Living on the edge: using cognitive filters to appraise environmental risk

by Hamilton-Webb, A., Naylor, Manning, L. and Conway, J.

DOI: http://dx.doi.org/10.1080/13669877.2017.1378249

Hamilton-Webb, A., Naylor, Manning, L. and Conway, J. 2017. Living on the edge: using cognitive filters to appraise environmental risk. *Journal of Risk Research*

20 September 2017

Re-Submitted to Journal of Risk Research 4th June, following acceptance subject to minor revision

'Living on the edge': using cognitive filters to appraise experience of environmental risk

Alice Hamilton-Webb [a], Rhiannon Naylor [a], Louise Manning [b], John Conway [a]

[a]Royal Agricultural University, Stroud Road, Cirencester, Glos, GL7 6JS, England alice.hamilton-webb@rau.ac.uk

[b]Harper Adams University, Newport, Shropshire, TF10 8NB, England

Abstract

The way in which individuals respond to an experience of risk, both in attitudinal and behavioural terms can in part, be explained by the way that such an experience is interpreted and appraised. Taking climate change as an example in this paper, there is existing evidence that experience of local flooding can inform individuals' attitudes towards climate change. This trend however is not observed in all cases, and is highly dependent on the local context. This paper postulates that the variation observed in attitudinal and behavioural responses to climate change, following experiences of local flooding can, in part, be explained by the 'Cognitive Filters of Experience Appraisal' Model introduced in this paper. The model is developed through a review of the existing literature concerning appraisal (cognitive and experience), and a series of fifteen face to face interviews with farmers in the county of Gloucestershire, England, who have all directly experienced local flooding in recent years. The study is exploratory in nature, and the qualitative data serve as contextualised accounts of the different patterns of experience appraisal. The model of experience appraisal suggests that due to a number of cognitive filters, including, farmers' pre-existing views on risk, their

perceptions relating to the severity of the experience, and their beliefs about other attributing factors; the sample population was found to be unlikely to appraise their experiences of flooding as evidence for global climate change. It is envisioned that with further research, the model of experience appraisal could be applied to various contexts of environmental risk in the future.

Keywords

Experience appraisal, cognitive appraisal, climate change, environmental risk, farmers

1. Introduction

Individuals respond to some form of risk on a daily basis; some risks may have minor consequences, while others may be more significant. Understanding what influences the way that individuals respond to risk is important, particularly when trying to encourage particular response actions. Communication strategies that emphasise the vivid elements of direct experience can be more successful at conveying risk than the provision of indirect stimuli such as scientific or statistical information (Weber 1997, Weber 2006, Joireman *et al.* 2010, Risen and Critcher 2011, Akerlof *et al.* 2013, Egan and Mullin 2014). As such, experience of risk can provide an individual with information that can be used to determine potential future risk (Weinstein 1989),can lead to greater risk knowledge (Hansson *et al.* 1982, Slovic 1987, Grimley *et al.* 2000, Martin *et al.* 2007), as well as more confident and persistent attitudes towards that risk (Fazio and Zanna 1981, Chawla 1999, Garvin 2001). Some researchers have postulated that individuals are more likely to respond to a risk, particularly a response of a self-protective nature, out of emotions such as concern and worry, which in turn, can be initiated by past direct experience (Haden *et al.* 2012). Thus, memories of significant

experiences are likely to be called upon when making a decision about responding to relevant incoming risk information.

Depending on the situation and conditions, past experience may positively or negatively affect attitudes towards risk, possibly leading to unrealistic views on the potential frequency and likely severity of future risk; and over-estimation or under-estimation of the actual level of risk. The relationship between experience and both attitudinal and behavioural response to environmental risk has been tested in a number of studies, and while some relationships have been established (Parker and Handmer 1998, Grimley*, et al.* 2000, Parker *et al.* 2009, Spence *et al.* 2011a, Capstick *et al.* 2015), other authors have warned of the limits on the extent that experience of risk can influence response (Whitmarsh 2008, Wachinger *et al.* 2013, Lawrence *et al.* 2014) with a number of intervening and mediating factors and processes in operation.

In light of this, one of the overarching intervening processes in operation is that of how an experience of risk is interpreted by an individual. In reality, individuals 'appraise' similar experiences in different ways and attach varied meanings to stressful events, resulting in diverse responses. In general, little emphasis has been given to the role of subjective considerations in shaping individuals' patterns of response to experience (Rochford and Blocker 1991), and there is little conceptualisation of the 'appraisal' process with regard to risk experience (i.e. experience appraisal), particularly in the context of experience of environmental risk and climate change specifically. As emphasised by Gifford *et al.* (2011:19) future research "*should more closely examine the impact of contextual factors on environmental behaviour and how these factors interact with psychological determinants."*

Thus, in order to fill this research gap, the aim of this paper and the associated empirical research is to **establish the context in which experience appraisal takes place, and the factors that are involved in, and influence the process.** To aid conceptualisation, the case study of climate change is used. The rationale for this is that climate change is an example of a significant environmental risk to both natural and human systems worldwide. Existing literature is critiqued and then details of the case study are subsequently provided, and reflected upon in order to consider the appraisal process at the level of the individual.

2. Conceptualisation of the experience appraisal process

In general terms, 'appraisal' initiates the process of definition, as individuals accumulate and evaluate information about both the cause, and the future threat of a risk (Lazarus and Launier 1978). 'Appraisal' has been described as the most critical factor in predicting how individuals cope with and respond to events, including those that are particularly stressful (Lazarus 1966, 1981). The notion of 'experience appraisal' specifically is a key component of Grothmann and Patt's (2005) socio-cognitive process Model of Private Proactive Adaptation to Climate Change (MPPACC), presented later, and is said to have a particular role in informing an individual's perception of risk or 'threat appraisal.' Although Grothmann and Patt (2005) define the 'experience appraisal' process as an individual '*assessing the severity of a threat experience that has occurred in the past,'* there is a lack of clarity as to what the process entails, in what context it takes place, and what conditions inform the process.

While there is a lack of literature on the 'experience appraisal' process, a number of authors have attempted to conceptualise **'cognitive appraisal**,' defined as a process whereby an

individual evaluates whether a particular experience with the environment is relevant to his or her well-being, and if so in what ways (Scherer 2001). While the notion of 'experience appraisal' as defined by Grothmann and Patt (2005) is concerned with assessing the *severity* of an experience or encounter, 'cognitive appraisal' is concerned with a wider evaluative process, that can be classified as 'primary' or 'secondary' and is conceptualised as fundamental in shaping different emotional responses. Whilst reviewing the literature, it appears that both 'cognitive' and 'experience' appraisal have been used synonymously; with both processes involving an individual's interpretation of an *encounter* or *experience* with his or her environment. In this paper, literature that discusses 'cognitive appraisal' is reviewed to help develop a better understanding and more detailed conceptualisation of the 'experience appraisal' process.

As described, in terms of immediate output of a cognitive appraisal, the result is a particular emotional response (Smith and Lazarus 1990). Bowman *et al.* (2003) explain that a primary cognitive appraisal can result in an individual interpreting an experience as either; (1) irrelevant, (2) positive, or (3) stressful, prompting positive or negative emotions (Lazarus and Folkman 1984). It is well established that individuals are motivated to self-protectively respond to risk by changing their environment in ways that will reduce feelings of worry (Weber 1997, Weber 2006, Haden*, et al.* 2012). In turn, an individual may go on to change elements of the environment that give rise to concern as a result of an encounter being appraised as 'stressful.'

In attempting to understand the relationship between an encounter and subsequent emotional responses, appraisal theories of emotion have been developed, and have very much evolved

over the years (Aronson *et al.* 2005). While the 'structural model of (cognitive) appraisal' by Lazarus (1991) seeks to depict the components of the appraisal process, the 'relational model of appraisal' by Smith and Kirby (2009) can be called on to help us understand the antecedents of cognitive appraisal, i.e. what feeds into, and influences the process. With regard to the former and as noted, researchers have distinguished between two separate components; primary and secondary cognitive appraisal (Lazarus and Folkman 1984). Primary appraisal, which forms the focus of this study, involves the evaluation of harm associated with an experience whereby an individual tends to answer the questions "what does this stressor and/or situation mean?" and "how is it relevant to my needs?" Where a situation is perceived to be highly relevant to one's wellbeing, and is also perceived to cause a threat or risk, such an experience is likely to be appraised as ‘stressful’, and thus a more intense emotional response tends to be prompted (Smith and Kirby 2009).

Conversely, secondary appraisal largely involves people's evaluation of their resources and options for coping (Lazarus 1991). The process takes into account what coping options are available and the likelihood that a given coping option will accomplish what it is supposed to, as well as the likelihood that one can apply a particular strategy (Lazarus and Folkman 1984). Like primary appraisal, secondary appraisal can also shape the resultant emotional reaction, for example, if a person feels helpless to deal with a threat, the stress will be relatively greater. One aspect of secondary appraisal that has resonance with this empirical research, is the evaluation of who should be held accountable. While individuals may see an experience as a result of 'chance,' others may instead attribute blame for a harmful event, with 'others,' which in turn can guide efforts to cope with the emotions that they experience. Coping is the process of changing cognitive or behavioural efforts to manage specific external and/or

internal demands that are appraised as taxing (Lazarus and Folkman 1984), and can involve managing the problem causing the distress and/or regulating emotional response to the problem. The former is described as ‘problem-based coping,’ when one feels as though they know how to manage a problem to gain a positive outcome (Folkman and Lazarus 1984). The latter is conceptualised as 'emotion-focused coping;’ used when one perceives little control over a situation, and is unsure how to cope, and thus may lead to avoidance as a means of response. To illustrate this trend, Rochford and Blocker (1991) revealed that victims who viewed the process of flooding as controllable and unnatural would feel threatened by the likelihood of future flooding and become involved in public protests (problem-based coping strategy) compared to those who appraised flooding as an uncontrollable natural hazard; instead undertaking individualistic modes of response, i.e. emotion focused coping strategies. In this respect, appraisal of experience results in varied perceptions of future risk, and helps to shape the behavioural response that ensues.

As opposed to the process itself, some authors have conceptualised the factors of influence before the primary level of appraisal, commonly described as antecedents. These can be ‘**person**’ centred factors related to the individual (appraiser) themselves, such as personal beliefs, or personal circumstances, or **‘situation’** factors. With regard to personal characteristics, any experiential encounter that interfaces with a strongly held commitment or value will be appraised as meaningful and anything that is perceived to threaten ones commitments will be evaluated as more stressful. Commitments together with an individual’s beliefs can form a perceptual lens through which encounters are inherently appraised (Lazarus and Folkman 1984).

With regard to situation factors as antecedents of appraisal, the degree of impact or loss associated with an encounter is likely to affect appraisal. Greater harm is linked to a heightened perception of risk (Grothmann and Reusswig 2006, Solberg *et al.* 2010, Reser *et al.* 2012), which is likely initiated through more intense negative emotions, such as distress. In accordance with the influence of heuristics (cognitive biases) (Kahneman and Tversky 1979, Nicholls 1999) experiences that are more significant and severe are more likely to be easily accessed from memory when future decisions are made and thus thatparticular experience will more likely serve as a 'filter' for an individual through which future risk may be perceived and judged. At the same time however, where experiences are less severe, the associated risk awareness decays with time after the experience, and thus risk perception diminishes (Di Baldassarre *et al.* 2013).

Person and situation variables are ultimately interdependent; components of a dynamic person-situation relationship (Lazarus and Folkman 1984). The process of cognitive appraisal takes place continuously, and an experience can be 're-appraised' on the basis of subsequent information. Furthermore, the 'stimulus-appraisal-response' model is not necessarily linear and unidirectional. The response itself may have an impact on the person, and the environment, through a feedback mechanism, and in this respect antecedents can also be shaped by the consequences of previous experience(s). Likewise, the environment is constantly changing and so is the person and his or her relationship with it (Lazarus and Folkman 1984).

This short review has illustrated that 'experience appraisal,' owing to the previous conceptualisation of '(primary) cognitive appraisal' involves the evaluation of the **threat** and

192 **severity** of a prior experience, in accordance with the **perceived relevance** of that threat **to**
193 **one's wellbeing**. This process results in an experience being appraised as either positive,
194 stressful, or irrelevant, and thus stimulates resulting negative emotions such as worry and
195 concern, or alternatively positive emotions, such as happiness. Other literature has suggested
196 however, that the **perception of the cause of an experience is an integral part** of the
197 process (Lazarus and Launier 1978), and subsequently provides input into the perception of
198 who is to blame for the said experience, as a component of secondary cognitive appraisal.
199 This entire cognitive process is ultimately informed by important concrete person and
200 situation factors. Although this review has provided some insight into the process of
201 experience appraisal, in the context of flooding and climate change there is little evidence of
202 which of these components discussed here, are most important in the process; thus forming
203 the rationale for undertaking the empirical research.

204

205 ## *3.* Contextualising climate change experience

206 Climate change is used as a case study for this research, and more specifically the appraisal
207 of climate change *experience* is given attention. Climate change represents a unique risk
208 (Heath and Gifford 2006, Etkin and Ho 2007); consisting of characteristics that make it
209 different from other, better understood environmental hazards. Psychologically, climate
210 change is an intangible problem, frequently framed as an issue with international scope
211 (Stamm *et al.* 2000, Liu *et al.* 2008). Given this scale, it is often difficult to imagine the
212 personal relevance of climate change, with its current impact predominantly invisible and not
213 easily observed by the public, at least in the UK. This is a problem since people's perceptions
214 of climate change are often interpreted through personal life experiences of daily interactions
215 with the local environment, and thus local perceptions can lead to distinct location-based,

situational, responses (Weber 1997, Kuruppu and Liverman 2011). In reality, there are a number of individual, and societal barriers to climate change response (Lorenzoni 2007); both external (e.g. structural) and internal (e.g. psychological) barriers. Many researchers have commented on the "psychological distance" characteristic of climate change (Kollmuss and Agyeman 2002, Lorenzoni and Pidgeon 2006, Pidgeon and Fischoff 2011, Spence *et al.* 2011b) being a substantial personal barrier to engagement amongst the general public. Hence, it is assumed that by “experiencing” climate change, the risk can be more easily imagined. Individuals will have varied interactions with climate change and understand it to mean different things, and thus the notion of climate change can be said to be 'socially constructed' (Pettenger 2007). Recent research however has shown that the general public are most likely to base their climate change beliefs on experiences of extreme weather, particularly wet weather related events (Brody *et al.* 2008, Spence and Pidgeon 2010, Spence*, et al.* 2011a, Capstick *et al.* 2013, de Bruin *et al.* 2014, Taylor *et al.* 2014, Capstick*, et al.* 2015).

In theory, with increased personal experience, climate change would be perceived as a less distant issue, and thus concern for the problem may increase amongst populations, and in turn lead to an individual behavioural response that seeks to reduce risk. Messling *et al.* (2015) argue that there is now growing evidence that flooding and climate change are linked in the public mind, with those directly experiencing flooding being more likely to express concern and perceive its threat as high, based largely on quantitative modelling (Spence*, et al.* 2011a, Capstick*, et al.* 2013, Capstick*, et al.* 2015). Others have argued that there is a limit to which individuals tend to intuitively attribute local flooding to global climate change (Whitmarsh 2008, van der Linden 2015, Hamilton-Webb *et al.* 2016), and thus even the most extreme of flood experiences are unlikely to promote concern for, or encourage action against climate change. In this respect, the relationship between experience of local flooding, and response to global climate change deserves further qualitative un-picking.

For victims of flooding to perceive their experiences as evidence of climate change risk, rather than simply evidence of flood risk, likely **requires a more complex form of experience appraisal.** In their socio-cognitive process Model of Private Proactive Adaptation to Climate Change (MPPACC), Grothmann and Patt (2005) identify experience appraisal to have a particular role in informing an individual's perception of risk, which alongside other important drivers, can influence behavioural response in the form of 'adaptation.' The MPPACC (Figure 1) builds upon Protection Motivation Theory (PMT) (Rogers 1983a, Rogers 1983b, Rogers and Prentice-Dunn 1997), which provides an elaborate framework for understanding human behaviour in the face of risk (Grothmann and Reusswig 2006) and on its own has been applied to a variety of case studies to illustrate its predictive power (Floyd *et al.* 2000).

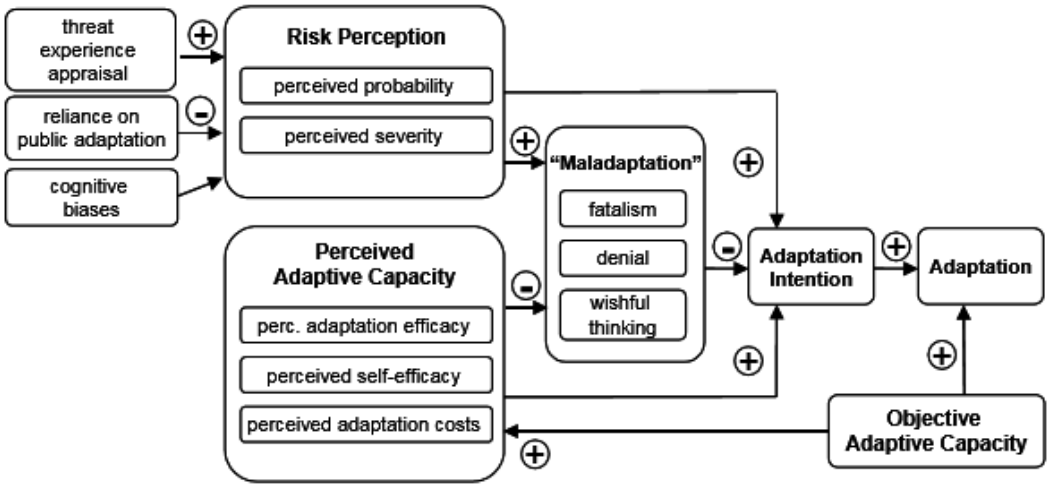


Figure 1 Socio-cognitive model of proactive private adaptation to climate change impacts by Grothmann and Patt (2005)

As mentioned in the previous section, despite the addition of the 'experience appraisal' variable, the authors do not go on to specify the nature in which the appraisal process may be

undertaken by an individual, instead noting where it fits in to the overall framework of private proactive adaptation. As illustrated, experience appraisal sits within an array of other cognitive processes that are deemed to influence adaptation or 'maladaptation,' as distinct behavioural outputs. In contrast to adaptation, maladaptation represents actions that artificially reduce the threat and thereby seemingly solve the problem, by blaming others, or through distancing oneself from the problem (Hamilton and Kaser 2009). In relation to the cognitive appraisal literature reviewed previously, 'maladaptation' would represent a form of 'emotion-focused' coping; avoiding the problem due to the nature of the appraisal. As depicted, experience appraisal is said to influence risk perception, and if perceived as high (on the probability and severity dimensions), could result in adaptation. The model specifically centres on adaptation as a positive response to climate change, and therefore does not address another important alternative individual response in the form of mitigation, and equally imperative form of risk response (Rosenzweig and Tubiello 2007). While the direct relationship between experience of risk and adaptation to said risk is now better established, individuals struggle to comprehend the logic of mitigation as a direct response to climate change risk, and experiences of risk (Lowe *et al.* 2006), with the benefits that emission reductions might have on climate change risk not being immediately visible or tangible.

The factor 'reliance on public adaptation', included in the MPPACC (figure 1) appears to correspond to the process described by Lazarus and Folkman's (1984) as 'secondary appraisal,' whereby blame for an encounter or experience may be attributed, however here, it is described as a separate input process. Grothmann and Patt (2005) explain that while public adaptation, i.e. governmental or policy responses to climate change is high, levels of risk are judged to be lower. This trend has also been observed in relation to managing flood risk, whereby Grothmann and Reusswig (2006) found individual response to minimise risk was

283 hampered by an over-reliance on public flood protection in Germany. This was considered
284 interesting given that recent local events had proven that there were severe limitations to
285 which the public flood protection could protect individuals from flooding. Similar results
286 have been reported by Whitmarsh (2008) and Dessai and Sims (2011). In terms of climate
287 change risk specifically, studied populations generally want governments to take on
288 necessary adaptation actions (Brügger 2010, Harvett *et al.* 2011, Bichard and Kazmierczak
289 2012). The MPPACC has been adjusted and applied in relation to different situations and
290 case studies over recent years (Grothmann and Reusswig 2006, Frank *et al.* 2011, Kuruppu
291 and Liverman 2011, Smith *et al.* 2011). Although understanding its role within the full
292 picture is useful, **this paper chooses to reflect solely on the process of 'experience**
293 **appraisal.' For the purposes of this paper, 'experience appraisal' is defined as the**
294 **process of evaluating the meaning, cause and threat of a past experience.**

295

296 While the evolution of the discourse of climate change amongst the general public is well
297 documented (DEFRA. 2002, Lorenzoni and Pidgeon 2006, Lowe*, et al.* 2006, Whitmarsh
298 2008, Wolf *et al.* 2010, Dessai and Sims 2011, Poortinga *et al.* 2011, Capstick*, et al.* 2013,
299 Taylor*, et al.* 2014, Capstick*, et al.* 2015), studies that explore the interactions of particular
300 groups with climate change are less common. Previous studies have noted how the risk of
301 climate change and its potential impact is currently perceived as low amongst farmers, as a
302 particular cultural group (Farming Futures 2011, Islam *et al.* 2013). This study develops this
303 research by further exploring the experience appraisal process among farmers specifically. In
304 many ways farmers will behave very much like other individual decision makers (Pike 2008).
305 However, there are some characteristics that distinguish farmers as a cultural group; such as
306 their geographic isolation, and close interaction with the environment that the general public
307 (at least urban population) may not experience (Willock *et al.* 1999). The discourse of climate

among farmers is worthy of consideration as 90% of UK land is managed by the agriculture and forestry sectors (Defra 2012), so it is imperative to understand how this cultural group are responding to climate change; both in terms of attitude and behaviour. There is currently a lack of evidence that captures farmers' current on-farm response to climate change risk in the UK (Environment Agency 2012), especially in a qualitative exploratory manner, with the exception of a few recent studies (Barnes and Toma 2012, Akerlof, *et al.* 2013). The way in which farmers in England judge their own and others' roles in relation to climate change response may also be an important part of the experience appraisal process. The methods taken to qualitatively explore experience appraisal are explained, after the local context in which the study is situated, is outlined.

4. Methodology and local context

England has experienced many instances of substantial regional flooding of national importance in recent history. It was the summer flooding of 2007, described in Sir Michael Pitt's review as *"the largest peacetime emergency since the Second World War"* (Pitt 2008:2), which sparked commentators to argue that climate change may have been a contributor (Carpenter 2007). The county of Gloucestershire in South West England forms the study area for this research. The flooding event of 2007 that affected a large area of farmland in the county represents one of the most recent examples of a potential, observable climate change risk to agricultural production. The main sources of flood risk in Gloucestershire originate from fluvial flooding from the River Severn and its tributaries, in addition to surface water drainage and sewer flooding in some locations (Environment Agency 2009). From the farmers' perspective, the 2007 flooding came at a time where crops

were nearing harvest and grassland was at its most productive; causing more significant impact than winter flooding would have. Posthumus *et al.* (2009) reported that most impact was associated with crop damage and yield reductions, while livestock farmers incurred indirect costs associated with re-locating livestock and buying in extra feed that was lost to the flooding. In addition to the flooding of summer 2007, subsequent extreme rainfall events that have occurred in more recent years, such as spring 2012, and winter 2013/14 (Huntingford *et al.* 2014, Slingo *et al.* 2014, Kendon and McCarthy 2015), provide further notable instances of flooding. The events most significantly impacted on those living on the Somerset levels; an area that gained much media attention at the time, but also impacted upon parts of Gloucestershire.

Fifteen face to face, qualitative interviews were undertaken with farmers in Gloucestershire. The sample was drawn from a population of 200 farmers who had responded to a previous quantitative postal survey, carried out at an earlier stage in this research. The original population represented a range of farm and farmer characteristics such as farm size, type, and location throughout Gloucestershire, and who had experienced local flooding to varied degrees, the details of which can be found in a paper by Hamilton-Webb *et al.* (2016). During the postal survey, farmers were given the opportunity to provide their contact details if they were willing to be contacted for an interview. Subsequently, 53 respondents (26.5%) provided their contact details and made up the sample population from which potential interviewees could be drawn. In order to explore the notion of experience appraisal, only those with direct experiences of flooding were selected, for example those who had reported that either their land, and/or home, and/or buildings had been affected by flooding in the past. Other criteria for selection were then followed to ensure that the interviewees represented a mix of different characteristics.Participants were also selected based on their response to

357 survey questions concerning climate change attitudes and behaviours to ensure a range of
358 views could be explored in more detail. The interviewees were from a mix of farm types and
359 sizes; the characteristics of which, along with their location are detailed in Table 1.

360

361 Table 1. Interviewees and a summary of their experiences of flooding

ID	Farmer	Experience of flooding
1	Male, 66-75 years old, 750 acres, arable farm, Cotswolds	Fluvial flooding yearly during winter months due to tributary running through farm. Negligible impact financially.
2	Male, 46-55 years old, 1800 acres, arable farm, Cotswolds	Some low lying land vulnerable to temporary flooding/water-logging during extreme rainfall - negligible impact with loss of straw
3	Male, 46-55 years old, 250 acres, dairy farm, Gloucester	Frequent fluvial flooding during winter (110 acres on Severn floodplain), particular financial impact during summer 2007, and spring 2012
4	Male, 66-75 years old, 300 acres, dairy farm, Gloucester	Two thirds of farm vulnerable to fluvial flooding on Severn floodplain, particular impact from summer 2007 floods
5	Male, 22-35 years old, 125 acres, mixed livestock farm, Stroud	Frequent minor fluvial flooding during winter (farm surrounded by River and brook). Significant impact from flooding during summer 2007 and 2008
6	Male, 66-75 years old, 1200 acres, arable farm, Gloucester	Frequent fluvial flooding from R. Severn during winter. Significant loss of crops during summer flooding 2007 and spring floods 2012
7	Female, 56-55 years old, 250 acres, dairy farm, Stroud	Vulnerable to waterlogging and temporary flooding during extreme rainfall. Routine disrupted during heavy rain in 2012
8	Male, 55-65 years old, 380 acres, dairy farm, Gloucester	Vulnerable to fluvial flooding from R.Severn during winter. Significant loss during summer 2007 floods
9	Male 55-65 years, 169 hectares, arable farm, Cotswolds	Vulnerable to minor pluvial flooding and waterlogging but suffered significant damage to business and home during summer 2007
10	Male, 22-35 years, 100 hectares, arable farm, Gloucester	Significant fluvial flooding and impact during summer 2007 floods
11	Male, 46-55 years old, 150 acres, dairy farm, Stroud	Minor temporary fluvial flooding during extreme rainfall of 2007 and 2010 - negligible impact
12	Male, 46-55 years old, 540 acres, mixed farm, Cheltenham	On top of hill so only suffer from waterlogging but with loss of crop quality during extreme rainfall in 2012

13	Male, 56-65 years old, arable farm, Gloucester	Vulnerable to frequent fluvial and tidal flooding with significant financial loss with flooding in summer months
14	Male and female, 55-65 years old, 4.4 hectares, fish farm, Stroud	Flooded every 3- 5 years particularly impacted during summer 2007
15	Male, 46-55 years old, 107 acres, stud farm, Gloucester	Frequent minor fluvial flooding during winter months due to farm bordered by river and brook. Affected by summer 2007 floods but minor impact

362

363 Eight interviewees farmed in the Cotswold district where the hydrology of the gently rolling
364 landscape is characterised by complex meandering rivers and classed as an area of low to
365 moderate flood risk by the Environment Agency (2009), where the policy taken is to store
366 water or manage runoff in locations that provide overall flood risk reduction. Three of these
367 farmers (interviewees 1, 2, and 9) were located in Cotswold villages, on higher ground and
368 experienced flooding 'intermittently,' and mostly during the winter. For those farming in the
369 Stroud district (interviewees 5, 7, 11, and 14) and in Cheltenham (interviewee 12) both within
370 the Cotswold landscape, local conditions were described to explain their vulnerability to
371 flooding. For interviewees 7 and 12, their experiences revolved largely around infrequent
372 minor flooding or waterlogging of the land, largely impacting soil structure and workability.
373 In contrast to infrequent, but in some cases, severe flooding in the Cotswolds, seven
374 interviewees farmed in the district of Gloucester (Farmer 3, 4, 6, 8, 10, 13, and 15) a town
375 located in the Severn Vale area; occupying the low lying floodplains of the River Severn.
376 Due to close vicinity to the River Severn and its tributaries, interviewees in these regions tend
377 to experience flooding more frequently.

378 All interviewees were contacted by telephone prior to agreeing to be interviewed, and
379 interviews arranged to take place at the interviewees' home/farm at a convenient date and
380 time. All interviews were undertaken between January and March 2015, and on average
381 lasted 44 minutes, but ranged from 32 minutes to 1 hour 3 minutes. The interviews followed a

382 semi-structured approach (questions available on request) and explored farmers' previous
383 experiences of flooding, and response (attitudinal and behavioural) to climate change.
384 Interviewees were encouraged to recount in detail the specific experiences that they have had
385 with flooding, particularly those event(s) that they considered most extreme, throughout their
386 lifetime. They were probed on the nature of the events, such as onset, duration, and
387 frequency; all suggested as important variables to explore (Weinstein 1989, Weber 2006,
388 Harries 2013, Carlton 2014, Hopkins and Warburton 2014). Interviewees were then asked
389 about their views on that experience. These views related to the perceived causes of local
390 flooding, and perceived impact of such experiences, and approaches taken for minimising
391 future threat. Subsequently, interviewees were questioned on their attitudes towards climate
392 change, including: their interest in, knowledge of, observations of, and concern for climate
393 change. Farmers were then probed on their views concerning how agriculture could play a
394 role in mitigating climate change, and whether farmers had adapted their own practices in
395 light of these views. A semi-structured, flexible style of interviewing allowed for the in-depth
396 exploration of how interviewees had interpreted their experiences of flooding, and where
397 necessary, farmers could be asked to explain their views in detail and provide extra
398 information. Thus, **interviews served as contextualised accounts of how experience of**
399 **local flooding has been appraised and conceptualised in light of global climate change.**
400 All interviews were recorded and transcribed verbatim and transcripts analysed using NVivo
401 10. Following an initial reading of transcripts, a coding framework (identifying key themes)
402 was devised. Further themes also emerged from the data, and an iterative approach to the
403 analysis was taken (see Welsh 2002 for further detail). Analysis of the fifteen qualitative
404 interviews with farmers elucidated three important factors that acted as cognitive filters
405 through which flooding experiences were appraised. The primary and secondary data has

406 informed a conceptual model of experience appraisal (Figure 2), and the results are explored
407 in the following section in order to illustrate the model's development.

408

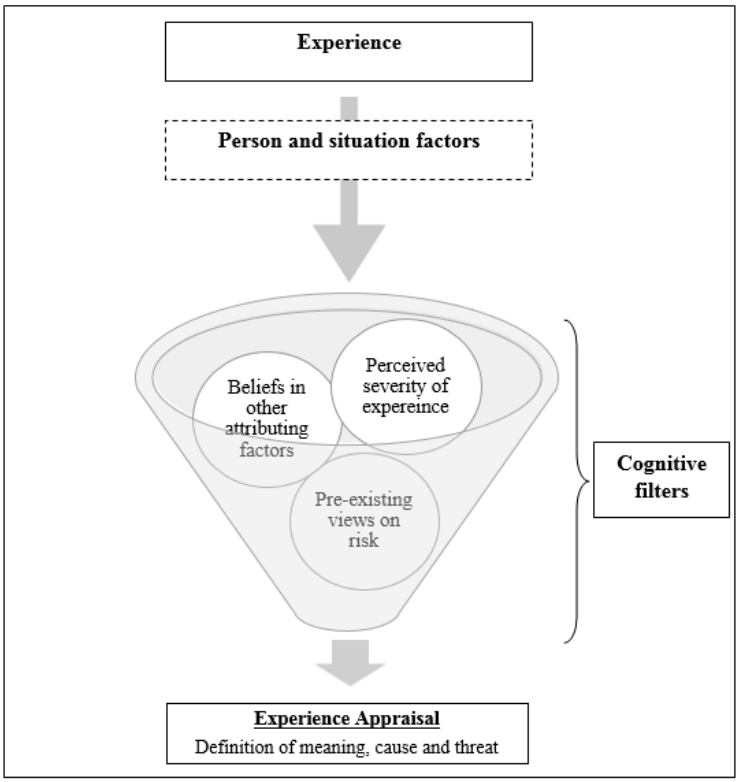
409 **5. Results**

410 ***5.1. Cognitive Filters of Experience Appraisal Model (CFEAM)***

411 As informed by the primary and elements of the secondary research, a conceptual model of
412 risk experience appraisal, through a set of cognitive filters is presented in Figure 2. Although
413 the model is thought of as a continuous process with feedback loops, rather than inputs and
414 outputs, the experience itself is conceptualised as the start point of the model. Calling on
415 what is known from previous research, the experience is ultimately appraised. Its meaning,
416 threat and cause are evaluated resulting in a specific emotional response that could be
417 positive or negative, (Lazarus and Folkman 1984). Subsequently, the emotional reaction may
418 shape the perception of future risk, i.e. climate change (Grothmann and Patt 2005), which
419 could go some way in informing ultimate behavioural response, in this case mitigation and/or
420 adaptation. **The model however, only seeks to conceptualise the process up until**
421 **perception of risk.** While it is understood that perception of risk informs behaviour, it is
422 clear that there are a range of other factors that mediate between perception of risk and
423 behavioural response to that risk; factors that are not covered in detail in this paper, but have
424 been explored in the associated research.

425

426 Figure 2. Cognitive Filters of Experience Appraisal Model (CFEAM)



Between the experience and its appraisal the primary research undertaken suggests there are factors that act as a set of cognitive filters through which the experience is interpreted. These in turn are informed by certain **person and situation factors**; ultimately shaping the the definition of the cause, meaning and threat of the experience. These three cognitive filters are introduced here (see Figure 2), in relation to the case study context as being:

a) Perceived severity of experience,

b) Pre-existing views on risk, and

c) Beliefs in other attributing factors

Depending on the way in which these filters influence the interpretation of experiences of flooding, farmers may or may not appraise their encounters, as experience of climate change. Although built on the case study of climate change, it is envisioned that the model

could be applied more generally to appraising experience of risk and would benefit from further research to explore its wider applicability.

5.1.1. Perceived severity of experience

The filter 'perceived severity of experience' corresponds to the appraiser asking the question 'How severe was this experience in terms of impact?' **Where experiences of flooding were perceived as particularly severe**, or extreme, especially in the context of recent or historic instances of flooding, the experience was seemingly **appraised as more stressful and of greater threat to well-being.** At the same time, **where experiences were perceived as particularly severe, especially in relation to normal conditions, they were more likely to be appraised as evidence of climate change**. Subsequently, farmers expressed more negative emotions such as worry. During interviews, farmers reported on the impact of flooding on their farm, and farming practices. **Concrete situational factors relating to the nature of the experience itself were key drivers of how farmers perceived its severity**, such as the extent of loss, time of year of flooding, predictability and familiarity of the experience. These factors are inevitably intertwined, with time of year and familiarity with flooding, to some extent influencing the degree of predictability for example, which in turn affects the overall perceived severity of the experience.

While interpreting severity of their experience(s), interviewees often recalled the time of year at which flooding occurred. Most farmers, particularly those who experienced flooding most frequently, and were located nearby watercourses would speak about expecting flooding in the winter, but extreme events in the summer were considered out of the ordinary, and generally resulted in greater loss and were thus interpreted as more severe and of higher risk to business. For example:

464 *"We're used to winter floods, we've grown up with winter floods, that's not a*
465 *problem – but to have a summer flood is completely different, because you've got a lot*
466 *of vegetation, you've got maize crops, some people are growing potatoes on the*
467 *meadow grounds- you've got a summer flood, it's a write off straight away."*
468 (Interviewee 3)

469 As described, for most of the interviewees, the summer flood of 2007 was interpreted and
470 recalled as the most significant experience of flooding in recent memory, with many
471 interviewees recalling it as "freak." This was seemingly linked to both the extreme nature of
472 the event (receiving one month's rainfall in 24 hours), as well as the general unexpected
473 nature of floods during summer months. A farmer whose land part occupies the River Severn
474 floodplain and expects some degree of flooding in winter months, relayed how even after the
475 floods of 2007, his normal routine was re-established; not expecting re-occurrence of summer
476 flooding:

477 *"We had the summer flood of 2007, which wiped out most of my maize and*
478 *forage....In 2008 we re-planted the maize– we never envisaged we'd have any more*
479 *problems, we thought it was just a one off – but it wasn't, the same thing happened*
480 *again...*"(Interviewee 9)

481 Linked to time of year and predictability, some farmers were naturally more familiar with
482 flood risk. This included farmers who were located in the Severn vale or in the vicinity of
483 watercourses. This had the effect of farmers appraising their experiences as less severe, and
484 thus exhibiting less concern. The trend was also associated with farmers' perception of the
485 controllability of flooding, as discussed in more detail later in the paper. Interviewee 10, an
486 arable farmer vulnerable to frequent fluvial flooding, which was at time exacerbated by high
487 tides provides an insight into this. Despite reporting major financial loss from disrupted yield,

his familiarity with flooding seemingly lead him to exhibit minimal concern over it, for example:

> *"I was down on the river bank watching the tide come over in last January and February going across hundreds of acres of land, and there's a person down the village who said to me "gosh, I feel so sorry for you..." I said "don't worry, there's nothing I can do about it..." I said the best thing I can do is get in my truck, go into the village and see if there's anybody there who's flooded and needs some help because there's nothing I can do out on the river bank – it's out of my control....we live on the edge."* (Interviewee 10)

In other cases, under certain conditions familiarity with flooding appeared to increase concern. This was the case with farmers who noted a recent pattern of increased frequency and impact from flooding. For instance, a farmer and his wife recorded the weather over time and became familiar with its patterns. This familiarity did not necessarily lead to reduced concern:

> *"The thing is, when you're a weather watcher, as we are – you know precisely all the time, how much rain it's going to take in one go to give you a flood. [how much of a concern is climate change?] Oh, huge!"* (Interviewee 14)

5.1.2. Pre-existing views on risk

It was evident that farmers called on their **pre-existing views on risk**, when appraising their experiences of flooding, in this case their views on climate change; influencing the **appraised meaning of their experience.** For example, where farmers exhibited high belief in anthropogenic climate change, and concern for its impacts, they were more likely to attribute

their experiences of flooding to global climate change, compared to those relatively less concerned with climate change risk. **'Person factors' in particular, are inevitable antecedents to this filter; such as the appraiser's world views, and attitudes to risk in general.**

Where farmers are already concerned about climate change, their experiences of flooding may reinforce these concerns and in turn lead to higher levels of worry and stress, which can then intensify perception of its risk. Thus, their existing view on risk acts as a filter through which the events of flooding were interpreted. For example, two interviewees in particular (interviewee 4 and 8) both farmed in the Severn vale and frequently experienced fluvial flooding. They both expressed a rather cynical view towards anthropogenic climate change. Although not disputing that there have been some changes over time, they argued that there was an overall lack of evidence of human's contribution and the overall seriousness of the issue, for example:

> *"I think there's a lot of propaganda going on about climate change and I'm not sure it's as severe as people think. It's probably because if you're a scientist and you're interested about climate change, it's worth exaggerating. To be completely cynical about it, it's to keep yourself in the job probably."* (Interviewee 8)

Those who expressed scepticism about the existence, and threat of climate change were understandably unlikely to appraise their experiences as evidence of climate change. Overall, interviewees displayed varied knowledge and interest in climate change. Some cited figures relating to the science, while others were less keen to discuss the topic. In total, only three interviewees were particularly engaged with climate change and specified their belief in anthropogenic warming, and a degree of confidence in those beliefs. Although acknowledging the influence of local factors that exacerbated the problem of flooding in their

535 area, these interviewees also attributed their experiences in part, to climate change. These
536 interviewees made reference to, or explicitly referred to occasions where they had read about
537 climate change; mostly in newspapers. They used this as evidence to support their views, for
538 example:

539 *"I've read everything there is to read and I personally take the view that we've 'had*
540 *it' – not within our lifetime, but I think our grandchildren have 'had it!'"* (Interviewee
541 14)

542

543 *I'm delighted to hear you call it climate change rather than global warming, because*
544 *people think it's going to get warmer – not necessarily, some places are going to get*
545 *colder...It's going to get windier, it's going to get wetter. Both my wife and me would*
546 *be very environmentally minded and concerned about it."* (Interviewee 15)

547

548 *5.1.3. Beliefs in other attributing factors*

549 The filter concerning **'beliefs in other attributing factors'** relates to the farmer attributing
550 his/her experience to certain factors and conditions. This appeared **instrumental in guiding**
551 **farmers' appraisals of their flooding experiences, particularly the perceived cause of**
552 **their experience.** During interviews, farmers would judge whether, and to what extent their
553 experiences of flooding were attributed to climate change, amongst other factors.
554 Importantly, when asked about the cause of local flooding, farmers tended to consider local
555 environmental factors rather than refer to global climate change. In particular, farmers cited a
556 lack of watercourse maintenance and local land use changes as the most significant
557 attributors to recent flooding. Farmers were certain about the influence of these factors, while

there was generally less certainty over the role of climate change. During interviews, six farmers focused on the lack of river maintenance as the principal cause of flooding that had been experienced. For most farmers, this conclusion was reached due to direct observation in the local area (driven by concrete situation factors), whereby they had remembered a time when the nearby watercourses were dredged and flooding was less frequent, for example:

> *"[The river] would have been dredged last in the 90s. Then it was about 2003, 2004 they stopped weed cutting...it became an annual argument with the EA woman. They would agree to do something and by the time they got back to their offices, they'd do what they wanted to do. It was just a nightmare with them."* (Interviewee 5)

The type of flood experience and impact from flooding did not seem to influence interviewees' beliefs in attributing factors. Instead, **situation factors like the farmer's location was a clear antecedent to this filter;** highlighting the concept of situational risk. For example, six farmers around the Gloucester area were most prone to focus on the local area in terms of development and conveyance when describing the problem of recent flooding, rather than attributing the problem to climate change. In contrast, interviewee 14, who represented a couple who own a fish farm in the Stroud area were more confident in attributing their increased experiences of flooding to climate change, due to their lack of proximity to other watercourses. This trend illustrates how location and situational context can help farmers appraise their experiences, to determine perceived cause.

Regardless of firstly farmers' beliefs in other attributing factors, and also their pre-existing views on climate change risk, in the majority of cases, interviewees cited feeling a lack of control over local flooding (and climate change), in terms of their personal role in reducing risk and adapting practices to minimise impact. Overwhelmingly, farmers attributed responsibility to others, such as the general public and governmental agencies for responding

582 to climate change risk, refusing to acknowledge that farming practices were contributors to
583 the problem. Even those most engaged with the notion of anthropogenic climate change often
584 emphasised their own inability to mitigate the problem:

585 *"I think nuclear things and chemical plants and all that, I'd say it had a more*
586 *damaging effect than farming." (Interviewee 5)*

587

588 *"I don't think farming is the biggest problem, its industrial pollution. The EA*
589 *[Environment Agency] to my mind, if they disappear for a few years, nobody would*
590 *know. The EA would be exactly the same when they got back" (Interviewee 4)*

591 The conceptual model is now discussed further in terms of the secondary literature.

592

593 **6. Discussion**

594 The conceptual model has depicted a triad of cognitive filters, (a) Perceived severity of
595 experience, (b) Pre-existing views on risk, and (c) Beliefs in other attributing factors, through
596 which an experience is interpreted and appraised. These filters were found to be important
597 with regard to the appraisal of experiences of flooding specifically, but also could be
598 generalised to inform the understanding of experience appraisal under different risk contexts.
599 Importantly the filters within the model may well firstly inform each other, and secondly for
600 some appraisers will be specific to context, and will not all be equally important. Through
601 introducing and describing the nature of each filter, as identified in this research, various
602 patterns of experience appraisal become clear. For example, where farmers already believe in
603 the existence of climate change and consider it a threat, they are more likely to perceive
604 climate change as an important attributing factor to their experiences of flooding. This is also

likely if farmers perceive their experiences of flooding to be particularly severe or unusual/extreme in the context of previous instances and events. **Under these conditions, farmers appraise their actual experiences as evidence of climate change, which then has the potential to inform their attitudinal and behavioural response to climate change.**

As illustrated by this research, farmers' pre-existing engagement with anthropogenic climate change serves as a filter through which their experiences of flooding are interpreted. It is well known that an individual's risk attitude can cause him/her to evaluate a risk situation in a favourable or unfavourable way and thus shape risk perception (Fishbein and Azjen 1975), and because of this, a number of previous studies have sought to group farmers based on their attitude to risk (Thompson *et al.* 1990, Rohrmann 2004, Weber 2006, Coble and Barnett 2008). It is the cultural cognition of risk theory that posits a collection of psychological mechanisms that dispose individuals to selectively agree with or disagree with evidence of risk in patterns that fit with the values that they hold (Douglas and Wildavsky 1982), thus forming perceptions of risk that reinforce their idealized "way of life" (Kahan *et al.* 2011). In a recent study, Howell *et al.* (2016) confirmed that pre-existing attitudes and beliefs towards climate change served as a filter through which study participants interpreted written climate change risk information. Other research has observed similar patterns (Repetto 2008, Hart and Nisbet 2011). However, despite the importance of an individual's engagement with, and attitudes to climate change and its interaction with experience appraisal, the construct does not independently feature in Grothmann and Patt's (2005) MPPACC, introduced earlier in this paper (Figure 1).

However, when it came to interpreting their own experiences in light of climate change, at times even those who exhibited belief in and concern for climate change, did not automatically attribute their own experiences of local flooding in itself to the concept of global climate change. This was due to their beliefs in the influence of other situational attributing factors, which were informed by their interaction with the local environment and proximity to watercourses. Thus, although some interviewees exhibited some belief in, and concern for anthropogenic warming, their beliefs in other attributing factors were stronger, thus overriding their pre-existing views. **Importantly, where farmers are unable to attribute *local* flooding to *global* climate change, their experiences will not act as a filter through which they might respond to climate change.**

This research identified a tendency for farmers to strongly attribute their experiences of local flooding to local factors which in turn, influenced their feelings of responsibility. This concurs with a similar study with the general public that found flood victims to readily attribute their experiences of flooding to local factors, rather than global climate change (Whitmarsh 2008). As a result, flood victims frequently attributed responsibility of minimising flood risk to local authorities, and at the same time, did not perceive a connection between global climate change and localised flooding. Based on this finding, Whitmarsh (2008) emphasized the importance of individuals perceiving a connection between flooding and climate change, in order for their experiences to be used to inform their resultant perception of climate change risk. Thus, farmers' beliefs in other attributing factors to their experiences (i.e. local situation factors) and farmers' existing views on risk appeared to be instrumental in informing their appraisal of the 'who is to blame?' construct of appraisal; as set out in figure 2. Whether farmers chose to accept some personal responsibility or rather attribute blame and accountability solely to others as part of their appraisal, was important in

their overall discourses of local flooding and global climate change. Regardless of whether their experiences of flooding were appraised as evidence for climate change or not, responsibility for mitigation of climate change was frequently assigned to other groups of people, such as the government or the general public before farmers were ascribed any accountability. Furthermore, even those most engaged with the notion of anthropogenic climate change often emphasised the limit to their own ability to mitigate the problem, and thus were prone to emotion-focused coping as defined by Lazarus and Folkman (1984) Thus, where farmers appraised their experiences as events that were controllable and unnatural, either as a result of local factors such as lack of river maintenance, or as a result of climate change linked to man-made activity, different emotional responses ensued such as feelings of frustration, and worry, compared to where farmers felt that their experiences were a result of uncontrollable and natural hazards, such as a result of natural, cyclical climate change.

The likelihood of farmers perceiving a connection between local flooding and global climate change, and at the same time expressing feelings of personal responsibility for minimising its risk, is very likely dependent on local context. Marshall (2014) confirms that emotionally charged extreme weather events tend to be accompanied by strong blame narratives, especially towards government, and points to the case of the British floods of 2013-14, whereby initial media narratives of resilience swiftly changed to that of a discourse of blame, with newspapers covering public anger against the government for its inadequate preparation and response. At policy level, farmers are now expected to adapt to localised flood risk through natural flood management rather than rely on hard, structural defences that, due to government finances, will not be built. This policy has likely gone against what farmers have deemed as correct and fair in terms of 'social contracts' (Adger *et al.* 2012). Relevant to both flooding and climate change, Adger *et al.* (2012) discuss how perceived roles and responsibilities for different risks evolve over time, and that where authorities are deemed to

678 be falling short of their expected 'social contract' and responsibilities, as expected by
679 citizens, feelings of helplessness and anger have prevailed. This appears to be the situation
680 with many farmers in Gloucestershire who in particular, have observed a lack of river
681 dredging in recent years together with an increase in the frequency of flooding.

682

683 **7. Conclusion**

684 Existing literature concerning 'cognitive appraisal,' and interviews with victims of flooding
685 in Gloucestershire has informed the development of the Cognitive Filters of Risk Experience
686 Appraisal Model (CFREAM). The cognitive filters shown in the model have been discussed
687 in relation to the case study, whereby interviews with farmers have provided insight into the
688 appraisal of local flooding experiences in light of global climate change. These filters
689 include: (a) Perceived severity of experience, (b) Pre-existing views on risk, and (c) Belief in
690 other attributing factors. The appraisal process conceptualised here is highly dependent on
691 local context, person factors and situation variables. While the model is based on a small case
692 study that is exploratory in nature, it has the potential to be applied to other situations, and
693 would benefit from further research.

694 Through patterns of experience appraisal, farmers in this research did not readily appraise
695 their experiences of flooding as evidence of climate change, and furthermore, were not likely
696 to view their experiences as prompts for individual response; largely due to lack of personal
697 responsibility. The research has provided in-depth qualitative data that provides an
698 explanation for patterns of results illustrated in previous quantitative research, whereby
699 experiences of flooding have not resulted in a behavioural response to climate change
700 (Whitmarsh 2008, Hamilton-Webb*, et al.* 2016).

While in this research, the concept of experience appraisal has been inferred from what a person reports, e.g. a person is considered to be threatened or stressed because he/she reports feelings of being threatened or stressed, the analysis of in-depth qualitative accounts of flooding experience by farmers has given insight into the antecedents and consequences of the use of cognitive filters in experience appraisal. As cautioned by Lazarus and Folkman (1984), there are limitations to engaging with individuals at one given point in time. Indeed, the interviews with farmers here have captured an account of how an experience was appraised at a particular point in time; not necessarily how the encounter has and will unfold into the future. However, through reflection on existing literature and primary qualitative research some insight has been gained into the potential use of cognitive filters through which appraisal is shaped. In this sense, the research presented here goes beyond pure description and aims to contribute towards the development of broader a conceptual model that could be used to develop a means of predicting how individuals will react to experiences of environmental risk in the future.

Acknowledgements

This paper is based on PhD research funded by the Royal Agricultural University.

References

Adger, W. N., Quinn, T., Lorenzoni, I., Murphy, C., and Sweeny, J. (2012) Changing social contracts in climate change adaptation. *Nature Climate Change*, 3(4): 330-333

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., and Neuman, A. (2013) Do people "personally experience" global warming, and if so how, and does it matter? *Global Environmental Change,* 23(1): 81-91

Aronson, E., Wilson, T. D. and Akert, R. M. (2005) *Social Psychology*. Canada: Pearson Education

Barnes, A. P., and Toma, L. (2012) A typology of dairy farmer perceptions towards climate change. *Climatic Change,* 112(2): 507-522

Bichard, E., and Kazmierczak, A. (2012) Are homeowners willing to adapt to and mitigate the effects of climate change? *Climatic Change*, 112(3-4) 633-654

728 Bowman, K. F., Deimling, G. T., Smerglia, V., Sage, P., and Kahana, B. (2003) Appraisal of the
729 cancer experience by older long-term survivors. *Psycho-Oncology,* 12(3): 226-238

730 Brody, S. D., Zahran, S., Veldlitz, A. and Grover, H. (2008) Examining the relationship between
731 physical vulnerability and public perceptions of global climate change. *Environmental Behaviour*,
732 40(1): 72-95
733

734 Bronstert, A. (2003) Floods and Climate Change: Interactions and Impacts. *Risk Analysis.* 23(3):545-
735 557

736 Brügger, A. (2010) Support for mitigation and adaptation policies and personal intentions to act:
737 explorations in the UK and in Switzerland. Research Student Conference on Human Behaviour and
738 Climate Change, Cardiff, UK

739 Capstick, S., Pidgeon, N., and Whitehead, M. (2013). Public perceptions of climate change in Wales:
740 Summary findings of a survey of the Welsh public conducted during November and December 2012.
741 Climate Change Consortium of Wales (C3W), Cardiff

742 Capstick, S. B., Demski, C. C., Sposato, R. G., Pidgeon, N. F., Spence, A., and Corner, A. (2015).
743 Public perceptions of climate change in Britain following the winter 2013/2014 flooding. Cardiff
744 University, Cardiff

745 Carpenter, G. (2007). Wrong type of rain: Impact and Implications of 2007 UK Floods December
746 2007. Guy Capenter & Company LLC, London

747 Chawla, L. (1999) Life paths into effective environmental action. *Journal of Environmental*
748 *Education,* 31(1): 15-26

749 Clayton, S., Manning, C. M. *and Hodge, C.* (2014). Beyond storms and droughts: The psychological
750 impacts of climate change. American Psychological Association and ecoAmerica: Washington, DC
751
752 Coble, K. H. and Barnett, B. J. (2008) An Assessment of Risk Exposure in Agriculture: A Literature
753 Revew. In, OECD. (ed.) Managing Risk in Agriculture. OECD Publishing: 105-166
754

755 Bruine de Bruin, W. B., Wong-Parodi, G., and Morgan, M. G. (2014) Public perceptions of local
756 flood risk and the role of climate change. *Environmental Systems,* 34(4): 591-599

757 Defra (2002). *Survey of public attitudes to quality of life and to the environment -2001*. Defra [Online]
758 Acessed from
759 <http://webarchive.nationalarchives.gov.uk/20130822084033/http://www.defra.gov.uk/statistics/files/
760 pas-survey2001.pdf> [Date Accessed 19/09/16]
761

762 Defra (2012). *UK Climate Risk Assessment Sector Report*. Department for Environment, Food and
763 Rural Affairs, London.
764
765 Demski, C., Capstick, S., Pidgeon, N., Sponsato, R.G., and Spence, A. (2016) Experience of extreme
766 weather affects climate change mitigation and adaptation responses. *Climatic Change,* 1-16
767

768 Dessai, S., and Sims, C. (2011) Public perception of drought and climate change in Southeast
769 England. *Environmental Hazards*, 9(4): 340-357

Di Baldassarre, G., Viglione, A., Carr, G., Kuil, L., Salinas, J. L. and Bloschl, G. (2013) Socio-hydrology: conceptualising human-flood interactions. *Hydrology and Earth System Sciences*, 17(8):3295-3303

Douglas, M., and Wildavsky, A. (1982) *Risk and Culture: An essay on the section of technological and environmental dangers.* University of California Press: Berkeley

Egan, P. J. and Mullin, M. (2014) Psychology: Local weather and climate concern. *Nature Climate Change*, 4(2): 89-90

Environment Agency (2009) *River Severn Catchment Flood Management Plan (CFMP).* Environment Agency. [Online] Accessed from: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289103/River_Severn_Catchment_Management_Plan.pdf> [Date Accessed 19/09/16]

Environment Agency (2012) *Are farmers ready for the challenge of climate change.* Environment Agency. [Online] Accessed from: <http://www.promar-international.com/_userfiles/publications/files/UK%20Agriculture%20and%20Farmer%20Attitudes%20to%20Climate%20Change.pdf> [Date Accessed 19/09/16]

Etkin, D., and Ho, E. (2007) Climate change: perceptions and discourses of risk. *Journal of Risk Research,* 10(5): 623-641

Farming Futures (2011) *Farming Futures: Climate Change Survey Stage Five Report.* Farming Futures. [Online] Available from <http://www.farmingfutures.org.uk/sites/default/files/files/Farming%20Futures%20survey%20February%202011.pdf> [Date Accessed 19/09/16]

Fazio, R. H. (1986) How do attitudes guide behaviour? In, Sorrentino, R. M. and Higgins, E. T. (eds.) *Handbook of Motivation & Cognition: Foundations of Social behaviour.* The Guildford Press: New York

Fazio, R. H. and Zanna, M. P. (1981) Direct experience and attitude-behaviour consistency. **In**, Berkowitz, L. (ed.) *Advances in Experimental Social Psychology.* New York: Academic Press, pp. 161-202

Fishbein, M., and Azjen, I. (1975) Belief, attitude, intention and behaviour. Reading: Introduction to theory and research.

Floyd, D., Prentice-Dunn, S., and Rogers, R. (2000) A meta analysis of research on protection motivation theory. *Journal of Applied Social Psychology*, 30(2): 407-429

Frank, E., Eakin, H., and Lopez-Carr, D. (2011) Social identity, perception and motivation in adaptation to climate risk in the coffee sector of Chiapas, Mexico. *Global Environmental Change*, 21: 66-76

Garvin, T. (2001) Analytical paradigms: the epistemological distance between scientists, policy makers, and the public. *Risk Analysis*, 21(3): 443-455

Gifford, R. (2011) The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. *American Psychologist,* 66(4): 290-302

Grimley, D. M., Williams, C. D., Miree, L. L., Baichoo, S., Greene, S., and Hook, E. W. (2000) Stages of readiness for changing multiple risk behaviours among incarcerated male adolescents. *American Journal of Health Behaviour,* 24(5): 361-369

Grothmann, T. and Patt, A. (2005) Adaptive capacity and human cognition: the process of individual adaptation to climate change. *Global Environmental Change*, 15(3): 199-213

Grothmann, T. and Reusswig, F. (2006) People at risk of flooding: why some residents take precautionary action while others do not. *Natural Hazards*, 38(1-2): 101-120

Haden, V. R., Niles, M. T., Lubell, M., Perlman, J. and Jackson, L. E. (2012) Global and Local Concerns: What Attitudes and Beliefs Motivate Farmers to Mitigate and Adapt to Climate Change? *PLoS One,* 7(12): e52882

Hamilton, C., and Kaser, T. (2009) Psychological adaptation to the threats and stresses of a four-degree world. In, Four Degrees and Beyond Conference. Oxford University, Oxford 28th-30th September 2009

Hamilton-Webb, A., Manning, L., Naylor, R. and Conway, J. (2016) The relationship between risk experience and risk response: a study of farmers and climate change. *Journal of Risk Research*, 1-15

Hansson, R. O., Noulles, D., and Bellovich, S. J. (1982) Knowledge, warning and stress: A study of comparative roles in an urban floodplain. *Environment and Behaviour*, 14(2): 171-185

Harries, T. (2013) Responding to flood risk in the UK. **In**, Joffe, H., Rossetto, T. and Adams, J. (eds.) *Cities at risk: Living with perils in the 21st century.* Dordrecht, Germany: Springer, pp.45-72

Hart, P. S., and Nisbet, E. C. (2011) Boomerang effects in science communication: How motivated reasoning and identity cues amplify opinion polarization about climate mitigation policies. *Communication Research*, 39(6):701-723

Harvett, J., Petts, J., and Chilvers, J. (2011) Understanding householder responses to natural hazards: flooding and sea level rise comparisons. *Journal of risk research,* 14(1): 63-83

Heath, Y., and Gifford, R. (2006) Free-market ideology and environmental degradation: the case of belief in global climate change. *Environment and Behaviour*, 38(1): 48-71

Hopkins, J., and Warburton, J. (2014) Local perception of infrequent, extreme upland flash flooding: prisoners of experience? *Disasters*, 39(3): 546-569

Howell, R. A., Capstick, S., and Whitmarsh, L. (2016) Impacts of adaptation and responsibility framings on attitudes towards climate change mitigation. *Climatic Change*, 136(3-4): 445-461

Huntingford, C., Marsh, T., Scaife, A., Kendon, A., Hannaford, J., Kay, A. L., Lockwood, M., Prudhomme, C., Reynard, N. S., Parry, S., and Lowe, J. A. (2014) Potential influences on the United Kingdom's floods of winter 2013/14. *Nature Climate Change,* 4(9): 769-777

Huntington, T. G. (2006) Evidence for intensification of the global water cycle: review and synthesis. *Journal of Hydrology*. 319:(1-4)83-95

Islam, M. M., Barnes, A. and Toma, L. (2013) An investigation into the scepticism among farmers. *Journal of Environmental Psychology*, 34: 137-150

Joireman, J., Truelove, H. B., and Duell, B. (2010) Effect of outdoor temperature, heat primes and anchoring on belief in global warming. *Journal of Environmental Psychology,* 30(4):358-367

Kahan, D. M., Jenkins-Smith, H., and Braman, D. (2011) Cultural cognition of scientific consensus. *Journal of Risk Research*, 14(2): 147-174

Kahneman, D. and Tversky, A. (1979) Prospect theory: an analysis of decision under risk. *Econometrica*. 47: 263-291

Kendon, M., and McCarthy, M. (2015) The UK's wet and stormy winter of 2013/2014. *Weather*, 70(2): 40-47

Kollmuss, A., and Agyeman, J. (2002) Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour. *Environmental Education Research*, 8(3): 239-260

Kuruppu, N., and Liverman, D. (2011) Mental preparation for climate adaptation: the role of cognition and culture in enhancing adaptive capacity for water management in Kiribati. *Global Environmental Change*, 21(2): 657-669

Lawrence, J., Quade, D., and Becker, J. (2014) Integrating the effects of flood experience on risk perception with responses to changing climate risk. *Natural Hazards,* 74(3): 1173-1794

Lazarus, R.S. (1966) *Psychological stress and the coping process.* McGraw-Hill: New York

Lazarus, R.S. (1981) The Stress and Coping Paradigm, In Eisdorfer, C., Cohen, D., Kleinman, A., and Maxim, P. (Eds.) *Theoretical Bases for Psychopathology*. New York: Spectrum, pp. 173-209

Lazarus, R. S. (1991) Progress on a cognitive-motivational-relational theory of emotion. *American Psychologist,* 46(8): 819-834

Lazarus, R. S. and Folkman, S. (1984) *Stress, appraisal and coping.* Springer: New York

Lazarus, R. S. and Launier, R. (1978) Stress-related transactions between person and environment. In, Pervin, L. (ed.) *Perspectives in interactional psychology.* New York: Springer, pp.287-327

Liu, X., Vedlitz, A. and Alston, A. (2008) Regional news portrayals of global warming and climate change. *Environmental Science & Policy*, 11:379-393

Lorenzoni, I., Nicholson-Cole, S., Whitmarsh, L. (2007) Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, 17(3): 445-459

Lorenzoni, I. and Pidgeon, N. (2006) Public views on climate change: European and USA perspectives. *Climatic Change,* 77(1-2): 73-95

Lowe, T., Brown, K., Dessai, S., de Franca Doria, M., Haynes, K. and Vincent, K. (2006) Does tomorrow ever come? Disaster narrative and public perceptions of climate change. *Public Understanding of Science,* 15(4): 435-457

Martin, I. M., Bender, H., and Raish, C. (2007) What motivates individuals to protect themselves from risks: The case of wildland fires. *Risk Analysis,* 27(4):887-900

Messling, L., Corner, A., Clarke, J., Pidgeon, N. F., Demski, C., and Capstick, S. (2015). Communicating flood risks in a changing climate. Oxford: Climate Outreach

Nicholls, N. (1999) Cognitive illusions, heuristics and climate prediction. Bulletin of the American Meteorological Society. 7: 1385-1397

Parker, D. J., and Handmer, J. W. (1998) The role of unofficial flood warning systems. *Journal of Contingencies and Crisis Management,* 6(1): 45-60

Parker, D. J., Priest, S. J. and Tapsell, S. M. (2009) Understanding and enhancing the public's behavioural response to flood warning information. *Meteorological Applications,* 16(1): 103-114

Pettenger, M. E. (2007) *The social construction of climate change: Power, knowledge, norms, discourses.* Ashgate: Hampshire, England

Pidgeon, N. and Fischoff, B. (2011) The role of social and decision sciences in communicating uncertain climate risks. *Nature Climate Change,* 1(1):35-41

Pike, T. (2008). *Understanding behaviours in a farming context.* Defra Agricultural Change and Environment Observatory Discussion Paper, Defra, November 2008

Pitt, M. (2008) Learning lesson from the 2007 Floods. London: Cabinet Office

Poortinga, W., Spence, A., Whitmarsh, L., Capstick, S., and Pidgeon, N. F. (2011) Uncertain climate: An investigation into public scepticism about anthropogenic climate change. *Global Environmental Change,* 21(3): 1015-1024

Posthumus, H., Morris, J., Hess, T., Neville, D., Phillips, E., and Baylis, A. (2009) Impacts of the summer 2007 floods on agricultural in England. *Journal of Flood Risk Management,* 2(3):182-189

Repetto, R. (2008). The climate crisis and the adaptation myth. Working Paper Number 13, Yale School of Forestry and Environmental Management, Yale University

Reser, J. P., Bradley, G. L., Ellul, M. C., and Callaghan, R. (2012). Public risk perceptions, understandings and responses to climate change and natural disasters in Australia and Great Britain. National Climate Change Adaptation Research Facility, Gold Coast, Queensland.

Risen, J. L. and Critcher, C. R. (2011) Visceral fit: While in a visceral state, associated states of the world seem more likely. *Journal of Personality and Social Psychology,* 100(5): 777

Rogers, E. M. (1983a) Diffusion of innovations. New York: Free Press

936 Rogers, R. W. (1983b) Cognitive and physiological processes in fear appeals and attitude change: A
937 revised theory of protection motivation. In, Cacioppo, B. L. and Petty, L. L. (eds.) *Social*
938 *Psychophysiology: A sourcebook.* London: Guildford, pp. 153-17

939 Rogers, R. W. and Prentice-Dunn, S. (1997) Protection motivation theory. In, Gochman, D. S. (ed.)
940 *Handbook of health behaviour research 1: Personal and social determinants*. Plenum Press: New
941 York 505

942 Rohrmann, B. (2004). Project RAS - Risk attitude scales. University of Melbourne, Australia

943 Roseman, I.J., and Evdokas, A. (2004) Appraisals cause experienced emotions: Experimental
944 evidence. *Cognition and Emotion,* 18(1):1-28

945 Rosenzweig, C., and Tubiello, F. N. (2007) Adaptation and mitigation strategies in agriculture: an
946 analysis of potential synergies. *Mitigation and Adaptation Strategies for Global Change*, 12(5): 855-
947 873

948 Scherer, K. R. (2001) Appraisal considered as a process of multilevel sequential checking. In,
949 Scherer, K.R., Schorr, A., and Johnstone, T. (Eds.) *Appraisal processes in emotion: Theory, Methods,*
950 *Research.* New York: Oxford University Press, pp.92-120

951 Slingo, J., Scaife, S., McCarthy, A., Saulter, M., McBeath, K., Jenkins, A., Huntingford, C., Marsh,
952 T., Hannaford, J. and Parry, S. (2014). *The recent storms and floods in the UK.* London: Met Office

953 Slovic, P. (1987) Perception of risk. Science. 236(4799): 280-285

954 Smith, C., Kniveton, D. R., Wood, S. and Black, R. (2011) Climate change and migration: A
955 modelling approach. In, Williams, C. J. R. and Kniveton, D. R. (eds.) *African climate and climate*
956 *change, advances in global change research.* Netherlands: Springer, pp.179-201

957 Solberg, C., Rossetto, T., and Joffe, H. (2010) The social psychology of seismic hazard adjustment:
958 re-evaluating the international literature. *Natural Hazards Earth System Science,* 10(8):1663-1677

959 Spence, A., and Pidgeon, N. F. (2010) Psychology, climate change and sustainable behaviour.
960 *Environment,* 52: 9-18

961 Spence, A., Poortinga, W., Butler, C., and Pidgeon, N. F. (2011a) Perceptions of climate change and
962 willingness to save energy related to flood experience. *Nature Climate Change*, 1(1): 46-49

963 Spence, A., Poortinga, W. and Pidgeon, N. F. (2011b) The Psychological distance of climate change.
964 *Risk Analysis*, 32(6): 957-972

965 Stamm, K. R., Clark, F. and Reynolds, E. P. (2000) Mass communication and public understanding of
966 environmental problems: the case of global warming. *Public Understanding of Science*, 9: 219-237

967 Taylor, A., Bruine de Bruin, W. and Dessai, S. (2014) Climate change beliefs and perceptions of
968 weather related changes in the UK. *Risk Analysis*, 34(11):1995-2004

969 Thompson, M., Ellis, R. and Wildavsky, A. (1990) Cultural Theory. Boulder, CO: Westview Press

970 Van der Linden, S. (2015) The social-psychological determinants of climate change risk perceptions:
971 towards a comprehensive model. *Journal of Environmental Psychology,* 41:112-124

972 Wachinger, G., Renn, O., Begg, C. and Kuhlicke, C. (2013) The risk perception paradox -
973 Implications for governance and communication of natural hazards. *Risk Analysis,* 33(6): 1049-1065

974 Weber, E. (1997) Perception and expectation of climate change: precondition for economic and
975 technological adaptation. In, Bazerman, M., Messick, D. and Tenbrusel, A. (eds.) *Environment, Ethics*

and Behaviour: The psychology of Environmental Valuation and Degradation. San Francisco: New Lexington Press

Weinstein, N. D. (1989) Effects of personal experience on self-protective behaviour. *Psychological Bulletin,* 105(1): 31-50

Welsh, E. (2002) Dealing with Data: Using NVivo in the Qualitative Data Analysis Process. *Qualitative Social Research,* 3(2)

Whitmarsh, L. (2008) Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research,* 11(3):351-374

Willock, J., Deary, I. J., McGregor, M. J., Sutherland, A., Edwards-Jones, G., Morgan, O., Dent, J., Grieve, R., Gibson, G., and Austin, E. (1999) Farmers' attitudes, objectives, behaviours and personality traits. The Edinburgh study of decision making on farms. *Journal of Vocational Behaviour,* 54:5-36

Wolf, J., Adger, W. N., Lorenzoni, I., Abrahamson, V., and Raine, R. (2010) Social capital, individual responses to heat waves and climate change adaptation: An empirical study of two UK cities. *Global Environmental Change,* 20(1): 44-52

1010

1011

1012

1013

1014

1015

1016

1017

1018

1019