences (direct flooding).

- c) The small positive associations between Loc-Int and Educ (+0.235) shows those with higher educational attainment levels also tend towards higher internal locus scores.
- d) The small negative association between Income and TrigCat (-0.257) would suggest those with higher incomes tend to be those who take action in response to lower affect initial experiences, or in 'no affect' situations ie the absence of any experience at all (aka Anticipatory Adapters).

Table 7.5 Spearman's rank order correlation matrix for all variables

|                |         |                         | TrigCat | Gender | Age     | Income  | Educn | MitScore | GSE    | LoC-Int | LoC-PO | LoC-Ch  |
|----------------|---------|-------------------------|---------|--------|---------|---------|-------|----------|--------|---------|--------|---------|
| Spearman's rho | TrigCat | Correlation Coefficient | 1.000   | .117   | .148    | -.257*  | -.081 | .236*    | -.110  | -.079   | .069   | .047    |
|                |         | N                       | 72      | 61     | 61      | 58      | 59    | 72       | 67     | 66      | 66     | 66      |
|                | Gender  | Correlation Coefficient | .117    | 1.000  | -.126   | -.091   | -.064 | .073     | -.263* | -.248*  | .199   | .289*   |
|                |         | N                       | 61      | 61     | 61      | 58      | 59    | 61       | 60     | 60      | 60     | 60      |
|                | Age     | Correlation Coefficient | .148    | -.126  | 1.000   | -.487** | .093  | .024     | -.088  | .104    | -.027  | .031    |
|                |         | N                       | 61      | 61     | 61      | 58      | 59    | 61       | 60     | 60      | 60     | 60      |
|                | Income  | Correlation Coefficient | -.257*  | -.091  | -.487** | 1.000   | .277* | .198     | .429** | .184    | -.204  | -.356** |
|                |         | N                       | 58      | 58     | 58      | 58      | 58    | 58       | 57     | 57      | 57     | 57      |
|                | Educn   | Correlation Coefficient | -.081   | -.064  | .093    | .277*   | 1.000 | .137     | .197   | .235*   | -.146  | -.131   |
|                |         | N                       | 59      | 59     | 59      | 58      | 59    | 59       | 58     | 58      | 58     | 58      |

|          |                         |       |        |       |         |       |        |         |        |         |         |
|----------|-------------------------|-------|--------|-------|---------|-------|--------|---------|--------|---------|---------|
| MitScore | Correlation Coefficient | .236* | .073   | .024  | .198    | .137  | 1.000  | .358**  | .099   | -.108   | -.090   |
|          | N                       | 72    | 61     | 61    | 58      | 59    | 76     | 67      | 67     | 67      | 67      |
| GSE      | Correlation Coefficient | -.110 | -.263* | -.088 | .429**  | .197  | .358** | 1.000   | .348** | -.410** | -.341** |
|          | N                       | 67    | 60     | 60    | 57      | 58    | 67     | 67      | 66     | 66      | 66      |
| LoC-Int  | Correlation Coefficient | -.079 | -.248* | .104  | .184    | .235* | .099   | .348**  | 1.000  | -.108   | -.168   |
|          | N                       | 66    | 60     | 60    | 57      | 58    | 67     | 66      | 67     | 67      | 67      |
| LoC-PO   | Correlation Coefficient | .069  | .199   | -.027 | -.204   | -.146 | -.108  | -.410** | -.108  | 1.000   | .654**  |
|          | N                       | 66    | 60     | 60    | 57      | 58    | 67     | 66      | 67     | 67      | 67      |
| LoC-Ch   | Correlation Coefficient | .047  | .289*  | .031  | -.356** | -.131 | -.090  | -.341** | -.168  | .654**  | 1.000   |
|          | N                       | 66    | 60     | 60    | 57      | 58    | 67     | 66      | 67     | 67      | 67      |

\* Correlation is significant at the 0.05 level (1-tailed). \*\* Correlation is significant at the 0.01 level (1-tailed).

## 7.5 Validation using factor analysis

The data-sets produced by the survey in this study are multivariate, with each observational unit being characterised by numerous variables. As discussed above, these data have also been shown to be predominantly non-normal, hence non-parametric tests are most appropriate for analysis purposes. However, the purpose of the experimental design here was not to obtain, say, 'before and after' samples, nor to establish whether a random sample of respondents was representative of a population of interest. Further exploration of the data by means of commonly applied tests (such as Kruskal-Wallis H) are, therefore, inappropriate in this instance. Instead, the characteristics of a specific sub-group are themselves of interest and, in particular, any interactions that may exist between the variables.

A different approach based on factor analysis has, therefore, been adopted and will now be discussed.

### 7.5.1 Factor analysis

Factor analysis refers to a group of procedures designed to determine the number of distinct unobservable constructs needed to account for the pattern of correlations among a set of measures. These constructs may be referred to as 'common factors' (Davis, 2002 cited in Booth *et al.*, 2006), and these hypothetical entities can be used to understand and account for observed phenomena. (Equivalent concepts from the physical sciences would be 'gravity' and 'magnetism': neither can be directly observed, only studied via observed events). The procedures typically provide information regarding the number of such factors, together with estimates of their strength and direction of influence, the latter being termed 'factor loadings'. It must be emphasised that these procedures are essentially mathematical (as opposed to statistical) techniques, hence the results are not subjected to any significance testing. Variants of this type of analysis have been used in the field of psychology for over a century (Spearman, 1904; de Roover *et al.*, 2017), including the original development and testing of the 'IPC Locus of Control Scale' (Levenson, 1973) used in the present study, as well as the 'Multidimensional Health Locus of Control (MHLC) Scales' (Wallston and Wallston, 1981). Although well-suited to analysis of complex

multivariate situations, their use has not been without criticism (Ford *et al.*, 1986; Fabrigar *et al.*, 1999) much of it due to incomplete and/or inaccurate reporting of the use of such methodologies in some studies.

This procedure is performed using the 'Minitab 17' application (by selecting 'Stat; Multivariate; FactorAnalysis'). The key graphical outputs are shown and discussed, in the next section; see table in Appendix 9 for detailed procedure.

#### 7.5.2 Simultaneous r- and q--mode factor analysis results

The 'Scree Plot' (Figure 7.19) shows four factors with Eigenvalues exceeding 1.0, with Factors 1 and 2 being of greatest interest, as these explain the 'lion's share' of the variance.

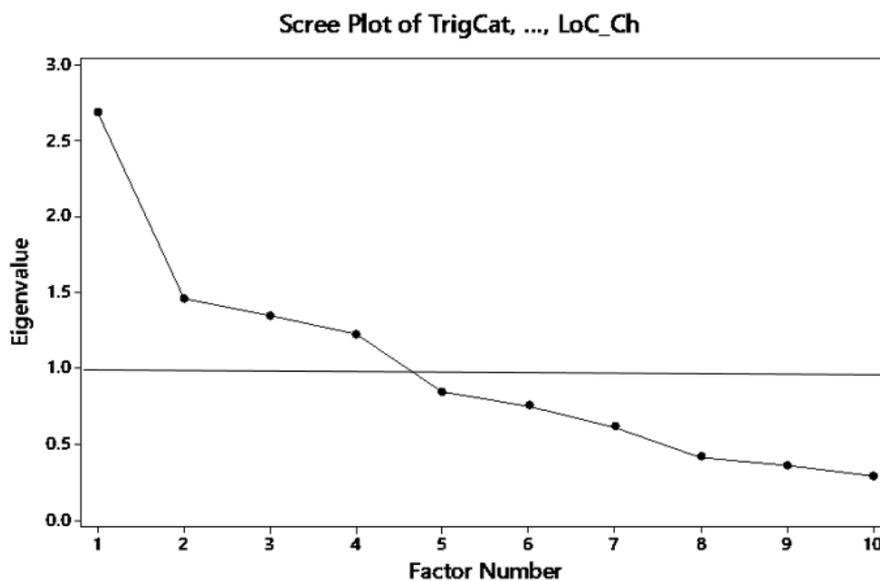


Figure 7.19 'Scree plot' of factors 1 and 2 (from Minitab analysis)

In the 'Loading Plot' (Figure 7.20) the lines closest to the Horizontal axis are those of the Variables (Loc-Int, MitScore and GSE) that control Factor 1; those closest to the Vertical (Age only here) control Factor 2. Parameters plotting in close proximity to each other on the 'Loading Plot' are generally highly correlated.

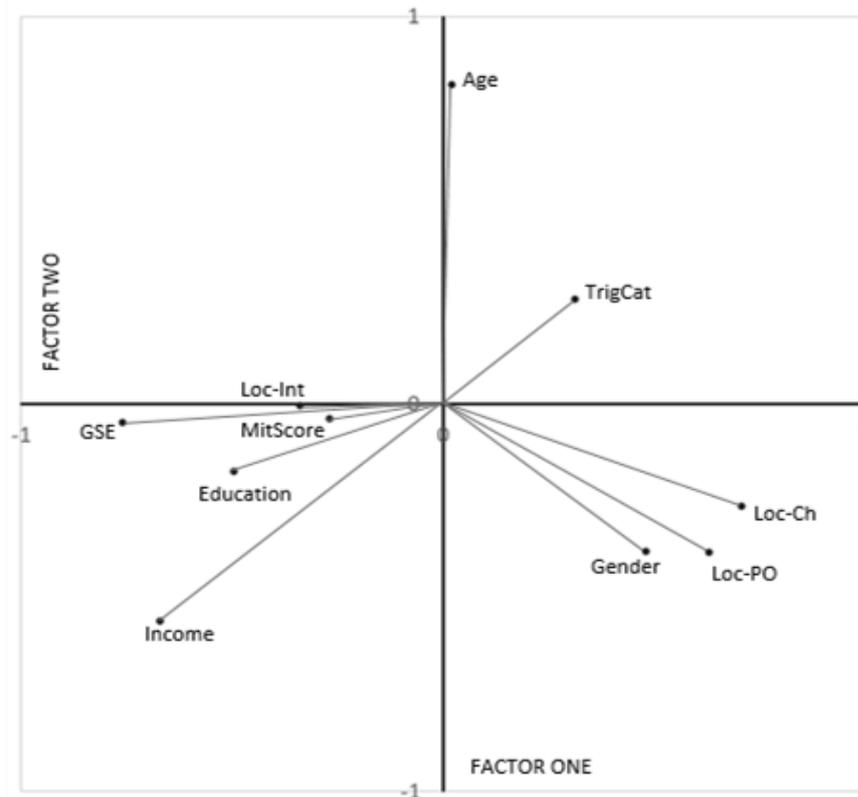


Figure 7.20 'Loading plot' of parameters (from Minitab analysis)

Note: this is a two-dimensional plot of multi-dimensional space, and the lengths of the lines do not indicate anything of significance in themselves.

In the 'Factor Analysis Plot' (Figure 7.21) there are three key points to be noted, as follows:

- Variables 1 to 5 have positive loadings on Factor 1, as the endpoints of these parameters are to the right of the vertical axis. These are: Age; TrigCat; Loc-Ch; Loc-PO; and Gender.
- Only two variables 1 and 2 (Age and TrigCat) have positive loadings on Factor 2, as the endpoints of these parameters are above the horizontal axis.
- The remaining variables, clustered in the bottom left quadrant, are all negatively loaded on both Factors 1 and 2.

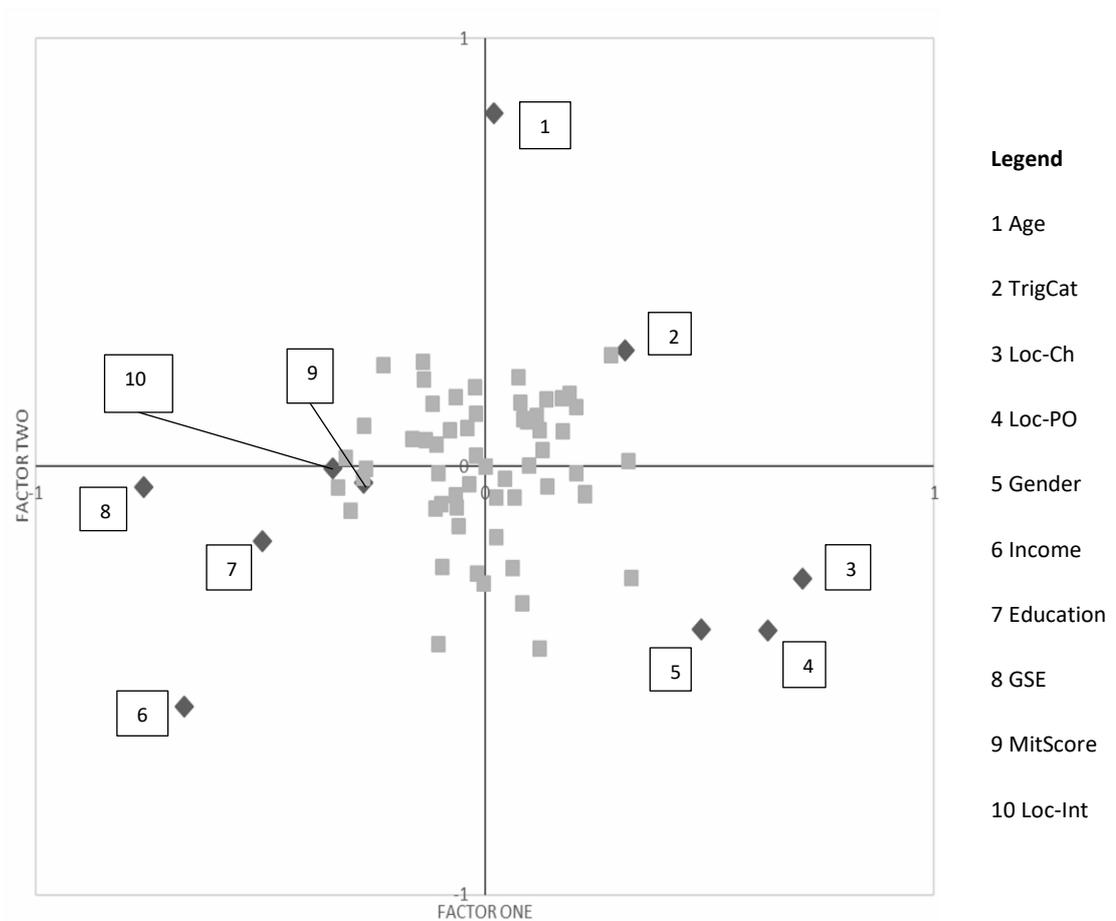


Figure 7.21 Simultaneous r- and q-mode factor analysis plot of Factor1 versus Factor 2, showing the relationship between the variables (from Minitab analysis)

Note: black diamonds are the ends of the axes for the parameters (the variables); the grey squares are the samples (the individual respondents).

Summary results from the factor analysis of the 10 parameters for the 79 samples (only 57 of which could be processed by Minitab owing to missing data) are shown in Table 7.6. Over 41% of the total variance is explained by factors 1 and 2; just over 67% is explained by Factors 1 to 4 (where the Eigenvalues exceed 1.0). As shown above, the variables Loc-Int, MitScore and GSE score influence Factor 1; while Age influences Factor 2. MitScore is the dependent variable in the conceptual framework (the proxy value of the actions that have actually been taken, as influenced by the range of variables suggested by the literature).

Table 7.6 Summary results from the factor analysis

showing the eigenvalues, total variance (%), cumulative eigenvalues, and cumulative total variance (%)

| Factors | Eigenvalues | Total Variance % | Cumulative Eigenvalues | Cumulative Total Variance % |
|---------|-------------|------------------|------------------------|-----------------------------|
| 1       | 2.68        | 26.82            | 2.68                   | 26.82                       |
| 2       | 1.46        | 14.60            | 4.14                   | 41.42                       |
| 3       | 1.35        | 13.47            | 5.49                   | 54.90                       |
| 4       | 1.23        | 12.26            | 6.72                   | 67.15                       |
| 5       | 0.85        | 8.46             | 7.56                   | 75.61                       |
| 6       | 0.75        | 7.53             | 8.31                   | 83.15                       |
| 7       | 0.61        | 6.15             | 8.93                   | 89.29                       |
| 8       | 0.42        | 4.18             | 9.35                   | 93.47                       |
| 9       | 0.36        | 3.61             | 9.71                   | 97.08                       |
| 10      | 0.29        | 2.92             | 10.00                  | 100.00                      |

#### 7.5.1.1 Interpretation of simultaneous r- and q-mode analysis

The results support much of the correlational analysis carried out previously (Section 7.4): both GSE score and Education plot closely to MitScore (in the lower left quadrant), which is consistent with the positive associations identified using Spearman's test. However, another factor plotting in close proximity here is LoC-Int score, which the literature suggested would be associated with positive behaviours, but which the Spearman's test did not identify as having a significant correlation. The other factor occupying this quadrant is income, which confirms the association indicated by the literature: those possessing an internal locus tend to have higher educational attainment and, therefore, be equipped to earn higher incomes.

Two factors that plot diametrically opposite each other are Income and TrigCat. This is consistent with the negative association found using Spearman's test (such that higher Income earners tend to take action in response to flood experiences less laden with severe 'affect' (such as indirect/vicarious types) or in the absence of any identifiable triggering (behaviour driving) events. The only anomalous result concerns the relationship between MitScore and TrigCat; the Spearman's test indicated a small positive association between these factors, but the r- and q-analysis shows these factors in diagonally opposed quadrants, though not in a direct line relationship. In summary, the validation using simultaneous r- and q-mode analysis

is supportive of the majority of the earlier correlational analysis, as well as being consistent with the results anticipated from the literature review.

## 7.6 Summary

In this chapter, the findings from the questionnaire survey have been presented, including the characteristics of the survey sample and calculation of two proxy variables to represent data derived from the date information provided, and the extent of mitigation carried out, respectively. The relationships between the variables were then examined by means of non-parametric tests and other techniques appropriate to the nature of the data collected. The implications of the findings are discussed in greater detail in the following chapter.

## CHAPTER 8 – DISCUSSION

### 8.1 Introduction

This chapter addresses the first element of the seventh objective stated in section 1.5. The results of the data analysis conducted in Chapter 7 are examined in depth together with the implications of the findings for a range of stakeholder groups, and the limitations of the study are identified.

### 8.2 Flood group membership characteristics

The data collected in this study was derived from a specific sub-group of the at-risk population, namely members of local flood groups. As was demonstrated in Chapter 6, this group of respondents appears to be atypical in a number of respects in comparison with the commonly identified characteristics of those living in flood risk areas. For example, the extent of flood experience has frequently been identified as a factor in the decision to make preparations for further floods (Grothmann and Reusswig, 2006; Siegrist and Gutscher, 2008). Two UK examples include Harries (2013) who found only 14% (69 out of 495) of householders adopted property level measures until *more than two* ‘floods in the home’ had occurred; conversely, 12 months after a severe flood event with a return period estimated as >1:200 years (Marsh, 2008) in Sheffield, just 2.7% of those eligible for flood warnings had registered for the service (Walsh, 2008).

It is noteworthy that an unusually high number (67%) of the respondents in this survey had taken one or more mitigation action(s) even though they had experienced only one, two, or no floods at all in their homes; this figure rises to 78% when indirect flood experiences are also taken into account. Similarly, over 46% of those who were registered for flood warnings had done so prior to having any direct flood experiences (30.8% had some indirect experience; 15.4% had none at all). Bearing in mind that much previous work has been predicated on a binary ‘Flooded/Not flooded’ basis, there is clearly a need to ascertain the nature of householders’ flood experiences in more detail in order to categorise the at-risk population more appropriately when devising initiatives to increase mitigation behaviours.

The sample is dominated by highly educated people, with their highest educational attainment being either a Bachelor's degrees (or equivalent) or post-graduate/professional qualifications (64.4% in all). This is substantially higher than the 42% of the UK adult population who possessed higher education qualifications in 2017 (HESA, 2018). This may be indicative of the type of individual most likely to volunteer for community-based groups, or factors such as being confident/comfortable with using the online survey methodology. Barnett *et al.* (2008), reporting on interactions between the Environment Agency and special interest groups (of all kinds) note that members of such groups tend to be 'motivated, mobilised individuals' who have the confidence to communicate with officialdom, founded on possession of both educational and social capital. In respect of flood groups, the same report also notes evidence the motivation for joining often includes altruistic concern for other community members, not simple self-interest; this is also consistent with the findings of Organ (2015) in relation to energy efficiency measures. These findings would suggest membership of such groups is unlikely to be representative of the full range of at-risk individuals, hence the current sample profile is not unexpected. Future work, therefore, might usefully explore these aspects of flood group membership.

To qualify for participation in the survey, the person completing the questionnaire had to be a flood group member. (This was a stipulation of the ethics permission, to avoid asking those vulnerable by reason of PTSD to participate). It is therefore possible that this was not necessarily the same person responsible for major financial decisions (such as adoption of extensive water-entry strategy measures) in the household concerned. If this did occur, then the psychometric scores obtained may not have belonged to the decision-maker and it is recognised that this could compromise the findings where such a situation pertained. Future research on this topic would therefore benefit from an additional filtering question, positioned early in the survey instrument, to eliminate this risk.

The population at flood risk in the UK was not sampled randomly, as this would not have accorded with the research aim: representativeness of the at-risk population was not sought, as generalisability was not the intention. The response rate was

calculated as being below 10%, the population total being the estimated number of flood group members in the UK. This aspect of the study may well have been impacted by two issues: firstly, the use of 'gatekeepers' to distribute the invitations to participate means the total number actual contacted could not be accurately ascertained; secondly 'survey fatigue' may have affected those who did receive the invitation, as discussed by Paton *et al.* (2015), as flooding has been the subject of a great deal of research in the UK in recent years.

Overall, the findings provide confirmation that flood group members (as discussed in Chapter 6) represent an atypical sub-group of the at-risk population, displaying high rates of adoption of flood resilience measures, as was anticipated by the experimental design.

### 8.3 Research questions

The research questions stated previously will now be examined in turn.

#### 8.3.1 The nature of flood experiences

*Q: To what extent does the nature (direct or indirect) of flood experiences correlate with the first adoption of flood resilience measures in at-risk areas?*

*A: Experience was confirmed to be a driving factor, but both direct and indirect flood exposure had acted as triggers to action: 37% had already had one or more direct floods prior to acting; a further 36% had either vicarious experience (knew people affected) or indirect experience (eg flooding in garden/locality but not home). Unique to this study is that the remainder of this sample had no identifiable motivational triggers at the time their first mitigating actions were taken.*

The proxy variable named 'TrigCat' (behaviour driving factor) signifies the nature of the earliest flood exposure (if any) revealed by examining the respondents' date information. The highest percentage of those who had taken action (37.5%) had also experienced one or more direct floods and this is broadly in line with the findings of many previous studies (for example, Harries, 2007; Deeming, 2008): these experiences are likely to have acted as drivers of mitigation activity. The second

largest group, however, comprised those with no apparent triggers that could have motivated their actions (26.4%). Compared with the findings from the previous literature, this is an unusually large number: Harries (2007) reported the figure to be around 6% (of those who were aware they lived in a flood risk area); similar proportions (between 5-9%) are noted by others (Baumann and Sims, 1978; Kunreuther, 2008; Lamond *et al.*, 2009). Both types of indirect experience (vicarious - impacting upon other people; other - affecting places outside the home, or combinations of the two) were also present in substantial proportions (18% in each case) which underlines the importance of framing questions about previous 'flood experience' in a more nuanced manner than has been the case in many previous investigations. This would suggest the role of vicarious and other indirect experiences in the decision-making process around flood mitigation may have been underestimated in some studies. It is also consistent with the research need identified by Becker *et al.* (2017): study of the diverse types of hazard experience is required if we are to better understand the drivers and barriers involved in preparedness decision-making in individuals from at-risk communities.

The experience issue also has implications as regards another variable: the perception of self-efficacy. This does not remain static, but changes throughout adult life and, as discussed previously (Section 4.3) the types of experiences contributing to increased levels of perceived self-efficacy are explicitly stated to include vicarious as well as direct forms (Bandura, 1977). Witnessing how other people deal with flooding and its aftermath could, therefore, affect an individual's perception of their own likelihood of coping successfully in similar circumstances (such as their ability to imitate appropriate strategies, whilst noting less fruitful actions that are to be avoided). Whilst vicarious experiences may not be as effective as direct experience in eliciting action, they may provide a 'window of opportunity' for such learning experiences:

*"Consistent with the social learning analysis of the sources of self-efficacy, experiences based on performance accomplishments produced higher, more generalized, and stronger efficacy expectations than did vicarious*

*experience, which in turn exceeded those in the control condition.*"(Bandura, 1977) (page 205)

Although direct experience of flooding itself cannot be delivered to individuals for obvious ethical and practical reasons, differing kinds of indirect experience can be provided: for example, a project in the UK sought to engage local communities with historic flood events in their area, by means of oral histories, photographs and a presentation on a tsunami that occurred in the seventeenth century (McEwen, 2006). Another method, developed in Germany, makes use of a transparent water-tight box containing items of furniture to resemble a domestic lounge; a volunteer enters the room and water is introduced mimicking the flooding process, including the reactions of the volunteer as the depth increases (Pasche *et al.*, 2007). This method contributes to a more vivid visualisation of the flood experience by the spectators, which is associated with evoking a greater degree of emotional 'affect'. By means of innovative approaches such as these, effective indirect flood experiences can be provided in ethically acceptable forms.

### 8.3.2 Governance issues

*Q: To what extent have governance issues (such as insurance costs and/or availability; government grant provision) influenced the patterns of measure adoption?*

*A: Insufficient respondents cited insurance issues within the sample for this to be pursued; 60% of those in receipt of grants had opted for a combined solution, which is an unusually high proportion.*

#### 8.3.2.1 Insurance

As Joseph *et al.* (2015) note, uninsured households stand to benefit financially, socially and health-wise by investing in mitigation measures. Until April 2016<sup>4</sup> when the Flood Re scheme commenced, many high-risk properties were uninsured, either because cover had been withdrawn, or made unaffordable following flood damage

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<sup>4</sup> Since this date, the 'Flood Re' scheme has ensured that affordable cover has again been made available for properties built prior to January 2008.

claims. It had been anticipated that such difficulties may have prompted some people to adopt mitigation measures, including joining a local flood group. In only one case, however, did the data reveal any mitigation activity specifically linked to an insurance issue (following an unusual instance of underground flooding caused by a fractured water main), therefore this line of enquiry could not be pursued any further in the present study. For this group of respondents, therefore, it appears that their decisions to adopt flood mitigation were prompted by other factors; any future research that looks back to decisions made prior to Flood Re's inception, may be able to clarify the matter.

#### *8.3.2.2 Government grant impacts*

As discussed in section 2.5.2, between 2006-2016 some areas of the UK benefitted from central-government funded grant schemes to help make homes more resilient to flooding. Findings are consistent with previous studies, in that resistance is the favoured option; however, in some other respects the results are very different. Review of the initial Defra grant scheme (Defra, 2008c), for example, shows that only 2% adopted an 'integrated strategy'; by contrast, 12 of the 20 grant recipients in this study (60%) had opted for a combined solution, whereby water is excluded in low level floods, but ingress is accepted in more extreme events (typically for water depths exceeding 600mm where hydrostatic pressure can cause structural damage). This unusually widespread tolerance of potential ingress could indicate these respondents have a better understanding of the relevant flood damage processes: allowing floodwater into the home can be a highly emotive issue, not least because of fears regarding potential or actual contaminants (Lamond *et al.*, 2017). Further work at the individual level would be needed, however, to better understand the motivational process involved, and this was not possible in an anonymised study such as this.

#### 8.3.3 Socio-psychological factors and flood protection

*Q: Are socio-psychological factors associated with the extent of enacted flood resilience actions?*

*A: Yes, a positive relationship was found to exist between level of mitigation investment and GSE score (at the time of the survey). The position regarding*

*LoC was less clear cut, but where a tendency toward an external locus existed, this was more frequently the 'Chance' type rather than the 'Powerful others' type.*

#### *8.3.3.1 General Self Efficacy (GSE)*

The data analysis methods described in the preceding chapter indicate a positive relationship exists between MitScore (mitigation investment equivalent, indicating the extent of flood mitigation already undertaken) and GSE score. As also shown, the survey respondents differ significantly from the general adult population ( $p < 0.01$ ;  $n=68$ ). In particular, their range of scores (between 23 and 40) reveals an absence of respondents who believe themselves to have low general self-efficacy. These findings are consistent with self-efficacy forming an important element of positive 'Coping Appraisal' as conceived in 'Protection Motivation Theory' (Bubeck *et al.*, 2013), in that flood-group members are likely to feel capable/confident in their own abilities to carry out or implement mitigation measures. It also aligns with the findings of Dittrich *et al.* (2016) who examined the effects of self-efficacy on the uptake of floodgates and flood warnings amongst flood group members; the deduced mechanism for this is that such groups typically afford both information and training to their members, sometimes in conjunction with their local authorities (for example, Rose, 2014). As the present study is not longitudinal in nature, however, it is not possible to distinguish between those respondents who had high self-efficacy scores prior to joining a flood group, and those whose self-efficacy may have been enhanced during the course of their membership. Future work could usefully investigate 'before and after' GSE scores (at the point of formation of new flood groups, and after a period of membership during which information on/exposure to mitigation measures has been provided). If enhancement can be demonstrated, there may be scope for using self-efficacy appraisal as a means of monitoring and evaluating the effectiveness of other initiatives designed to increase mitigation uptake in the UK (such as community engagement schemes).

#### *8.3.3.2 Locus of control*

Whilst it was not possible to compare the LoC scores for the current study with a randomly selected sample of UK adults, the finding that the mean score for 'Powerful

Others' externality was far lower than that for 'Chance' externality is of interest (particularly as US studies have means for both measures of externality roughly equal). Most inland flood events in the UK are due to 'chance' in the sense of intermittent prolonged or intense rainfall, which is followed by rivers overflowing their banks, overwhelmed drainage systems or rising groundwater. In the aftermath of flooding, however, it is well-documented (worldwide) that people often become angry, attributing the inundation to failures/incompetence of government agencies and/or local authorities (for example, Brilly and Polic, 2005; Pasche *et al.*, 2007). Such 'blame shifting' has been identified as an anxiety-avoidance strategy (Harries, 2013): if 'Powerful others' are believed to be responsible, then the remedy is also believed to lie with those people or organisations, hence there is no intrinsic risk to the home and the owners feel justified in not adopting mitigation measures. The survey respondents are, on average, more likely accept chance as an explanation for life's events than to hold 'Powerful others' responsible. Future work might, therefore, usefully explore the nuances of external attribution within a flood context in the UK.

At the opposite end of the locus of control spectrum, one respondent had undertaken extensive resilience works in the same year as their first flood experience (1998); they also attained one of the highest scores for Internal locus of control. This raises the possibility of an additional variable that may warrant attention in future work: the length of time people have been exposed to risk (either at the same property, or consecutive properties). Where people have not only acquired the knowledge of appropriate mitigation methods, but also deployed these effectively on multiple occasions, it is consistent with the locus of control construct that this would reinforce their belief that they are in control of life's events, strengthening internality.

Cross-sectional studies such as this are, however, limited in scope and the scores on the psychometric tests provide a 'snapshot' of the respondent's outlook on a given day. In some cases, repair work following flooding was ongoing (as evidenced by grant applications which were still to be determined); for others, a number of years may have elapsed since the last (physical) mitigation action had been undertaken. As all the recipients confirmed they were (still) a member of a community flood group,

their ongoing involvement would not be consistent with a fundamental shift in outlook.

#### 8.3.4 Proxy variables

In two cases, the nature of the data collected was not amenable to direct analysis, hence proxy variables were developed, namely 'MitScore' and 'TrigCat', which will now be discussed.

##### *8.3.4.1 Mitigation actions taken*

Counting the total number of actions would have constituted an overly simplistic metric, owing to the considerable differences between measures such as registering for flood warnings, and the major financial investment required for many of the resilience options. However, it is noteworthy that 92% of the respondents who had completed all the flood sections of the survey had undertaken between one and fifteen mitigation actions *in addition* to joining a flood group (the latter being a requirement for survey eligibility).

Further examination, looking at the earliest choices made in each of the three measure categories, revealed sandbags were the commonest of the resistance methods employed. Despite the many drawbacks of sandbag use, it should be borne in mind that commercially produced exclusion measures have only become widely available in recent years. One respondent, referring back to the floods of 1998, had made use of both 'door barriers' and sandbags: this may well indicate the use of home-made 'flood boards' (which were often deployed in conjunction with sandbags) to reduce water ingress via doorways in areas prone to frequent flooding (Harries, 2012).

The earliest resilience method commonly chosen was to raise the height of electrical sockets/ fuse-boxes/ meters, followed by replacement of flooring; however, it is not known whether these measures were undertaken as part of post-flooding restoration by an insurer, or at the specific behest of the householder concerned. Siting of sockets at a minimum of 450mm above floor level is part of Building Regulations (H M Government. Building Regs 2010 - Access to and Use of Buildings - Part M), which does not actually apply to repair of extant dwellings, but in some cases

reinstatement contractors have been found to routinely move sockets to this height unless the householder actively objects (Lamond *et al.*, 2016c)). No firm conclusions can, therefore, be drawn from this finding, but future work might benefit from more detailed investigation on this matter, as the former situation does not necessarily represent a 'choice' made by an individual, whilst the latter one does.

#### *8.3.4.2 Mitigation investment equivalent (MitScore)*

This weighting procedure was applied to derive a more meaningful measure of respondents' mitigation behaviours. The finding that 55% of the survey respondents had MitScores of between 2-8 represents an investment equivalent of over £1,000 per household. To place this in context, taking every action listed in the 'Other' category would have yielded an investment equivalent of only £350. This provides another example of the way in which flood group members are different from the general flood risk population surveyed previously in the UK: the 55% taking actions that require actual financial outlay in the present study contrasts markedly with the findings of Thurston *et al.* (2008) in which just 33% had taken any steps of any kind (including the cost free options). More recently, Bhattacharya-Mis *et al.* (2015) obtained very similar results in Sheffield and Wakefield (UK) several years after the severe floods of 2007 had affected both locations: the commonest measure remained sandbags (39%) and just 19% had invested in the lowest priced resistance options (airbrick/vent covers and automatic airbricks).

#### *8.3.4.3 Drivers of positive action (TrigCat)*

Over 26% of the survey respondents were found to have taken some kind of action prior to having had any flood experience (direct or otherwise); this constitutes an unprecedented level of 'anticipatory adaptation' (as discussed in Section 3.3.3.2) compared with previous studies (where this group has usually comprised 6-9%). However, if less searching questions had been posed regarding the nature of the respondents' flood experiences, both the respondents who had been 'indirectly flooded' and those with vicarious experience could have been (erroneously) assigned to the same category as those with no flood experience whatsoever. Sixty-two percent of the respondents would then have appeared to have taken action despite having had 'no' flood exposure. This clearly demonstrates that a more nuanced

definition of 'experience' should be employed in future work investigating the variables involved in mitigation choices.

#### 8.3.5 Correlation between variables

The literature review indicated that clear-cut linear relationships were unlikely to be found linking flood mitigation (the MitScore) with any one variable, owing to the well documented complexity of human behaviours. The results of the Spearman's rank-order correlation, as shown in the previous chapter, will now be examined in greater detail. Correlation is not, of course, indicative of causation; however, previous studies in this area can illuminate potential causal pathways in some instances.

##### *8.3.5.1 The medium positive association between GSE and MitScore (significant at 0.01)*

Those respondents perceiving themselves as more self-efficacious are also those investing more in flood mitigation measures over time. This finding is consistent with Grothmann and Reusswig's (2006) adaptation of PMT in relation to flood precautionary actions: self-efficacy is a key component of 'Coping Appraisal', which is believed to contribute to the decision-making process. As those perceiving themselves as more efficacious, and thus scoring high on GSE, appear to take more appropriate adaptive actions (rather than resorting to maladaptive behaviours such as denial) this supports the argument that such a causal link exists. This opens up the possibility that any interventions which could be shown to increase the perception of self-efficacy in preparing for/dealing with flooding in members of the at-risk community (such as community engagement processes), could constitute a worthwhile investment by the relevant authorities seeking to enhance resilience to flooding.

##### *8.3.5.2 The small positive association between MitScore and TrigCat (significant at 0.05)*

Those respondents making greater investment in mitigation over time also tend to be those with direct flood experiences; this is consistent with the findings of Siegrist and Gutscher (2008) who argued that those lacking in flood experience underestimated the 'negative affect' evoked by flood events and, therefore, failed to prepare for future inundations. Although actual flood experiences clearly cannot be

manipulated for experimental purposes, there are interventions that have been found to act as proxies: these include simulated flood events, such as that demonstrated by the 'Hamburg Flood Box' (Pasche *et al.*, 2007) and innovative virtual reality methods (Zaalberg and Midden, 2013; Fraustino *et al.*, 2018) (both of which would require stringent controls to avoid the risk of either harmful or undesirable outcomes, such as denial); and techniques designed to stimulate community level discourse leading to heightened salience (McIvor *et al.*, 2009; McEwen *et al.*, 2012).

*8.3.5.3 The small negative association between Income and TrigCat and the small positive associations between Loc-Int and Education (both significant at 0.05)*

The first finding would suggest those with higher incomes tend to be those who take action in response to initial experiences with 'low affect', or in 'no affect' situations (the absence of any experience at all), in other words, 'Anticipatory Adapters'. The withholding of income data by many of the respondents must also be borne in mind here, however, as if full income data were available this correlation may have been different. Similarly, although the second finding indicates those with higher educational attainment levels also tend towards higher internal locus scores, the reduced completion rate for the demographic section of the survey renders this correlation less reliable than the two discussed above.

#### 8.4 Implications for audiences of this research

Both General Self-efficacy and vicarious/indirect flood experiences have, for the first time in a UK study, been shown to be important driving factors for individuals who display positive adaption behaviours in terms of flood mitigation measures. Of the households who completed all the relevant sections, 92% were found to have taken one or more flood preparedness actions (in addition to the prerequisite of being a flood group member); this considerably exceeds the results of the majority of previous UK studies, which sampled the wider at-risk population. The policy-making community across the UK, (chiefly Defra and the Environment Agency, but potentially SEPA and National Resources Wales) will find these results of utility in identifying cost-effective initiatives in the area of enhanced resilience. Firstly, the personality characteristic of self-efficacy constitutes a potential metric for policy-makers to

monitor the effectiveness of future flood resilience interventions (as individuals' initial scores can be enhanced by employing extant appropriate methods); secondly, the relevance of indirect types of experience not only highlights the need for more carefully nuanced segmenting of the at-risk population when designing future research, but also strengthens the argument for governmental input as regards creating and supporting community flood groups, as a means of achieving the desired enhanced levels of resilience in the context of our changing climate.

### 8.5 Summary

This chapter has reviewed, and answered as far as possible, the research questions posed in Section 1.4. It has also examined individual variables, and their importance for decision-making, in the light of the data collected and analysed. The implications for the expected audiences for this research were also outlined. The final chapter will now provide a conclusion to the study, including the contributions to knowledge.

## CHAPTER 9 – CONCLUSION AND RECOMMENDATIONS

### 9.1 Introduction

This chapter seeks to draw conclusions from the findings of this research, and make recommendations for future work, thereby addressing the remaining elements of the seventh and final objective stated in section 1.5. The research objectives are reviewed, and the limitations of the research discussed. This is followed by a review of the key research findings, as well as the implications of these. The contributions made to the body of knowledge are stated, and conclusions are drawn, with particular reference to their importance for specific stakeholder groups. The chapter concludes with recommendations for future research in this area.

### 9.2 Review of research objectives

The seven research objectives defined in section 1.5 will now be discussed in turn.

#### 9.2.1 Objective one

*Examine flood resilience issues applicable to the domestic sector in the UK to contextualise the need for increased uptake of measures.*

This objective was met by the material contained in Chapter 2, which covered flood resilience approaches at both property and community levels and also examined governance issues specific to the UK, namely the operation of the British insurance industry in relation to flooding, and the government grants for enhancing property level resilience that have been made available in some areas. It concluded with an outline of the health and social impacts of flooding, which are helping to drive the need to improve resilience uptake.

#### 9.2.2 Objective two

*Undertake a critical review of psychological theory relating to risk and decision-making, at the household level, in order to develop an appreciation of the role of socio-psychological factors in relation to governance, experience and other variables contributing to hazard adaptation uptake.*

This objective was met by the material contained in Chapter 3, which considered preparedness in relation to natural hazards, and the psychology of decision-making with an emphasis on risk environments. Individual factors, both external (such as

hazard experience) and internal (such as belief systems) which have previously identified as affecting risk decisions were then considered, as was the interaction of individual and social influences.

#### 9.2.3 Objective three

*Undertake a critical review of theories relating to behavioural change processes, particularly those designed for, or already used in, natural hazard preparedness contexts, with the aim of identifying those pertinent to the UK flood-risk population.*

This objective was met by the material contained in Chapter 4, which examined a range of theories including Protection Motivation Theory, and also examined the personality traits of self-efficacy and locus of control in more detail, including their relevance in driving or inhibiting preparedness behaviours.

#### 9.2.4 Objective four

*Develop an explanatory conceptual framework mapping out the relationship between psychological and situational factors, with particular reference to the influence of these variables upon positive flood mitigation behaviours in the UK at-risk population including those displaying 'anticipatory adaptation'.*

This objective was met by the material contained in Chapter 5, which examined research on UK behaviours in respect of flood risk, together with existing theories and models, in order to derive a suitable conceptual framework for empirical research. The latter explicitly focusses upon drivers of positive behaviours, as opposed to factors acting as barriers to hazard resilience.

#### 9.2.5 Objective five

*Develop a methodology to enable data collection for empirical investigation of the conceptual framework.*

This objective was met by the material contained in Chapter 6, which defined the research approach to be adopted, as well as consideration of the methods and sampling strategy appropriate to fulfilment of the stated research aims. The design of the survey instrument was discussed, as was the piloting and revision of this.

#### 9.2.6 Objective six

*Collect and analyse data to determine the contribution of psychological and other factors to positive flood mitigation behaviours.*

This objective was met by the material contained in Chapter 7, in which the data collected was subjected to a range of analyses appropriate to its nature. These included investigation of the correlation between variables, and a factor analytic technique to provide validation of the results.

#### 9.2.7 Objective seven

*Draw conclusions from the findings of the study and, on that basis, make recommendations for stakeholders (including policymaking bodies such as Defra and the Environment Agency) and for further research.*

This objective was met in part by the material contained in Chapter 8, which examined in detail the characteristics of the sample, as well as exploring the answers obtained in respect of the research questions specified. The implications of the findings for the expected audiences of this research were also outlined. The remainder of the objective has been met by the present chapter.

### 9.3 Research limitations

Some limitations exist in relation to this study, as was discussed in chapter 8. Briefly, the key issues comprise the following:

- Cross-sectional studies are acknowledged to provide a 'snapshot' of the respondents' situations and viewpoints on a given day, which may be atypical. They cannot establish causation, unlike longitudinal investigation.
- The response rate calculated may be an underestimate, as use of 'gatekeepers' to distribute some of the invitations to participate meant the total number actually contacted could not be accurately ascertained.
- In some instances, it is possible the flood group member who completed the survey was not the person responsible for making financial decisions in the same household.

### 9.4 Contribution to the body of knowledge

At the beginning of this study three anticipated contributions to knowledge were identified, each of which will now be discussed in turn.

- a) Understanding the characteristics of a hitherto under-researched minority (those who have already adopted resilience measures) to shed light on some of the driving factors that are lacking, or in need of strengthening, in the wider at-risk community.

This sub-group of the at-risk community in the UK had never been investigated in such detail prior to this study. The very high rate of adoption of mitigation measures requiring financial outlay (55%) among flood group members is a key finding, as is the significantly higher average GSE score displayed by the respondents. The high incidence of 'anticipatory adapters' within the respondents is also a unique empirical confirmation, albeit one that the literature indicated was probable.

- b) Identification of any factors likely to be of utility to the policymaker community in designing and targeting interventions/campaigns to increase the rate of household flood resilience.

The most promising factor identified is that of self-efficacy, as the GSE score of the respondents was found to be positively correlated with the extent of enacted mitigation behaviour to a significant degree. Although cross-sectional studies such as this cannot demonstrate causation, the underlying theory of self-efficacy formation provides a mechanism explaining how this relationship would arise.

The second most important finding is the high incidence of vicarious experience associated with the commencement of mitigation activity; direct hazard experience has frequently been shown to promote adaptation, but here 18% of the non-flooded individuals had taken action to reduce damage to their own homes after people known to them had been impacted by floods.

- c) Where such factors are identified, and are amenable to quantitative measurement, they may have the potential to provide a means of monitoring and evaluating the effectiveness of different intervention types and/or campaigns, via before-and-after testing.

As self-efficacy is not immutable, but varies in response to life experiences (including vicarious and indirect forms), this personality factor is amenable to strengthening via the use of appropriate interventions (as has been done in many other spheres, such as health). The General Self Efficacy (GSE) inventory is a brief, easily administered test providing a numerical score which, therefore, renders it a suitable metric for

further investigation as regards monitoring and evaluating resilience initiatives. A flood-specific efficacy test could also be developed, if research resources for its development were to be made available.

Changing people's understanding of flood hazard via vicarious and indirect experience provision has already been investigated in the US and Germany but, as far as can be ascertained, these techniques have not yet been explored in the UK. Pursuing these potentially resource-hungry options could pose a challenge, and both the costs and the benefits would, of course, need to be explored in detail.

### 9.5 Conclusions drawn

This research has yielded new insight on the links between flood resilience behaviours, personality traits and the nature of flood experience. It has done so by developing an understanding of the characteristics of a hitherto under-researched minority, shedding light on some of the factors associated with active hazard mitigation. The highly significant positive correlation found between General Self-efficacy score, and the extent of mitigation behaviour adopted, has not been demonstrated in a UK flood-risk population previously. This finding raises the need to consider how differing personality types may respond to the way interventions, campaigns and communications regarding flood resilience are designed and is, therefore, a key outcome for the policy-maker community. An individual's perceived self-efficacy is not an immutable trait: it can be strengthened by means of appropriate interventions, as has been demonstrated in the health sphere, for example; furthermore, as a trait capable of quantitative measurement, self-efficacy tests could be employed to monitor and evaluate interventions such as community engagement programmes.

The association found between indirect types of flood exposure, particularly vicarious experience, and the onset of mitigation behaviours is of key importance for future research in this area: the use of binary 'flooded/not flooded' questions can now be seen to lack the requisite granularity. Furthermore, the potential utility of creating (carefully and ethically designed) indirect flood experiences, as a means of enhancing flood resilience uptake, warrants wider examination in the UK. Monitoring

and evaluation of such techniques could also be achieved if used in conjunction with self-efficacy measurement.

The identification of the very high rate of adoption of mitigation measures requiring financial outlay among flood group members is another key output, as this lends support to the need to support to existing groups, as well as establishing new ones in at-risk communities. The short-term potential resource costs of interventions, campaigns and communications regarding flood resilience must be weighed against both the tangible and intangible longer-term impacts of flooding, particularly in the light of the likely increase in occurrence resulting from climate change.

### 9.6 Recommendations for future work

- Longitudinal research would be useful, both to establish causation and also to investigate ‘before and after’ GSE scores (for example, at the point of formation of a new flood group, and after a period of membership during which information on/exposure to mitigation measures has been provided). This could also gather evidence regarding the use of self-efficacy appraisal as a predictive factor in mitigation uptake.
- Future work might also pursue the nuances of external locus of control attribution within the flood mitigation context: for example, are individuals with a marked ‘powerful others’ locus more inclined to abrogate responsibility for flood mitigation to ‘the authorities’? Is there a link between having a ‘chance’ locus and adoption of ‘unrealistic optimism’ and, therefore, denial?
- It is recommended that a more nuanced definition of ‘experience’ than a binary ‘flooded/not flooded’ should be employed in any future work regarding the variables involved in mitigation choices, to avoid conflating the ‘unflooded’ and the ‘indirectly flooded’ segments of the at-risk population.

### 9.7 Summary

The final chapter of this thesis has reviewed the research objectives, and the limitations of the research have been acknowledged. The key research findings have also been reviewed, as have their implications. The contributions made to the body

of knowledge have been stated, and finally conclusions were drawn, with particular reference to their importance both for policy-makers and future research in this area.

### 9.8 Concluding remarks

This research is situated in the wider context of the increasingly urgent need to improve the uptake of property flood resilience, ideally before the effects of climate change worsen still further. If this is not accomplished the resultant damages will comprise not only the short-term physical and financial impacts, but also the longer-term burden of psychological harm, with implications for health care provision and the associated costs to society as a whole:

*“People who reported persistent flood related damage in their homes had higher odds of probable psychological morbidity. There are likely to be significant health gains from repairing properties as soon as possible ....”*(Jermacane *et al.*, 2018) (p 6 of 8).

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## APPENDIX 1 – DISTRIBUTION OF I-E SCALE SCORES

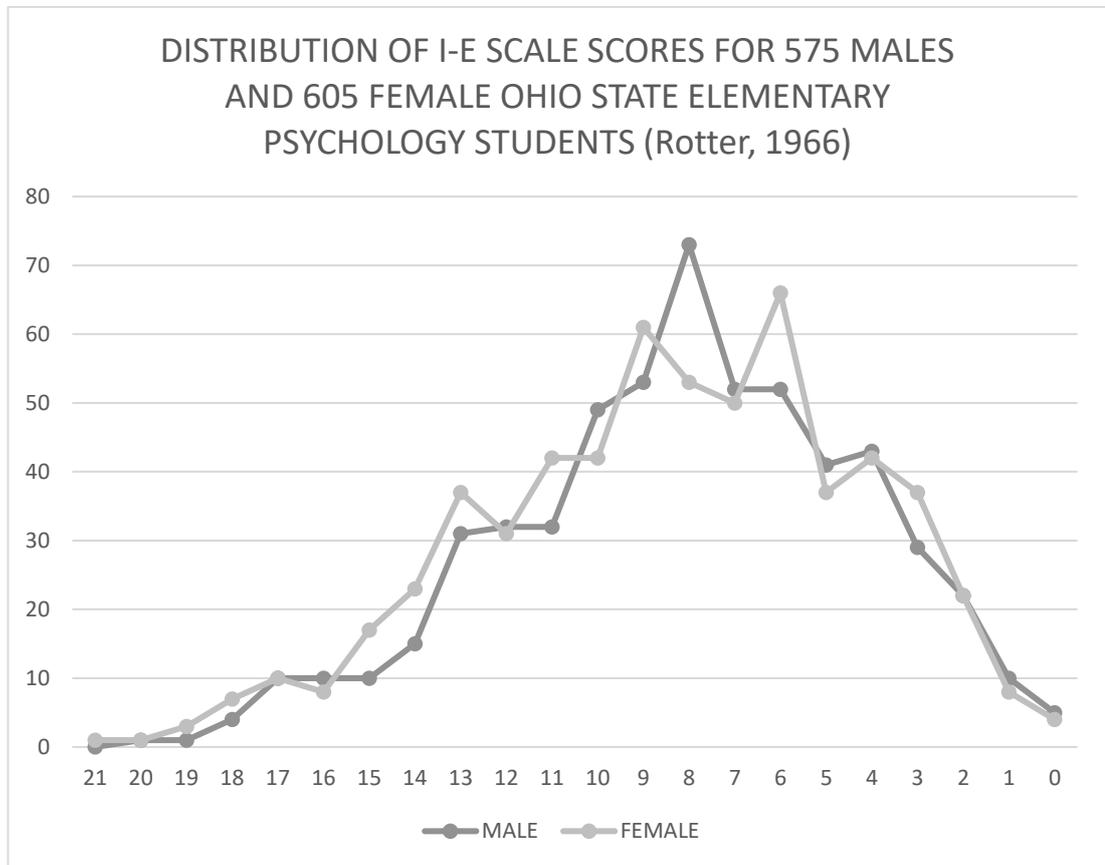


Chart showing approximately normal distribution of I-E scores

for males and females

(after data in Rotter, 1966 - material in public domain; chart

created by this author)

## APPENDIX 2 – TABLE OF VARIABLES

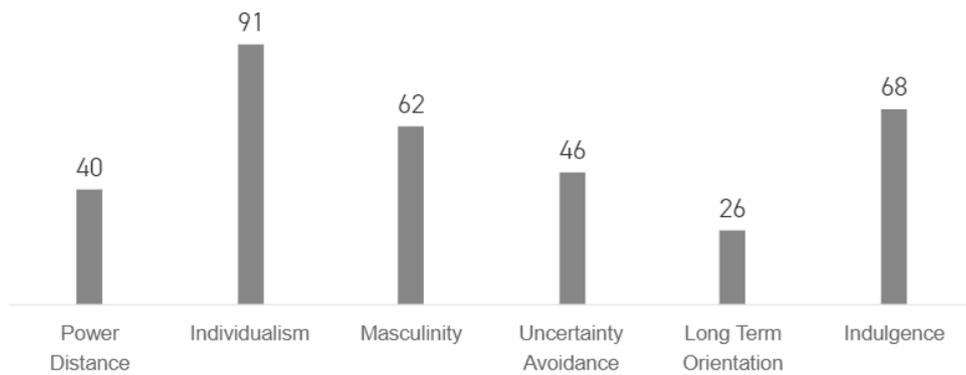
Data collected for quantitative analysis

| Variable   | Type              | Min<br>poss | Max<br>poss |
|--|-------------------|-------------|-------------|
| LoC - I (8 qs)   | Interval<br>scale | 0           | 48          |
| LoC - P (8 qs)   | Interval<br>scale | 0           | 48          |
| LoC - C (8 qs)   | Interval<br>scale | 0           | 48          |
| GSE (10qs)   | Interval<br>scale | 10          | 40          |
| Insurance Y/N  |                   | 0           | 1           |
| Insurance qs= text   |                   |             |             |
| Grant funding for resis/resil meas -<br>year                       | nominal           | 2006        | 2017        |
| Direct Fld Exp - event count (recalc<br>on years listed)           | ratio             | 0           | n/a         |
| present or prev home   |                   | 1           | 2           |
| Direct Fld Exp most damaging year                                  | nominal           | 1920        | 2017        |
| Direct Fld Exp other years   | nominal           | 1920        | 2017        |
| Direct Fld Exp source  |                   | 0           | 4           |
| Indirect Fld Exp (deepest near<br>misses) (recalc on years listed) | ratio             | 0           | n/a         |
| Indirect Fld Exp 3 most recent<br>year(s)                          | nominal           | 1920        | 2017        |
| text - Indir Fld Exp - 3 worst years                               | nominal           |             |             |
| Indirect Fld Exp source  |                   | 0           | 4           |
| Indir Flats Y/N (routing option only)                              |                   | 0           | 1           |

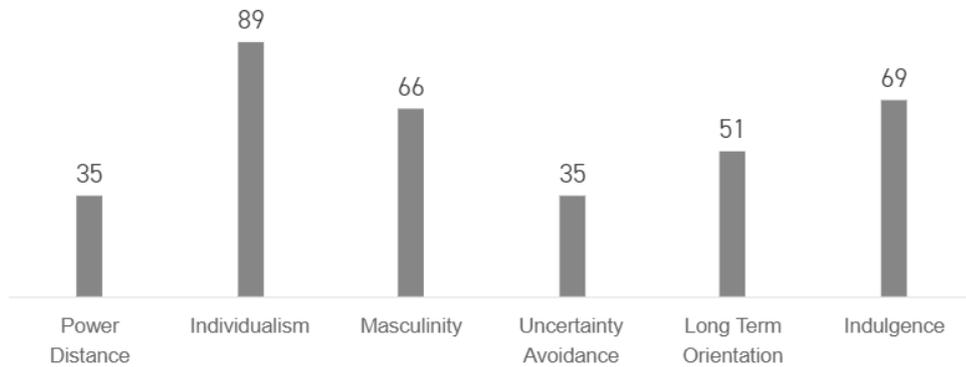
|  |         |      |      |
|--|---------|------|------|
| Indir Flats year   | nom     | 1920 | 2017 |
| text - 3 deepest years                                     | nom     |      |      |
| Indir Flats source   |         | 0    | 4    |
|  |         |      |      |
| Indir Fld Exp (people) (recalc on years listed)            | ratio   | 0    | n/a  |
| Indir Fld Exp (people) 3 worst years                       | nom     | 1920 | 2017 |
| others' exps? text   |         |      |      |
|  |         |      |      |
| Insurance increases after claims y/n?                      | nom     | 1    | 2    |
| detail of above  |         |      |      |
| postcode(present)  |         |      |      |
| postcode(prev)/place name                                  |         |      |      |
|  |         |      |      |
| Gender   | nom     | 1    | 3    |
| Age gp   | Ordinal | 1    | 6    |
| Income gp  | Ordinal | 1    | 4    |
| Educ gp  | Ordinal | 1    | 8    |
| Tenure   | Ordinal | 1    | 3    |
| <i>Proxy - Trigger (Affect order with direct=4)</i>        | Ordinal | 1    | 4    |
| <i>Proxy – MitScore (mitigation investment equivalent)</i> | Ordinal | 1    | 8    |

## APPENDIX 3 – HOFSTEDE ‘CULTURAL DIMENSION’ COMPARISON FOR UK AND USA

Hofstede – UK compared to USA (from: <https://www.hofstede-insights.com/product/compare-countries/>)



USA profile above; UK profile below

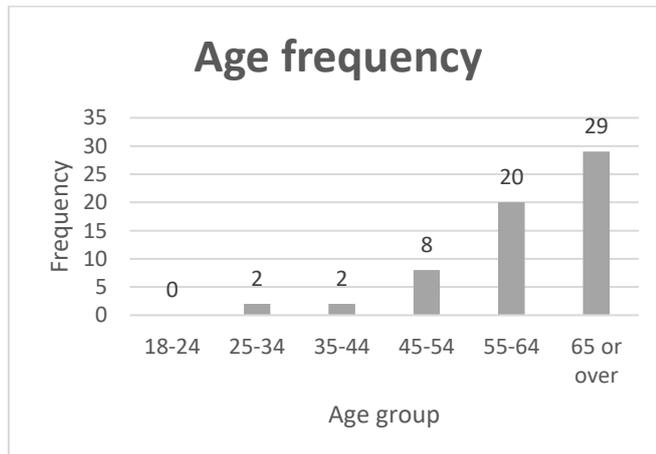
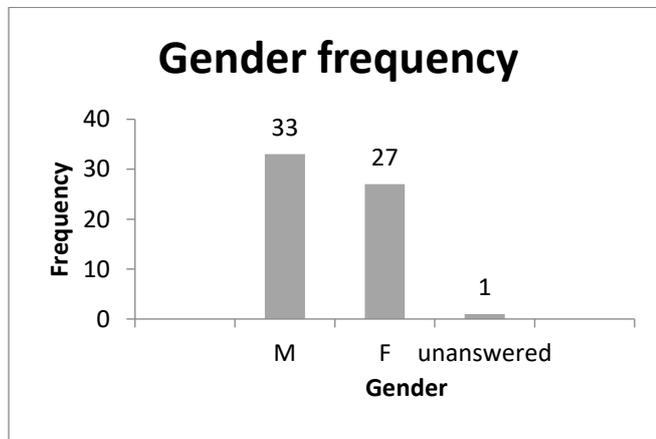
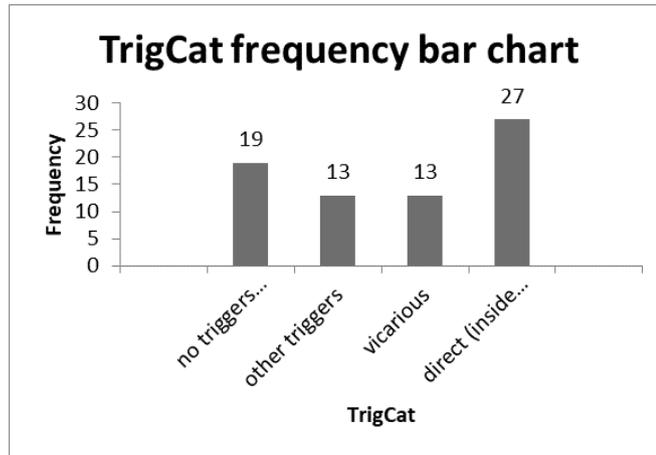


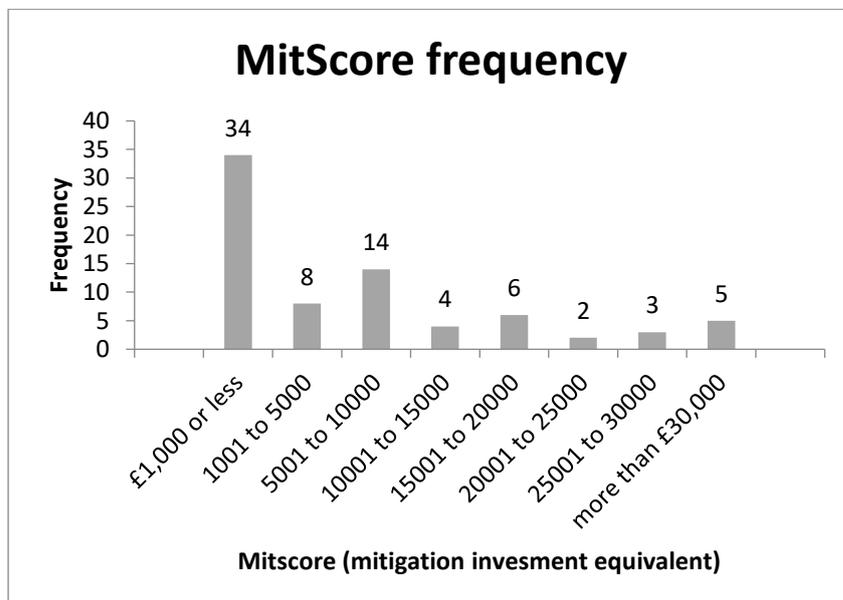
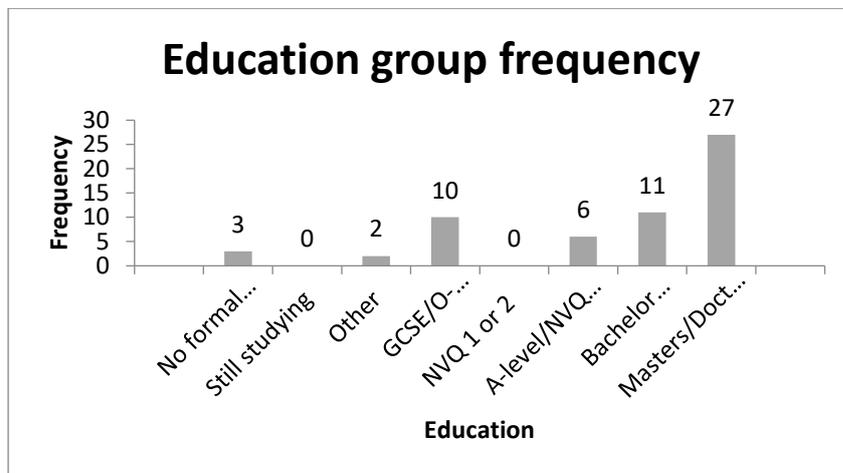
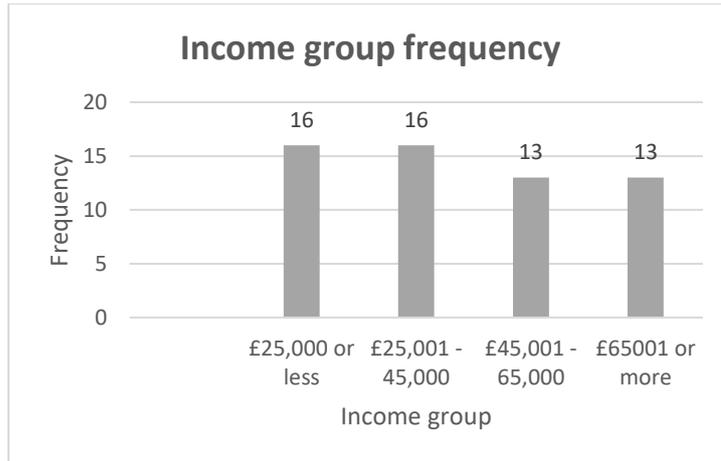
## APPENDIX 4 - DESCRIPTIVE STATISTICS FOR ALL VARIABLES

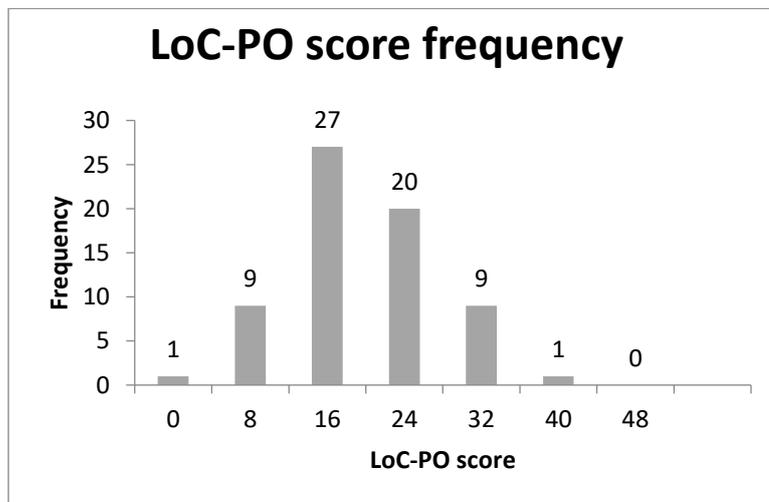
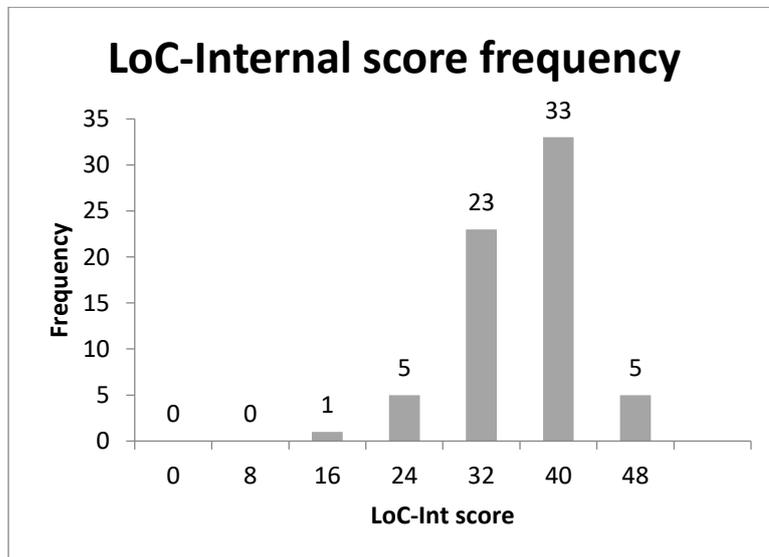
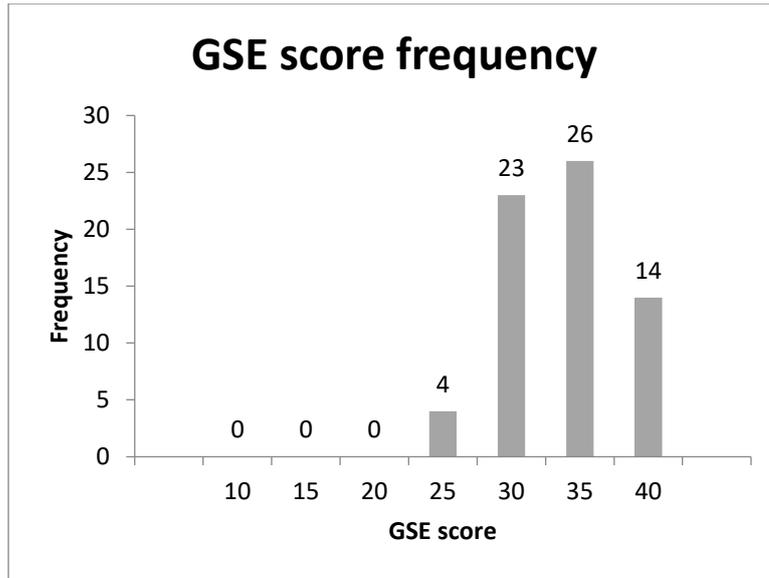
### Descriptive Statistics

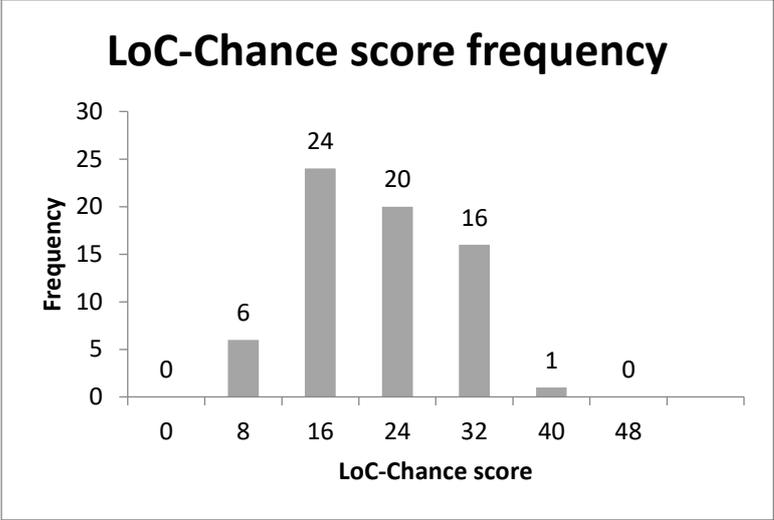
|                    | N         | Range     | Minimum   | Maximum   | Mean      |            | Std. Deviation | Variance  | Skewness  |
|--------------------|-----------|-----------|-----------|-----------|-----------|------------|----------------|-----------|-----------|
|                    | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic      | Statistic | Statistic |
| TrigCat            | 72        | 3         | 1         | 4         |           |            |                |           | -.211     |
| gender             | 61        | 2         | 1         | 3         |           |            |                |           | .437      |
| age                | 61        | 4         | 2         | 6         |           |            |                |           | -1.384    |
| income             | 58        | 3         | 1         | 4         |           |            |                |           | .152      |
| Educn              | 59        | 7         | 1         | 8         |           |            |                |           | -1.216    |
| MitScore           | 76        | 7         | 1         | 8         |           |            |                |           | 1.156     |
| GSE                | 67        | 17        | 23        | 40        | 31.84     | .481       | 3.941          | 15.533    | .097      |
| LoC_Int            | 67        | 29        | 15        | 44        | 33.30     | .734       | 6.008          | 36.091    | -.954     |
| LoC_PO             | 67        | 34        | 0         | 34        | 16.22     | .901       | 7.375          | 54.389    | .311      |
| LoC_Ch             | 67        | 29        | 5         | 34        | 18.22     | .890       | 7.282          | 53.025    | .131      |
| Valid N (listwise) | 57        |           |           |           |           |            |                |           |           |

## APPENDIX 5 - FREQUENCY BAR CHARTS, ALL VARIABLES









## APPENDIX 6 – MITIGATION SCORE CALCULATION

(mitigation investment equivalent).

| Resp<br>no | RESIST<br>TOTAL<br>VALUE<br>£ | RESIL<br>TOTAL<br>VALUE<br>£ | OTHER<br>TOTAL<br>VALUE<br>£ | Mitigation<br>score for<br>each<br>respondent<br>in £ | Mitigation<br>score for<br>each<br>respondent<br>in £k | Mitigation<br>score for<br>each<br>respondent<br>in £k to 1dp | MitScore |
|------------|-------------------------------|------------------------------|------------------------------|---|--|---|----------|
| 1          | 425                           | 0                            | 300                          | <b>725</b>  | 0.725  | 0.7   | 1        |
| 2          |                               |                              |                              | <b>0</b>  |  |   |          |
| 3          | 0                             | 0                            | 100                          | <b>100</b>  | 0.1  | 0.1   | 1        |
| 4          | 0                             | 0                            | 250                          | <b>250</b>  | 0.25   | 0.3   | 1        |
| 5          | 6500                          | 0                            | 200                          | <b>6700</b>   | 6.7  | 6.7   | 3        |

|    |       |       |     |              |        |      |   |
|----|-------|-------|-----|--------------|--------|------|---|
| 6  | 425   | 0     | 100 | <b>525</b>   | 0.525  | 0.5  | 1 |
| 7  | 18250 | 0     | 50  | <b>18300</b> | 18.3   | 18.3 | 5 |
| 8  | 425   | 0     | 150 | <b>575</b>   | 0.575  | 0.6  | 1 |
| 9  | 18675 | 25750 | 250 | <b>44675</b> | 44.675 | 44.7 | 8 |
| 10 | 425   | 0     | 250 | <b>675</b>   | 0.675  | 0.7  | 1 |
| 11 | 0     | 0     | 150 | <b>150</b>   | 0.15   | 0.2  | 1 |
| 12 | 8350  | 0     | 250 | <b>8600</b>  | 8.6    | 8.6  | 3 |
| 13 | 3675  | 0     | 200 | <b>3875</b>  | 3.875  | 3.9  | 2 |
| 14 |       |       |     | <b>0</b>     |        |      |   |
| 15 | 425   | 0     | 150 | <b>575</b>   | 0.575  | 0.6  | 1 |
| 16 | 0     | 0     | 100 | <b>100</b>   | 0.1    | 0.1  | 1 |
| 17 | 4575  | 3250  | 150 | <b>7975</b>  | 7.975  | 8.0  | 3 |
| 18 | 425   | 0     | 100 | <b>525</b>   | 0.525  | 0.5  | 1 |

|    |      |       |     |              |        |      |   |
|----|------|-------|-----|--------------|--------|------|---|
| 19 | 3250 | 4375  | 100 | <b>7725</b>  | 7.725  | 7.7  | 3 |
| 20 | 300  | 50    | 50  | <b>400</b>   | 0.4    | 0.4  | 1 |
| 21 | 9750 | 10875 | 300 | <b>20925</b> | 20.925 | 20.9 | 6 |
| 22 | 0    | 0     | 50  | <b>50</b>    | 0.05   | 0.1  | 1 |
| 23 | 4100 | 0     | 100 | <b>4200</b>  | 4.2    | 4.2  | 2 |
| 24 |      |       |     | <b>0</b>     |        |      |   |
| 25 | 0    | 0     | 100 | <b>100</b>   | 0.1    | 0.1  | 1 |
| 26 | 0    | 0     | 150 | <b>150</b>   | 0.15   | 0.2  | 1 |
| 27 |      |       |     | <b>0</b>     |        |      |   |
| 28 |      |       |     | <b>0</b>     |        |      |   |
| 29 | 0    | 0     | 150 | <b>150</b>   | 0.15   | 0.2  | 1 |
| 30 | 3300 | 25875 | 200 | <b>29375</b> | 29.375 | 29.4 | 7 |
| 31 | 2025 | 3250  | 300 | <b>5575</b>  | 5.575  | 5.6  | 3 |

|    |       |      |     |              |        |      |   |
|----|-------|------|-----|--------------|--------|------|---|
| 32 | 425   | 6500 | 350 | <b>7275</b>  | 7.275  | 7.3  | 3 |
| 33 | 15425 | 0    | 100 | <b>15525</b> | 15.525 | 15.5 | 5 |
| 34 | 50    | 0    | 200 | <b>250</b>   | 0.25   | 0.3  | 1 |
| 35 | 0     | 6500 | 300 | <b>6800</b>  | 6.8    | 6.8  | 3 |
| 36 | 525   | 1125 | 150 | <b>1800</b>  | 1.8    | 1.8  | 2 |
| 37 | 3725  | 6500 | 300 | <b>10525</b> | 10.525 | 10.5 | 4 |
| 38 | 20225 | 3250 | 300 | <b>23775</b> | 23.775 | 23.8 | 6 |
| 39 | 5575  | 3250 | 400 | <b>9225</b>  | 9.225  | 9.2  | 3 |
| 40 | 50    | 0    | 100 | <b>150</b>   | 0.15   | 0.2  | 1 |
| 41 | 4100  | 3250 | 400 | <b>7750</b>  | 7.75   | 7.8  | 3 |
| 42 | 0     | 0    | 100 | <b>100</b>   | 0.1    | 0.1  | 1 |
| 43 | 21500 | 4375 | 250 | <b>26125</b> | 26.125 | 26.1 | 7 |
| 44 | 8475  | 4375 | 400 | <b>13250</b> | 13.25  | 13.3 | 4 |

|    |       |      |     |              |        |      |   |
|----|-------|------|-----|--------------|--------|------|---|
| 45 | 3675  | 6500 | 100 | <b>10275</b> | 10.275 | 10.3 | 4 |
| 46 | 19200 | 0    | 300 | <b>19500</b> | 19.5   | 19.5 | 5 |
| 47 | 21925 | 9750 | 400 | <b>32075</b> | 32.075 | 32.1 | 8 |
| 48 | 50    | 0    | 250 | <b>300</b>   | 0.3    | 0.3  | 1 |
| 49 | 425   | 3250 | 150 | <b>3825</b>  | 3.825  | 3.8  | 2 |
| 50 |       |      |     | <b>0</b>     |        |      |   |
| 51 | 8050  | 7625 | 250 | <b>15925</b> | 15.925 | 15.9 | 5 |
| 52 |       |      |     | <b>0</b>     |        |      |   |
| 53 |       |      |     | <b>0</b>     |        |      |   |
| 54 | 850   | 0    | 100 | <b>950</b>   | 0.95   | 1.0  | 1 |
| 55 |       |      |     | <b>0</b>     |        |      |   |
| 56 |       |      |     | <b>0</b>     |        |      |   |
| 57 |       |      |     | <b>0</b>     |        |      |   |

|    |       |       |     |              |        |      |   |
|----|-------|-------|-----|--------------|--------|------|---|
| 58 | 21975 | 7625  | 300 | <b>29900</b> | 29.9   | 29.9 | 7 |
| 59 | 5225  | 3250  | 250 | <b>8725</b>  | 8.725  | 8.7  | 3 |
| 60 | 0     | 0     | 150 | <b>150</b>   | 0.15   | 0.2  | 1 |
| 61 | 15000 | 0     | 300 | <b>15300</b> | 15.3   | 15.3 | 5 |
| 62 | 0     | 3250  | 250 | <b>3500</b>  | 3.5    | 3.5  | 2 |
| 63 | 0     | 0     | 150 | <b>150</b>   | 0.15   | 0.2  | 1 |
| 64 | 0     | 0     | 50  | <b>50</b>    | 0.05   | 0.1  | 1 |
| 65 | 3250  | 14375 | 250 | <b>17875</b> | 17.875 | 17.9 | 5 |
| 66 | 475   | 30125 | 350 | <b>30950</b> | 30.95  | 31.0 | 8 |
| 67 | 0     | 0     | 250 | <b>250</b>   | 0.25   | 0.3  | 1 |
| 68 | 4200  | 3250  | 200 | <b>7650</b>  | 7.65   | 7.7  | 3 |
| 69 | 4150  | 7625  | 200 | <b>11975</b> | 11.975 | 12.0 | 4 |
| 70 | 0     | 0     | 150 | <b>150</b>   | 0.15   | 0.2  | 1 |

|    |      |      |     |             |       |     |   |
|----|------|------|-----|-------------|-------|-----|---|
| 71 | 3300 | 0    | 200 | <b>3500</b> | 3.5   | 3.5 | 2 |
| 72 | 0    | 0    | 200 | <b>200</b>  | 0.2   | 0.2 | 1 |
| 73 | 0    | 6500 | 200 | <b>6700</b> | 6.7   | 6.7 | 3 |
| 74 | 2025 | 3250 | 300 | <b>5575</b> | 5.575 | 5.6 | 3 |
| 75 | 0    | 0    | 250 | <b>250</b>  | 0.25  | 0.3 | 1 |
| 76 | 0    | 0    | 200 | <b>200</b>  | 0.2   | 0.2 | 1 |
| 77 | 850  | 0    | 300 | <b>1150</b> | 1.15  | 1.2 | 2 |
| 78 | 475  | 0    | 200 | <b>675</b>  | 0.675 | 0.7 | 1 |
| 79 |      |      |     | <b>0</b>    |       |     |   |
| 80 |      |      |     | <b>0</b>    |       |     |   |
| 81 |      |      |     | <b>0</b>    |       |     |   |
| 82 |      |      |     | <b>0</b>    |       |     |   |
| 83 | 425  | 0    | 350 | <b>775</b>  | 0.775 | 0.8 | 1 |

|    |       |       |     |              |        |      |   |
|----|-------|-------|-----|--------------|--------|------|---|
| 84 |       |       |     | <b>0</b>     |        |      |   |
| 85 |       |       |     | <b>0</b>     |        |      |   |
| 86 |       |       |     | <b>0</b>     |        |      |   |
| 87 |       |       |     | <b>0</b>     |        |      |   |
| 88 | 0     | 0     | 200 | <b>200</b>   | 0.2    | 0.2  | 1 |
| 89 | 5150  | 34875 | 300 | <b>40325</b> | 40.325 | 40.3 | 8 |
| 90 | 0     | 0     | 50  | <b>50</b>    | 0.05   | 0.1  | 1 |
| 91 | 23100 | 10875 | 150 | <b>34125</b> | 34.125 | 34.1 | 8 |
| 92 | 0     | 0     | 100 | <b>100</b>   | 0.1    | 0.1  | 1 |
| 93 | 3250  | 0     | 150 | <b>3400</b>  | 3.4    | 3.4  | 2 |
| 94 | 0     | 0     | 50  | <b>50</b>    | 0.05   | 0.1  | 1 |
| 95 | 6500  | 0     | 150 | <b>6650</b>  | 6.65   | 6.7  | 3 |

|        | <b>318900</b> | <b>264675</b> | <b>15350</b> | <b>598925</b> | <b>598.925</b> | <b>598.9</b> |
|--------|---------------|---------------|--------------|---------------|----------------|--------------|
| mean   | 4196.0        | 3482.5        |              |               |                |              |
|        | 5             | 7             | 201.97       | 6304.47       | 7.88           | 7.9          |
| SD     | 6542.6        | 6950.1        |              |               |                |              |
|        | 4             | 4             | 95.02        | 10107.81      | 10.75          | 10.7         |
| median | 475.00        | 0.00          | 200.00       | 575.00        | 3.50           | 3.5          |

# APPENDIX 7 - GRANT-AIDED HOUSEHOLDS - DATE INFORMATION

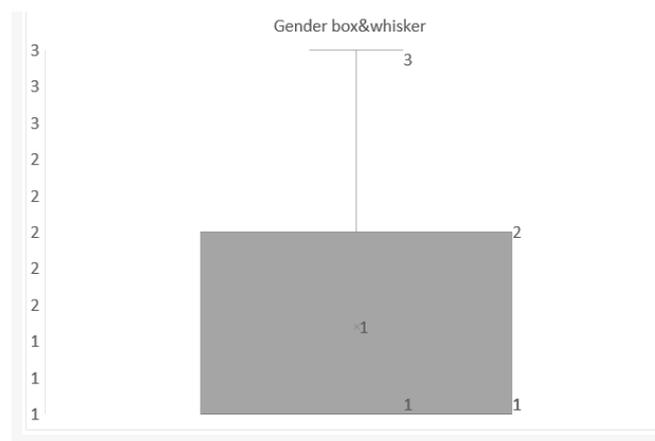
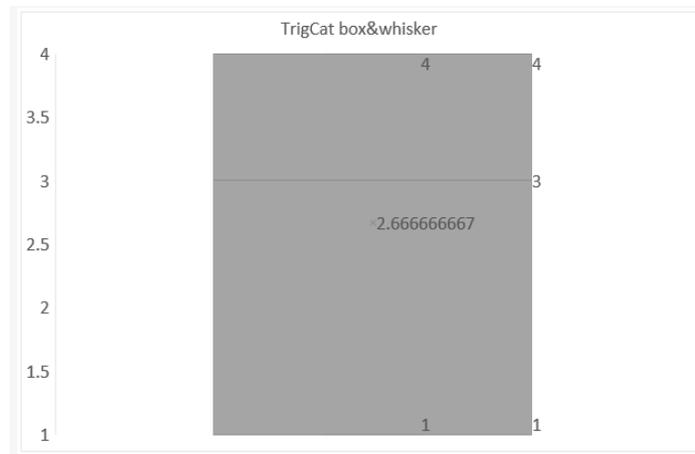
| Rep no | GRANTS Between 2006 and 2016 some areas of the UK have had | Grant used for  | Year of first RESISTANCE     | Year of first RESILIENCE | Year of first Other acts | Year first Direct food | Year first Indirect | Year first vicarious |      |
|--------|--|---|------------------------------|--------------------------|--------------------------|------------------------|---------------------|----------------------|------|
| 5      | 2015   | food retil doom purchased (WIP hence grant used to tank basement .. | FIRST RESIST                 | 0                        | 0                        | ?                      | 1978                | 1978                 | 0    |
| 9      | 2016   | resistance.   | ADDITIONAL                   | 2006                     | 2008                     | 2010                   | 2009                | 0                    | 2009 |
| 12     | 2016   | waiting result of application                                       | FIRST RESIST                 | 2016                     | 0                        | 1975                   | 1989                | 1989                 | 1989 |
| 16     | 2016   | All but sandbags in Resistance section this Pump(s)                 | ?                            | 0                        | 0                        | ?                      | 2007                | 2007                 | 2007 |
| 17     | 2011   | RESIST (WIP)  | ADDITIONAL                   | 2007                     | 2008                     | 2007                   | 2007                | 0                    | 2007 |
| 19     | 2015   | RUMPS PLUS RESILIENT MATS inc                                       | ADDITIONAL, BUT FIRST RESIST | 2014                     | 2008                     | 2008                   | 2007                | 0                    | 0    |
| 21     | 2015   | RESIST (WIP)  | ADDITIONAL                   | 2007                     | 2008                     | 2004                   | 2000                | 2000                 | 2000 |
| 36     | 2007   | RESIST (WIP)  | FIRST RESIL, ALSO RESIST     | 2008                     | 2007                     | 2007                   | 2007                | 0                    | 2007 |
| 38     | ?  | RESIST (WIP)  | ADDITIONAL                   | 2007                     | 2014                     | 2007                   | ?                   | 2007                 | 2007 |
| 59     | 2016   | Wp - mostly resistance, but some UNSPECIFIED - WIP?                 | FIRST RESIL, ALSO RESIST     | 2016                     | 2016                     | 2016                   | 2015                | 2015                 | 0    |
| 60     | 2016   | Large Barterforce RESIST (WIP)                                      | ?                            | 0                        | 0                        | 2009                   | 2009                | 0                    | 2009 |
| 61     | 2016   | Kitchen funded - RESIL.   | FIRST RESIST                 | 2017                     | 0                        | 2016                   | 2015                | 0                    | 2015 |
| 64     | 2016   | Resistance package plus elec move same                              | ADDITIONAL                   | 2010                     | 2010                     | 2006                   | 2005                | 0                    | 2005 |
| 68     | 2014   | COMBINED R&R  | FIRST RESIST & RESIL         | 2014                     | 2014                     | 1998                   | 2013                | 2000                 | 2000 |
| 69     | 2014   | Some resistance items.  | FIRST RESIST & RESIL         | 2014                     | 2014                     | 2008                   | 2013                | 0                    | 2013 |
| 71     | 2006   | RESIST ONLY   | FIRST RESIST.                | 2006                     | 0                        | 2006                   | ?                   | 0                    | 2005 |
| 78     | 2015   | Resistance and some real items 2008; more                           | FIRST RESIST.                | 2015                     | 0                        | 2012                   | ?                   | 2012                 | 2012 |
| 89     | 2007   | MIX OF RESIST AND RESIL   | FIRST RESIST & RESIL         | 2008                     | 2008                     | 2008                   | 2007                | 2007                 | 2007 |
| 91     | 2016   | UNSPEC - WIP  | ADDITIONAL, BUT NOT RESIL.   | 2012                     | 2016                     | 2010                   | 1995                | 1995                 | 1995 |
| 93     | 2015   | UNSPEC - WIP  | ADDITIONAL                   | 2008                     | 0                        | 2006                   | 2008                | 2007                 | 2008 |

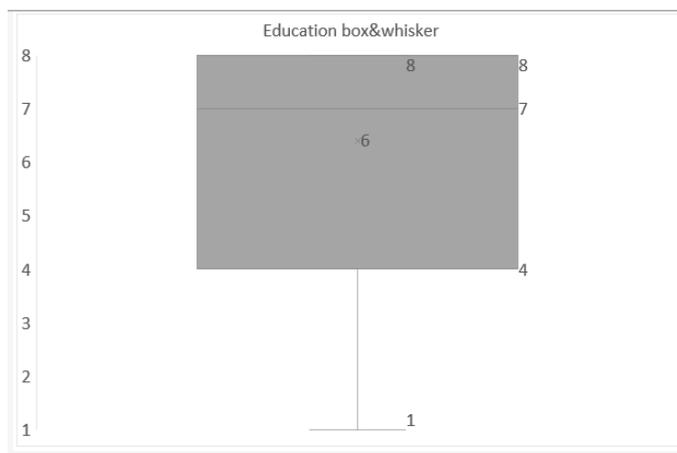
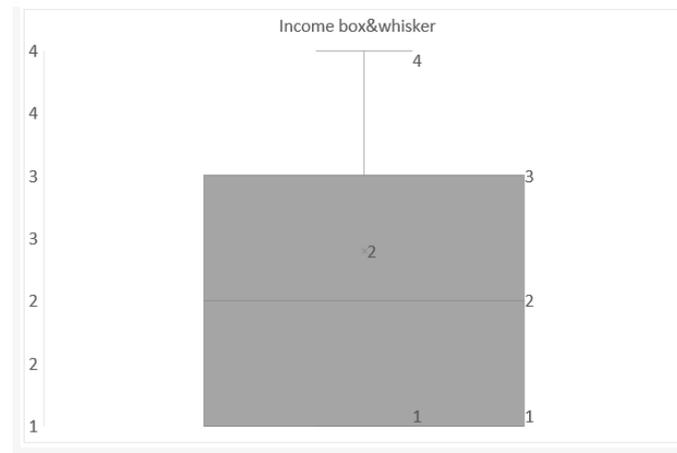
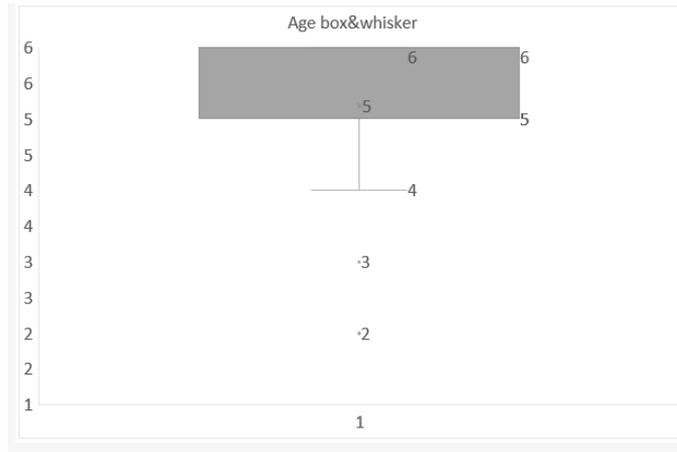
| TIMING OF FIRST Resil or resis ACTION VS GRANTS | Frequency |
|---|-----------|
| Pre-grant Res actions taken                     | 5         |
| Grant - first actions in a category             | 11        |
| Unknown   | 4         |
| <b>TOTAL</b>                                    | <b>20</b> |

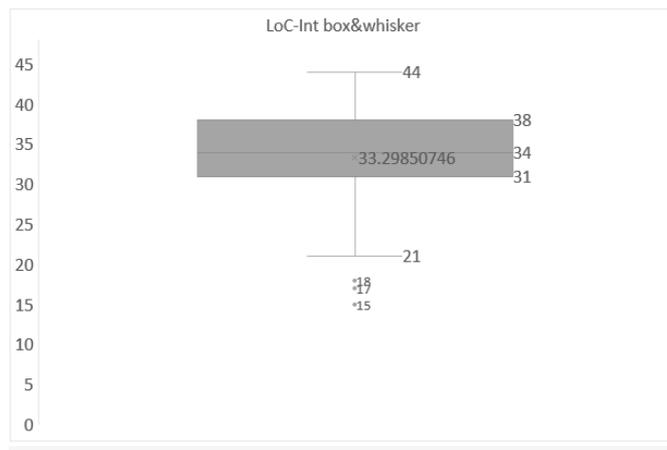
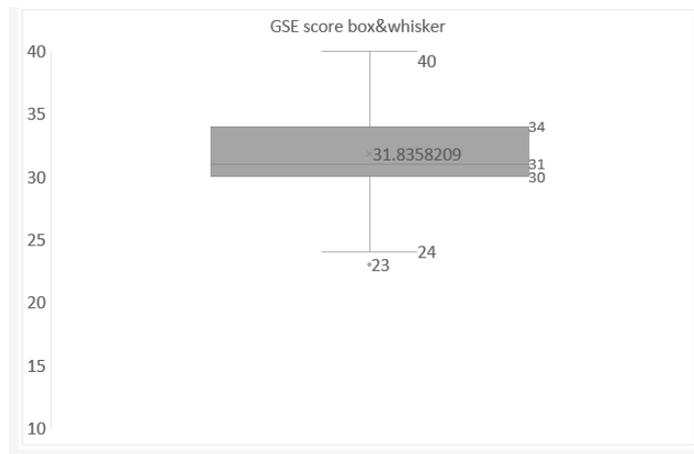
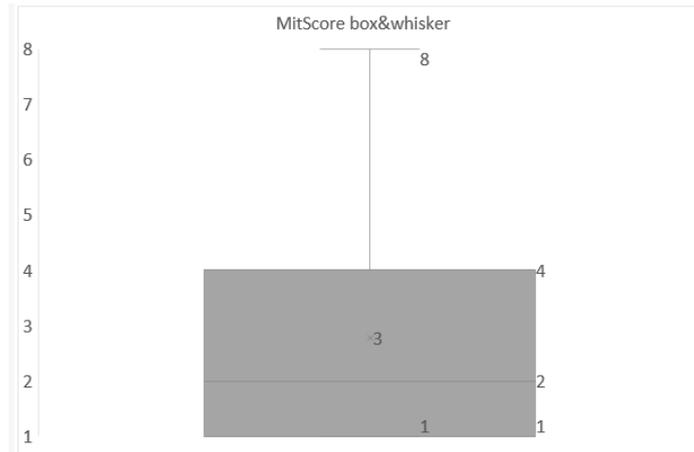
## Appendix 8 - Box and whisker plots – all variables

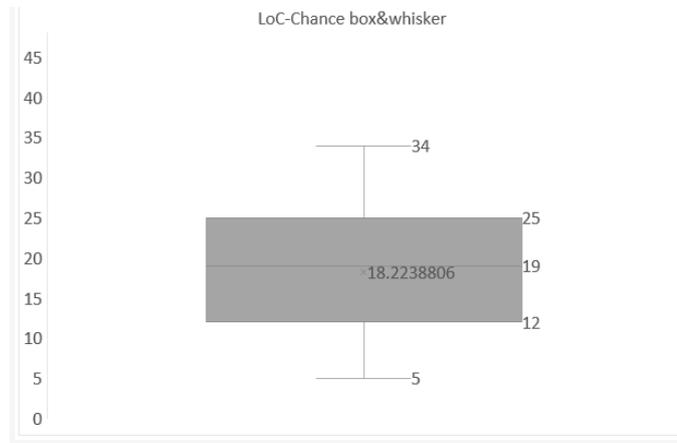
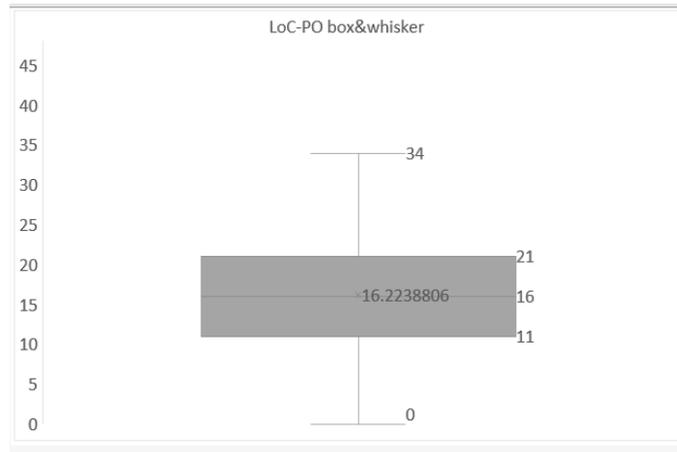
### Box plot elements

| Element                 | Meaning                                   |
|-------------------------|---|
| Top of upper whisker    | Maximum value of the sample               |
| Top of box              | 75 <sup>th</sup> percentile of the sample |
| Line through box        | Median of the sample                      |
| Bottom of box           | 25 <sup>th</sup> percentile of the sample |
| Bottom of lower whisker | Minimum of the sample                     |
| X markers               | Mean of the sample                        |









## APPENDIX 9 – SIMULTANEOUS R- AND Q- MODE FACTOR ANALYSIS

Table showing procedure for simultaneous r- and r-mode factor analysis (Booth *et al.*, 2006) Used with author's permission.

| Step | Procedure   |
|------|---|
| 1    | Compile a raw data matrix of $n$ samples (rows) by $m$ parameters (columns) denoted by $[X]$ , as in conventional matrix algebra.   |
| 2    | $[X]$ is standardized to give $[W]$ . Each element of $[X]$ has its column (parameter) mean subtracted from it. It is then divided by the product of the column (parameter) standard deviation ( $s$ ) and the square root of $n$ .                         |
| 3    | $[W]'$ is created by transposing $[W]$ . This involves turning the rows of $[W]$ into the columns of $[W]'$ and the columns into rows.  |
| 4    | $[R]$ is created by matrix multiplication of $[W]' \cdot [W]$ . The matrix $[R]$ represents a correlation matrix between the parameters.  |
| 5    | Eigenvectors and eigenvalues are extracted from $[R]$ . The eigenvectors are used to form a matrix $[U]$ . The eigenvalues can be used to compute the percentage of the total variation in the original data set explained by the new "underlying" factors. |
| 6    | The square roots of the eigenvalues are placed in the top left to bottom right diagonal elements of a matrix $[\Lambda]$ . All other elements in this matrix are set to zero.   |
| 7    | $[A^R]$ is computed by multiplication from $[U] \cdot [\Lambda]$ . The matrix $[A^R]$ contains the R-mode (parameter) factor loadings. Each column represents the loadings of the original parameters on an individual factor (column 1 on factor 1, etc.). |

|   |  |
|---|--|
|   | <p>These are the values used when plotting the parameters in “factor space” in the form of scatter diagrams.</p>   |
| 8 | <p><math>[A^Q]</math> is computed by multiplication from <math>[W] \cdot [U]</math>. The matrix <math>[A^Q]</math> contains the Q-mode (sample) factor loadings. Each column represents the loadings of the original parameters on an individual factor (column 1 on factor 1, etc.). These are the values used when plotting the samples in “factor space” in the form of scatter diagrams.</p> |

## APPENDIX 10 – SURVEY INSTRUMENT

*Note - the two psychometric inventories were presented in random order to avoid sequencing effects (automated facility within Qualtrics software package).*

### SECTION A - INTRODUCTION

This study attempts to collect information about differences in the way people deal with household flood risk. The questionnaire consists of 40 questions (some of which will not apply to every person) and should take no more than 20 minutes of your time. Some questions are designed to determine how your household is equipped for future flooding, and others are about your individual outlook on life.

#### *INFORMATION TO PARTICIPANTS*

*You are invited to take part in a research study. **Before you decide it is important for you to understand why the research is being done and what it will involve.** Please take time to read the following information carefully – you can ask us (using the contact details supplied below) if there is anything that is not clear, or if you would like more information.*

*What is the purpose of the study?*

*The study will examine the uptake of a variety of flood protection measures, together with information on flood experience, questions asking about your general outlook on life and finally some background information on your household. The findings from the research will help to establish when and how people make decisions about protecting their homes and belongings from possible flood damage, which in turn will inform guidance for those people whose homes are likely to be at risk in the future.*

*Why have I been invited to participate?*

*We are inviting people who have joined a community flood group to complete this survey. This is because we are interested in contacting householders who live in areas that are at risk of flooding (whether they have already had floodwater in their homes or not) and, when deciding whether to protect their home from flood damage, people often turn to local flood groups for information and advice.*

*What will happen if I take part?*

*If you decide to take part in the study you can use the link provided to complete an on-line questionnaire. Most of the questions simply need a box to be checked, so it should not take up too much of your time. All the information collected is anonymous - names and addresses are not needed, just postcodes. It is up to you to decide whether or not to take part - you may choose not to continue with the survey at any point during the completion process without giving a reason.*

*If you do decide to take part, a copy of this information section is enclosed with this questionnaire, which you can keep. A decision not to take part, or to withdraw part way through the survey, will not affect you in any way.*

*What are the benefits of participating?*

*By participating in the project you will be helping other people who live in areas at risk of flooding, both now and in the future, by improving our understanding of how people make decisions about flood protection.*

*Will what I say in this study be kept confidential?*

*Your responses will be kept confidential and only the researchers will have access to the information. Any information which could identify you will be removed from published results of the study. Research data will be stored until it has been deleted by the primary investigator at the University of the West of England (typically around 5 years).*

*What will happen to the results of the study?*

*The results of the study will be used to recommend how guidance on flood protection can be improved. The results will be published in:*

- *Papers in refereed journals*
- *PhD thesis*
- *Academic books; and*
- *Conference papers*

*Who is organising and funding the study?*

*The study is part of a doctoral research programme, supported by the University of the West of England. It developed from a project called 'Community Resilience to Extreme Weather' funded by the Engineering and Physical Sciences Research Council between 2008 and 2011. No insurance companies have funded this survey, nor will they have direct access to the results (other than the summaries included in the publications listed above).*

*Questions about your Rights as Research Participants*

*If you have questions you do not feel comfortable asking the researcher, you may contact Dr Jessica Lamond on: 0117 328 3268 or via email at [jessica.lamond@uwe.ac.uk](mailto:jessica.lamond@uwe.ac.uk)*

*For further information - please contact the lead researcher:*

*Carly Rose - Centre for Floods, Communities and Resilience*

*University of the West of England*

*Frenchay Campus, Coldharbour Lane*

*Bristol BS16 IQY*

*Tel: 07982 749 982 or Email: [carly2rose@live.uwe.ac.uk](mailto:carly2rose@live.uwe.ac.uk)*

Thank you for taking the time to read this information.

If you wish to participate **please tick the box on the right** to confirm the following:

I have read, understood saved a copy of the above consent form, and desire of my own free will to participate in this study. I also confirm that I am at least 18 years of age and a member of a local community flood group.

## SECTION B - DEALING WITH FLOODS

Sometimes people do things to help keep water out of their home, or to help get their home back to normal more quickly after a flood. This section asks if any of these kind of things apply to your home.

These things may have been bought for, or made for, or done to your home. You should include anything that was already there when you moved in (such as equipment bought by people who lived there before you).

It doesn't matter if you don't have any of these things - at the end of each list there is a box you can tick saying 'None of the above'.

*(Please note - the big flood defence schemes that protect many homes are NOT what this question is about).*

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B2/B3

### FLOOD EQUIPMENT

The first list includes the sort of things that may have been bought, or made, for your home.

Please tick the boxes in the middle column next to ALL those you have at your current home, and then state the year you FIRST bought/installed or made this item (*not the first year you had to use them*). If an item was already there when you moved in, please enter XXXX in the box instead of a year.

If you don't have any of these, please tick the box by 'None of the above' and carry on to the next section.

| Item   |  | Year |
|--|--|------|
| Barriers that fix onto doors, windows, patio doors or garage doors | <input type="checkbox"/>   |      |
| Air brick covers - fixed   | <input type="checkbox"/>   |      |
| Air brick covers - temporary seals                                 | <input type="checkbox"/>   |      |
| Toilet plugs/bungs/sealing devices                                 | <input type="checkbox"/>   |      |
| Anti-back flow valves on drains/sewer pipes                        | <input type="checkbox"/> |      |

|   |                          |  |
|---|--------------------------|--|
| Pumps - fixed or portable<br>(not garden pond pumps)  | <input type="checkbox"/> |  |
| Sandbags/absorbent flood-<br>bags (or other re-usable<br>sandbag equivalents)               | <input type="checkbox"/> |  |
| Caravan flotation tanks/car<br>lifts  | <input type="checkbox"/> |  |
| Large barriers (eg special<br>flood walls/skirts protecting<br>a garden, patio or basement) | <input type="checkbox"/> |  |
| None of the above   | <input type="checkbox"/> |  |

B4/B5

REPAIRS/REPLACEMENTS

This second list includes other things that may have been done to your property (for instance, by builders/plumbers/electricians or by household members, when making repairs after a flood).

Please tick the boxes in the middle column next to ALL those you have at your current home, and then state the year this work was FIRST done.

If the work had already been done by a previous owner/occupier, please enter XXXX in the box instead of a year.

If you don't have any of these, please tick the box by 'None of the above' and carry on to the next section.

| Item   |   | Year |
|--|---|------|
| Replaced flooring materials with water-resistant ones (eg - hard flooring such as tiles/solid floors instead of suspended floorboards) | <input type="checkbox"/>   |      |
| Special flood-resistant materials used for repairs (eg Lime plaster/ 'tanked' walls/ plastic skirting boards)                          | <input type="checkbox"/> |      |

|   |                          |  |
|---|--------------------------|--|
| Cookers, washing machines and the like raised up on special plinths (higher than standard kitchen fittings) | <input type="checkbox"/> |  |
| Water-resistant kitchen units (eg plastic/metal) put in   | <input type="checkbox"/> |  |
| Changed from fitted units to free-standing furniture  | <input type="checkbox"/> |  |
| Electrical sockets/ fuse-boxes/ meters moved higher up on walls   | <input type="checkbox"/> |  |
| None of the above   | <input type="checkbox"/> |  |

B6/B7

OTHER ACTIONS

The last list in this section asks about some other things that people can do in case a flood happens.

You may have done some of these, as well as the things in the first two lists, but they are also useful for those who prefer not to make any changes to their homes, or who are not allowed to make changes (for example, if they live in a listed building/conservation area, or who rent their homes).

Please tick the boxes next to each thing that applies to you/your current home.

| Item  |   | Year |
|---|---|------|
| Joined a local flood group  | <input type="checkbox"/>   |      |
| Signed up to a flood warning service (for example Flood Warnings Direct, or a similar scheme) | <input type="checkbox"/>   |      |
| Made a household flood plan   | <input type="checkbox"/> |      |
| Made up a flood emergency kit (with a torch, radio, first aid items kept together).           | <input type="checkbox"/> |      |

|   |
|---|
|   |
| Moved important documents onto a higher level in the home (such as upper floors, or high shelves)                                       |
| Moved valuable or sentimental items (photo albums, videos and the like) onto a higher level in the home (upper floors, or high shelves) |
| Taken out insurance, or checked that flood damage is covered by any insurance policies you already have                                 |
| Made alterations to outside drains, soak-aways, gullies or ditches  |

|  |
|--|
|  |
|  |
|  |
|  |
|  |

None of the above

B8

OTHER

Are there any other actions, not listed in any of the sections above, that you have taken to deal with flooding at your present OR previous home(s)?

Yes

No

If you answered No, then please skip to the 'Funding' question at the foot of this page

B9

If you answered yes, please give brief details in the box below, present home first (if applicable) and any previous home(s) below that.

Present home

Previous home(s)

## FUNDING

Between 2006 and 2016 some areas of the UK have had special grant schemes to help make homes more resilient to flooding - for example, the 'Repair and Renew' scheme for places flooded in the winters of 2013/2014, and similar schemes for the floods of December 2015.

If you have received funding for flood protection from this type of scheme for your home, please enter the year of that funding in the box below.

(If you are still waiting to hear about an application made recently, please write 2016 followed by a question mark, like this: 2016?)

## SECTION C – FLOOD EXPERIENCES

This section asks about any flood experiences you may have had. For the purposes of this questionnaire, you have had 'flood experience' if you have had floodwaters invade your home at any time, as well as any flooding that has affected people you know well (but when your home was NOT flooded at the same time). It also covers situations like living in an upstairs flat, when lower floors of the same building have been flooded, or if floodwater affected places like your garden or garage (but the rooms you actually lived in stayed dry).

c1

Have floodwaters ever entered your home itself (meaning the rooms you actually live in) including your present or any previous properties that you lived in?

(Do not include flooding that only affected garage/sheds, gardens or the lower floors of blocks of flats, when your home itself stayed dry - there are questions about these experiences later on).

Never

Once

Twice

Three or more occasions

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If you answered Never, then please skip to **Section D on page 8**

c2

In which of your homes did you experience these floods? (Tick one, or both, as necessary)

Present home

Previous home(s)

c3

Out of all the floods you have experienced, in which year would you say **the most damaging** flood happened? (Give one answer only).

Present home - Year

OR

Previous home - Year

C4

Please list any other years in which floodwaters entered any of your homes, if applicable.

C5

What was the source of the floodwater? If it came from more than one source, please tick all that apply.

|                          |              |                          |               |
|--------------------------|--------------|--------------------------|---------------|
| <input type="checkbox"/> | Present home | <input type="checkbox"/> | Previous home |
|--------------------------|--------------|--------------------------|---------------|

|  |                      |                      |
|--|----------------------|----------------------|
|  |                      |                      |
| Sea  | <input type="text"/> | <input type="text"/> |
| River/stream                                       | <input type="text"/> | <input type="text"/> |
| Overflowing drains/sewers<br>/ditches/road surface | <input type="text"/> | <input type="text"/> |
| Don't know   | <input type="text"/> | <input type="text"/> |

#### SECTION D – OTHER FLOOD EXPERIENCES

There may have been times when floodwater did not enter your home itself, but affected other parts of the property, such as gardens, garages or other outbuildings.

Please tick **all the boxes** that are true for you, next to the type of area affected, and the year (or years) this happened. If there were more than 3 occasions for any category, please enter the 3 years you remember as involving the deepest flooding.

If none of these apply to you, please tick 'None of the above'

D1/D2

| Area                 | Year                 | Year | Year |
|----------------------|----------------------|------|------|
| Garden               |                      |      |      |
| Garage               |                      |      |      |
| Sheds/storage        |                      |      |      |
| Summerhouse          |                      |      |      |
| Other outbuilding(s) |                      |      |      |
| None of these        | <input type="text"/> |      |      |

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If you answered None of these , then please skip to page 9, starting at 'Have you ever lived in an upstairs flat ...'

D3

What was the source of the floodwater in each case? If it came from more than one source, please tick all that apply.

| <b>Area</b>             | <b>Sea</b> | <b>River/stream</b> | <b>Overflowing drains/<br/>sewers/ ditches/ road<br/>surface</b> | <b>Don't know</b> |
|-------------------------|------------|---------------------|--|-------------------|
| Garden                  |            |                     |  |                   |
| Garage                  |            |                     |  |                   |
| Sheds/storage           |            |                     |  |                   |
| Summerhouse             |            |                     |  |                   |
| Other<br>outbuilding(s) |            |                     |  |                   |

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D4

Have you ever lived in an upstairs flat/maisonette, or similar property, where flooding affected the ground floor of the building (even though your home itself was dry)?

No  Yes

If you answered No, please skip to page 10

D5

If you answered yes, please indicate the year (or years) the ground floor was affected in the box below. If there were more than 3 occasions, list the 3 years you remember as involving the **deepest** flooding.

D6

What was the source of the floodwater? If it came from more than one source, please tick all that apply.

| Area                             | Sea | River/stream | Overflowing drains/<br>sewers/ ditches/ road<br>surface | Don't<br>know |
|----------------------------------|-----|--------------|---|---------------|
| Ground floor of<br>building ONLY |     |              |   |               |

D7/D8

Even if floodwater has never entered your home, outbuildings or lower floors of a block of flats in which you have lived, you may know other people who have had their homes flooded, or perhaps your workplace, or that of a family member has been flooded?

Please tick all the boxes that are true for you, to show how you are connected to the people or places affected by flooding. For each answer one, please give the year (or years) these people or places were affected. If there were more than 3 occasions for any category, please enter the 3 years you remember as involving the deepest flooding.

| People/places |                          | Year | Year | Year |
|---------------|--------------------------|------|------|------|
| Friends       | <input type="checkbox"/> |      |      |      |

|                              |                          |  |  |  |
|------------------------------|--------------------------|--|--|--|
| Relatives                    | <input type="checkbox"/> |  |  |  |
| Neighbours                   | <input type="checkbox"/> |  |  |  |
| Workmates'<br>homes          | <input type="checkbox"/> |  |  |  |
| Your workplace               | <input type="checkbox"/> |  |  |  |
| Family member's<br>workplace | <input type="checkbox"/> |  |  |  |
| Other                        | <input type="checkbox"/> |  |  |  |

D9

Do you feel the flood experiences of people you know well has made a difference to the way you now deal with flooding? If so please give brief details,

*For example - "After some neighbours nearer to the river were flooded, we decided to sign up for flood warnings"*

D10

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Has an insurance company ever increased your premium, or the excess on your policy, by a large amount as a direct result of making a flood claim?

**\*\*\*Remember - this survey is completely anonymous, so your answer is confidential\*\*\***

Yes  No

If you answered yes to the last question, please give brief details, including the year (or years) when these large increases happened.

*For example - "Our excess increased to several thousand pounds after our second flood claim (2007)"*

**\*\*\*Remember - this survey is completely anonymous, so your answer is confidential\*\*\***

F6

What is the postcode of your present home? (The full address is NOT needed)

F7

If you have experienced flooding at any of your previous homes, please give EITHER the postcode for the property/ies, OR the name of the town(s)/village(s). (The full address is not

needed).

**Thank you for answering the flood-related part of this survey. The next part is about your individual outlook on life.**

SECTION E – OUTLOOK ON LIFE

There are no right or wrong answers here, just respond according to your feelings regarding each statement, by ticking in the column that most closely matches your outlook.

|   | <b>Not at all<br/>true</b> | <b>Hardly<br/>true</b> | <b>Moderately<br/>true</b> | <b>Exactly<br/>true</b> |
|---|----------------------------|------------------------|----------------------------|-------------------------|
| I can always manage to solve difficult problems if I try hard enough    |                            |                        |                            |                         |
| If someone opposes me, I can find the means and ways to get what I want |                            |                        |                            |                         |
| It is easy for me to stick to my aims and accomplish my goals           |                            |                        |                            |                         |
| I am confident that I could deal efficiently with unexpected events     |                            |                        |                            |                         |

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
| Thanks to my resourcefulness, I know how to handle unforeseen situations                         |  |  |  |  |
| I can solve most problems if I invest the necessary effort                                       |  |  |  |  |
| I can remain calm when facing difficulties because I can rely on my coping abilities             |  |  |  |  |
| When I am confronted with a problem, I can usually find several solutions                        |  |  |  |  |
| If I am in trouble, I can usually think of a solution I can usually handle whatever comes my way |  |  |  |  |

Office Use Only

Outlook on life ø

SECTION E – OUTLOOK ON LIFE

There are no right or wrong answers here, just respond according to your feelings regarding each statement by ticking in the column that most closely matches your outlook.

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|   | <b>Strongly disagree</b> | <b>Disagree</b> | <b>Slightly disagree</b> | <b>Slightly agree</b> | <b>Agree</b> | <b>Strongly agree</b> |
|---|--------------------------|-----------------|--------------------------|-----------------------|--------------|-----------------------|
| Whether or not I get to be a leader depends mostly on my ability. |                          |                 |                          |                       |              |                       |

|   |  |  |  |  |  |  |
|---|--|--|--|--|--|--|
| To a great extent my life is controlled by accidental happenings.                     |  |  |  |  |  |  |
| I feel like what happens in my life is mostly determined by powerful people.          |  |  |  |  |  |  |
| Whether or not I get into a car accident depends mostly on how good a driver I am.    |  |  |  |  |  |  |
| When I make plans, I am almost certain to make them work.                             |  |  |  |  |  |  |
| Often there is no chance of protecting my personal interest from bad luck happenings. |  |  |  |  |  |  |

|   |  |  |  |  |  |  |
|---|--|--|--|--|--|--|
|   |  |  |  |  |  |  |
| When I get what I want, it's usually because I'm lucky.   |  |  |  |  |  |  |
| Although I might have good ability, I will not be given leadership responsibility without appealing to those in positions of power. |  |  |  |  |  |  |
| How many friends I have depends on how nice a person I am.  |  |  |  |  |  |  |
| I have often found that what is going to happen will happen.  |  |  |  |  |  |  |

|  | <b>Strongly disagree</b> | <b>Disagree</b> | <b>Slightly disagree</b> | <b>Slightly agree</b> | <b>Agree</b> | <b>Strongly agree</b> |
|--|--------------------------|-----------------|--------------------------|-----------------------|--------------|-----------------------|
| My life is chiefly controlled by powerful others.  |                          |                 |                          |                       |              |                       |
| Whether or not I get into a car accident is mostly a matter of luck.   |                          |                 |                          |                       |              |                       |
| People like me have very little chance of protecting our personal interests when they conflict with those of strong pressure groups. |                          |                 |                          |                       |              |                       |

|   |  |  |  |  |  |  |
|---|--|--|--|--|--|--|
|   |  |  |  |  |  |  |
| It's not always wise for me to plan too far ahead because many things turn out to be a matter of good or bad fortune. |  |  |  |  |  |  |
| Getting what I want requires pleasing those people above me.  |  |  |  |  |  |  |
| Whether or not I get to be a leader depends on whether I'm lucky enough to be in the right place at the right time.   |  |  |  |  |  |  |

|   |  |  |  |  |  |  |
|---|--|--|--|--|--|--|
|   |  |  |  |  |  |  |
| If important people were to decide they didn't like me, I probably wouldn't make any friends. |  |  |  |  |  |  |
| I can pretty much determine what will happen in my life.                                      |  |  |  |  |  |  |

|  |                          |                 |                          |                       |              |                       |
|--|--------------------------|-----------------|--------------------------|-----------------------|--------------|-----------------------|
|  | <b>Strongly disagree</b> | <b>Disagree</b> | <b>Slightly disagree</b> | <b>Slightly agree</b> | <b>Agree</b> | <b>Strongly agree</b> |
| I am usually able to protect my personal |                          |                 |                          |                       |              |                       |

|   |  |  |  |  |  |  |
|---|--|--|--|--|--|--|
| interests.  |  |  |  |  |  |  |
| Whether or not I get into a car accident depends mostly on the other driver.                                    |  |  |  |  |  |  |
| When I get what I want, it's usually because I worked hard for it.  |  |  |  |  |  |  |
| In order to have my plans work, I make sure that they fit in with the desires of people who have power over me. |  |  |  |  |  |  |

|  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|
| My life is determined by my own actions.   |  |  |  |  |  |  |
| It's chiefly a matter of fate whether or not I have few friends or many friends. |  |  |  |  |  |  |

Thank you for answering the questions about your outlook on life.

The final section asks for general details about you and your household – this is so the researcher can check whether all groups of people across the country are represented by the survey responses received, so please do not omit this last section.

*Office Use Only*

SECTION F - GENERAL DETAILS

In each of the following questions please tick ONE category only:

F1

What is your gender?

Male  Female  Prefer not to say

F2

What was your age at your last birthday?

18 – 24    25 – 34    35 – 44    45 – 54    55 – 64    65 or over

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F3

Please indicate the approximate total income for your household (before tax), including pensions if relevant.

under £25,000    £25,001 - £45,000    £45,001 - £65,000    £65,001 or more

F4

Please indicate the highest level of education you completed.

GCSE/O-level/CSE/Standard Grades (Scotland)

NVQ 1 or 2

A-level/NVQ 3/Scottish Highers

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Bachelor degree/NVQ 4

Master's/Doctoral Degree/Professional qualification

Other

Still studying

No formal qualifications

F5

Would you describe your present home as:

Owned (with or without mortgage)

Rented (privately, from housing association

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or from local authority)

Other (including 'tied' to someone's job)

\*\*\*\*\*

That was the final question – thank you very much for taking the time to complete this survey. Please detach and keep the next two pages, then return the rest of the booklet to us in the prepaid envelope supplied.

\*\*\*\*\*

COPY OF PAGES 1 AND 2 FOR PARTICIPANTS TO DETACH AND KEEP

*INFORMATION TO PARTICIPANTS*

*You are invited to take part in a research study. **Before you decide it is important for you to understand why the research is being done and what it will involve.** Please take time to read the following information carefully – you can ask us (using the contact details supplied below) if there is anything that is not clear, or if you would like more information.*

*What is the purpose of the study?*

*The study will examine the uptake of a variety of flood protection measures, together with information on flood experience, questions asking about your general outlook on life and finally some background information on your household. The findings from the research will help to establish when and how people make decisions about protecting their homes and belongings from possible flood damage, which in turn will inform guidance for those people whose homes are likely to be at risk in the future.*

*Why have I been invited to participate?*

*We are inviting people who have joined a community flood group to complete this survey. This is because we are interested in contacting householders who live in areas that are at risk of flooding (whether they have already had floodwater in their homes or not) and, when deciding whether to protect their home from flood damage, people often turn to local flood groups for information and advice.*

*What will happen if I take part?*

*If you decide to take part in the study you can use the link provided to complete an on-line questionnaire. Most of the questions simply need a box to be checked, so it should not take up too much of your time. All the information collected is anonymous - names and addresses are not needed, just postcodes. It is up to you to decide whether or not to take part - you may choose not to continue with the survey at any point during the completion process without giving a reason.*

*If you do decide to take part, a copy of this information section is enclosed with this questionnaire, which you can keep. A decision not to take part, or to withdraw part way through the survey, will not affect you in any way.*

*What are the benefits of participating?*

*By participating in the project you will be helping other people who live in areas at risk of flooding, both now and in the future, by improving our understanding of how people make decisions about flood protection.*

*Will what I say in this study be kept confidential?*

*Your responses will be kept confidential and only the researchers will have access to the information. Any information which could identify you will be removed from published results of the study. Research data will be stored until it has been deleted by the primary investigator at the University of the West of England (typically around 5 years).*

*What will happen to the results of the study?*

*The results of the study will be used to recommend how guidance on flood protection can be improved. The results will be published in:*

- *Papers in refereed journals*
- *PhD thesis*
- *Academic books; and*
- *Conference papers*

*Who is organising and funding the study?*

*The study is part of a doctoral research programme, supported by the University of the West of England. It developed from a project called 'Community Resilience to Extreme Weather' funded by the Engineering and Physical Sciences Research Council between 2008 and 2011. No insurance companies have funded this survey, nor will they have direct access to the results (other than the summaries included in the publications listed above).*

*Questions about your Rights as Research Participants*

*If you have questions you do not feel comfortable asking the researcher, you may contact  
Dr Jessica Lamond on: 0117 328 3268 or via email at [jessica.lamond@uwe.ac.uk](mailto:jessica.lamond@uwe.ac.uk)*

*For further information - please contact the lead researcher:*

*Carly Rose - Centre for Floods. Communities and Resilience  
University of the West of England  
Frenchay Campus, Coldharbour Lane  
Bristol BS16 IQY*

*Tel: 07982 749 982 or Email: [carly2rose@live.uwe.ac.uk](mailto:carly2rose@live.uwe.ac.uk)*

## APPENDIX 11 – INVITATION TO PARTICIPATE

Email message text

Dear flood group co-ordinator

I would be very grateful if you could forward the message below to all the members of your group. Even if only one or two feel able to spare the time to complete the survey, this would be of great help in furthering the understanding of the issues involved.

kind regards

Carly Rose

\*\*\*\*\*

Dear Flood Group Members

My name is Carly Rose and I am a postgraduate researcher at the University of the West of England, Bristol. My main interest is how people deal with the risk of flooding, and I am looking into some aspects that have not been investigated in much detail before here in the UK.

You are invited to take part in an online survey, which should take no more than 20 minutes of your time.

The first page you will see explains more about this research - having read that section, you will then be invited to click a box if you consent to participating and this will open the question section. If you should need to break off part way through, the same link will bring you back to where you left off.

My full contact details, and those of my academic supervisor, are also provided within the survey.

To begin, either hold down the Control key and click on the link below (on a computer) or tap on the link (on a smart phone):

[https://qtrial2013.qualtrics.com/SE/?SID=SV\\_b10kyt3xnyobN6I](https://qtrial2013.qualtrics.com/SE/?SID=SV_b10kyt3xnyobN6I)

With grateful thanks

Carly B Rose PhD Researcher  
Centre for Floods, Communities and Resilience  
University of the West of England, Bristol

## APPENDIX 12- IPC SELF-ASSESSMENT INVENTORY

### Source

From *Differentiating Among Internality, Powerful Others and Chance* by H. Levenson. 1981. In H. M. Lefcourt (ed.), *Research with the Locus of Control* pp. 57—59. Copyright by Academic Press, Inc.

### *IPC self-assessment inventory - Scoring*

*Each of the subscales of Internality, Powerful Others, and Chance is scored on a six-point Likert format from minus 3 to plus 3. For example, the eight Internality items are 1, 4, 5, 9, 18, 19, 21, 23.*

*A person who has strong agreement with all eight items would score a plus 24; strong disagreement, a minus 24. After adding and subtracting the item scores, add 24 to the total score to eliminate negative scores. Scores for Powerful Others and Chance are similarly derived.*

### *Norms*

*For the Internality subscale, means range from the low 30s to the low 40s, with 35 being the modal mean (SD values approximating 7). The Powerful Others subscale has produced means ranging from 18 through 26, with 20 being characteristic of normal college student subjects (SO -8.5). The Chance subscale produces means between 17 and 25, with 18 being a common mean among undergraduates (SD 8).*

### *Scoring*

*Total the responses for the items listed for each of the three parts of the scale; **add +24 to each of the three totals.***

*Internal Locus of Control: Total the responses for items 1, 4, 5, 9, 18, 19, 21, and 23; then add +24.*

*Score: \_\_\_\_\_*

*Powerful Others: Total the responses for items 3, 8, 11, 13, 15, 17, 20, and 22; then add +24.*

*Score: \_\_\_\_\_*

*Chance: Total the responses for items 2, 6, 7, 10, 12, 14, 16, and 24; then add +24.*

*Score: \_\_\_\_\_*

*Scores should be between 0 and 48. A high rating on the Internal Locus of Control scale indicates a strong internal locus of control. An internal locus of control can be helpful for successful behavior change. High ratings on either the Powerful Others scale or the Chance scale indicate a strong external locus of control. If someone rates high on the Powerful Others scale, they typically believe that their fate is controlled by other people; if they rate high on the Chance scale, they believe their fate is controlled by chance.*

## APPENDIX 13 – GENERALISED SELF-EFFICACY INVENTORY

From: Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy scale. In J. Weinman, S. Wright, & M. Johnston, Measures in health psychology: A user's portfolio. Causal and control beliefs (pp. 35- 37). Windsor, England: NFER-NELSON.

<http://www.ralfschwarzer.de/> [accessed 23/05/11]

### ***Scoring procedure for the GSE***

*Add up all responses to a sum score. The range is from 10 to 40 points.*

