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Public priorities and expectations of climate change impacts in the United Kingdom

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ABSTRACT

Irrespective of the success of climate mitigation efforts, societies worldwide face the challenge of adapting to a changing climate. In this paper, we examine UK residents' expectations of future threats and opportunities associated with climate change impacts, along with willingness to prioritise different climate change impacts for investment. Using a national survey ($n = 2007$), we report on three main findings. First, UK residents tend to expect threats related to flooding and wet weather to be more likely and concerning than heat extremes or opportunities. Second, UK residents' expectations of climate change impacts do not align with expert assessments, especially showing lower estimates of heat-related threats as compared to experts. Third, willingness to allocate resources to potential climate change impacts tends to be more strongly associated with anticipated concern should they occur than climate change belief or the expected likelihood of them occurring. We discuss the implications of our findings for policies and communications about climate change adaptation in the UK and elsewhere.

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1. Introduction

Regardless of the success of ongoing global climate change mitigation efforts, past emissions have already committed the world to some level of climate change (Intergovernmental Panel on Climate Change 2014). Countries worldwide, therefore, face the challenge of adapting to climate change impact (Moss et al. 2013). Public support for climate change adaptation policy may determine how effectively countries will be able to manage the threats and opportunities posed by climate change impacts. The UK's National Adaptation Plan envisions an active role for both individuals and communities in preparing for future climate change impacts (Defra 2013). It is, therefore, important to better understand which impacts people believe should be prioritised for investment, and the extent to which these public adaptation priorities are consistent or inconsistent with scientific recommendations and the priorities of policy-makers.

Behavioural decision research has shown that expert and non-expert assessments of risk often differ, with experts applying formal models of risk analysis, and non-experts drawing on characteristics that are not included in these models, such as emotional response and the ease with which examples of threats and benefits come to mind (Bruine de Bruin and Bostrom 2013). This should not be taken to mean that risk assessments made by scientific experts are wholly objective and free of bias, nor that non-experts are incorrect to draw on factors beyond those used in formal risk assessments in perceiving risk. Indeed,

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the question of which factors should be included in formal assessments of climate change risk – such as how harm should be conceptualised – has been a subject for debate, as has ability of traditional risk analysis to capture the information needed for climate change policy and decision-making (Hultman, Hassenzahl, and Rayner 2010). Nonetheless, differences in the way that domain experts and non-experts assess risks can lead to failures in communication and disparities in expectations between these groups (Bruine de Bruin and Bostrom 2013). Moreover, while ease of recall and emotional response to risk are often adaptive in terms of efficiently guiding behaviour, when they are not well calibrated with the actual likelihood of threats occurring, or the severity of the consequences that would be experienced if they occur, they may lead to maladaptive decision-making (Slovic et al. 2004; Tversky and Kahneman 1973).

The UK's 2012 and 2017 national Climate Change Risk Assessments (CCRAs) have been produced by climate experts for policy-makers on the basis of outputs from scientific models. Specifically, both the 2012 and 2017 assessments project that a changing climate will lead to an increase in threats such as heatwaves, water shortages, flooding, wildlife loss, as well as opportunities, such as potential reductions in winter energy consumption and lower cold-weather morbidity (Committee on Climate Change 2016; Defra 2012). Yet, UK residents' climate change concerns seem to be most strongly associated with perceptions of increases in wet weather (Taylor, Bruine de Bruin, and Dessai 2014; Whitmarsh 2009). These findings have been attributed to the *availability* and *affect* heuristics (Slovic et al. 2007; Tversky and Kahneman 1973). That is to say that amongst UK residents, hot weather may be less *available* from memory than wet weather, while also evoking more positive *affect* or emotions (Lefevre et al. 2015; Palutikof, Agnew, and Hoar 2004). It has been found that those who feel more positive about hot weather are less likely to implement heat protection behaviours (Bruine de Bruin et al. 2016; Lefevre et al. 2015), which raises concerns that those living in temperate regions may be ill-prepared for climate change impacts associated with heat. Hence, these psychological barriers could compound the documented struggle to build adaptive capacity among UK households (Porter, Dessai, and Tompkins 2014).

Yet, experienced changes in weather may be more compelling than the abstract notion of climate change (Lorenzoni and Pidgeon 2006; Swim et al. 2009). Indeed, it has been found that perceived personal experience of climate change through local weather predicts intention to engage in mitigation (Broomell, Budescu, and Por 2015). In the context of adaptation, recent research conducted in the U.S. has also found that support for flood adaptation measures is higher among individuals who perceive flood risks to be increasing, independent of their concerns about climate change (Bruine de Bruin, Wong-Parodi, and Morgan 2014). Hence, the extent to which willingness to prioritise specific impacts for investment is predicted by these factors warrants exploration.

In this paper, we therefore address the following research questions:

- (1) What are UK residents' expectations and priorities with respect to climate change impacts?
- (2) How do UK residents' expectations of potential climate change impacts compare to expert assessments?
- (3) To what extent do expected impact likelihood, anticipated concern about impacts and beliefs about climate change predict willingness to allocate resources to specific impacts?

2. Method

We present a secondary analysis of survey data collected for the PREPARE (Programme of Research on Preparedness, Adaptation and Risk) research programme led by Ipsos MORI (Ipsos MORI 2013). The programme was funded by the UK government's Department for Environment Food and Rural Affairs (Defra).

2.1. Participants

Between 30 January and 5 February 2013, Ipsos MORI conducted the survey with a national UK sample. The sample included 2007 panel members, 1028 of whom were female (51.2%). Ages ranged from 16 to 94 ($M = 47.0$, $SD = 18.2$), with 816 (40.1%) having a university degree.

2.2. Measures

Below, we describe the measures relevant to our analyses, in the order in which they appeared in the survey. Participants were given the opportunity to answer 'Don't Know' to each question, which was coded as a missing response.

2.2.1. Expected likelihood of and anticipated concern about specific impacts

Each participant rated 10 potential climate change impacts for their likelihood of occurring in the UK by 2050 (recoded as: 1 = strongly disagree; 5 = strongly agree), as well as for their concern if they did occur (recoded as: 1 = not at all concerned; 4 = very concerned). These climate change impacts were randomly selected from a set of 19 (see Table 1), which were identified by the UK government's 2012 Climate Change Risk Assessment (CCRA) (Defra 2012). As in the 2012 CCRA, impacts were classified as 'Threats', 'Opportunities' or 'Both'.

2.2.2. Prioritisation of impacts

Participants were asked to indicate which potential climate change impacts should be prioritised in government adaptation policy. To this end, they distributed 15 tokens amongst the 10 climate change impacts for which they had also rated their likelihood and concern (see Section 2.2.1).

2.2.3. Climate change belief

Climate change belief was assessed with a three-item scale. Participants rated how convinced they were that climate change was currently affecting the planet and the UK (1 = not at all convinced; 4 = totally convinced), as well as how concerned they were about climate change (1 = not at all concerned; 4 = very concerned). Principal Components Analysis indicated that the three items loaded onto a single construct. An overall measure of climate change belief was computed by taking the mean score of the three items (Cronbach's alpha = .93).

2.3. Expert assessments of climate change impacts

To examine the extent to which participants' expectations of climate change impacts corresponded with expert assessments of the magnitude of their consequences, we used the 2012 UK Climate Change Risk Assessment (CCRA) (Defra 2012). The 2012 CCRA provides categorical (High, Medium and Low) ratings of 'Consequence' to denote how strongly positive or strongly negative experts project that the consequence of climate change impacts would be under a UK Climate Projections 2009 range. Some of the survey items encompassed multiple impacts from the 2012 CCRA. For those, we selected the impacts with the highest-ranked consequence for comparison (See the Supplemental Material for a full comparison of survey items with CCRA 2012 impacts). In comparing participants' expectations with expert assessments of the magnitude of impact consequence, we use the 2012 CCRA rather than the more recent 2017 CCRA for two reasons. Firstly, the 2012 CCRA was the most contemporary source of expert projections for the UK at the time at which the survey was conducted; with the impacts included in the survey having been directly informed by the 2012 CCRA. Secondly, the 2017 CCRA evidence reports do not consistently provide ratings of consequence for individual impacts, opting in many instances group-related impacts and assign a rating of urgency rather than anticipated consequence (Committee on Climate Change 2016).

The ratings of urgency included in the 2017 CCRA do however exist as a recommendation to prioritise types of impacts for immediate action (in order of most immediately urgent to least urgent: (1) More action needed, (2) Research priority, (3) Maintain current action, (4) Watching brief). Hence, as the 2012 CCRA did not include these, we discuss participants' willingness to prioritise impacts with reference to the 2017 CCRA's ratings of urgency for different types of impact (See the Supplemental Material for a comparison of survey items with CCRA 2017 impact categories)

Table 1. Mean (standard deviation) ratings of likelihood, concern and resource allocation for 19 specific climate change impacts occurring by 2050 and expert assessment of 'Consequence' and 'Urgency' according to the UK Climate Change Risk Assessments 2012 and 2017.

Impact	Expert assessment				Public expectations and priorities		
	Nature of impact (2012)	Projected 'Consequence' (2012)	Urgency ^a (2017)	Likelihood (1–5 scale)	Concern (1–4 scale)	Resource allocation (Out of 15)	
More homes being flooded as a result of heavy rainfall (<i>n</i> = 1019)	Threat	High	1	4.16 (0.78)*	3.29 (0.72)*	2.26 (1.88)*	
Poor harvests, due to extreme weather, pushing up food prices (<i>n</i> = 993)	Threat	No Rating	1	4.05 (0.83)*	3.46 (0.68)*	2.87 (2.11)*	
Low lying coasts being permanently flooded or eroded by rising sea levels (<i>n</i> = 977)	Threat	Medium	1	3.95 (0.83)*	3.20 (0.77)*	1.55 (1.52)	
Some types of wildlife are lost or decline in number because they cannot relocate to where the climate remains suitable for them (<i>n</i> = 1009)	Threat	Medium	1	3.95 (0.86)*	3.20 (0.83)*	1.44 (1.62)	
New pests and diseases become common in the UK (<i>n</i> = 1002)	Threat	Medium	2	3.76 (0.90)*	3.20 (0.80)*	1.81 (1.50)*	
Public services like roads, power stations, schools and hospitals being disrupted as a result of heavy rainfall (<i>n</i> = 1016)	Threat	High	1	3.74 (0.95)*	3.18 (0.74)*	2.52 (1.91)*	
Air pollution gets worse from hotter weather, which particularly affects people with poor health or breathing problems (<i>n</i> = 1000)	Threat	No Rating	2	3.70 (0.95)*	3.15 (0.79)*	1.86 (1.53)*	
A reduction in marine wildlife from changes in sea temperature (<i>n</i> = 973)	Threat	Medium	2	3.67 (0.94)*	3.16 (0.80)*	1.15 (1.26)*	
Droughts causing serious water shortages due to changes in rainfall patterns (<i>n</i> = 992)	Threat	High	1	3.63 (0.98)*	3.26 (0.78)*	2.37 (1.80)*	
New crops become more common in the UK due to a warmer climate (<i>n</i> = 996)	Opportunity	Medium	2	3.56 (0.90)*	2.04 (0.88)*	0.75 (1.37)*	
More people's health suffering in extreme heat due to more frequent heatwaves (<i>n</i> = 1014)	Threat	High	1	3.46 (1.03)*	3.16 (0.78)*	1.81 (1.58)*	
Increased demand for energy for cooling (e.g. air conditioning) due to a warmer climate (<i>n</i> = 987)	Threat	Medium	4	3.42 (1.03)*	2.72 (0.85)*	1.07 (1.36)*	
Cities and large towns, which trap heat, becoming unbearably hot due to heatwaves (<i>n</i> = 982)	Threat	Region specific	1	3.27 (1.07)*	2.82 (0.88)*	0.86 (1.07)*	
Fewer vulnerable people dying in the cold due to milder winters (<i>n</i> = 958)	Opportunity	High	1	3.14 (0.95)*	1.90 (0.93)*	0.64 (1.34)*	
More people living in the UK take their holidays in the UK rather than going on holiday abroad, due to a warmer UK climate (<i>n</i> = 985)	Opportunity	Medium	4	3.06 (1.06)	1.73 (0.80)*	1.07 (1.84)*	
Disruption to trains, roads, and public transport due to more frequent heatwaves (<i>n</i> = 1006)	Threat	Low	3	3.04 (1.06)	2.82 (0.83)*	1.47 (1.45)	
More people move to the UK because of changes in the climate of their own country (<i>n</i> = 963)	Both	No Rating	1	2.93 (1.02)	2.92 (0.91)*	0.31 (0.80)*	
Lower demand for energy due to warmer winters (<i>n</i> = 974)	Opportunity	Medium	4	2.92 (1.02)	1.71 (0.80)*	0.30 (0.89)*	
More tourists choosing to visit the UK because of a warmer climate (<i>n</i> = 986)	Opportunity	Medium	4	2.89 (1.00)*	1.82 (0.80)*	0.31 (0.73)*	

Note: Impacts are ordered by mean expected likelihood.

*Indicates that mean was significantly above or below the scale mid-point for ratings of likelihood (mid-point = 3) and concern (mid-point = 2.5), and significantly above or below the equal allocation point of 1.5 for resource allocation. In all cases, Bonferroni corrections have been applied to control for the increased risk of Type-1 errors as a result of multiple tests ($p \leq .003$); ^aCCRA urgency ratings have been coded on a scale of 1 (most urgent category) to 4 (least urgent category).

3. Results

3.1. What are UK residents' expectations and priorities with respect to climate change impacts?

Bonferroni-corrected one-sample *t*-tests were used to examine whether participants agreed that impacts were likely to occur in the UK by 2050 (Table 1). For all but three impacts, agreement was significantly above the scale midpoint of 3 (neither agree nor disagree). However, agreement tended to be comparatively low for opportunities, and for threats to humans and infrastructure from hot weather. Indeed, impacts perceived as least likely to occur were: 'More people permanently move to the UK because of changes in the climate of their own country', 'Lower demand for energy due to warmer winters' and 'More tourists choosing to visit the UK because of a warmer climate'. The three impacts felt to be most likely to occur were: 'More homes being flooded as a result of heavy rainfall', 'Poor harvests, due to extreme weather, pushing up food prices' and 'Low lying coasts being permanently flooded or eroded by rising sea levels'.

Table 1 shows a similar response pattern with respect to participants' anticipated concern should the impacts happen in the future, although water shortages and immigration were ranked as considerably more concerning than likely to occur. Bonferroni-corrected one-sample *t*-tests indicated that anticipated concern regarding opportunities was below the scale median of 2.5 (between 'a little concerned' and 'fairly concerned'). By contrast, concerns about all threats were rated significantly above the scale midpoint. Concern was strongest for threats directly related to food supply, water supply and residential flood risk. However, less concern was seen for threats to infrastructure and dwellings from heat extremes ('Cities and large towns, which trap heat, becoming unbearably hot due to heat waves' and 'Disruption to trains, roads, and public transport due to more frequent heat waves') than for wet-weather threats ('More homes being flooded as a result of heavy rainfall' and 'Public services like roads, power stations, schools and hospitals being disrupted as a result of heavy rainfall').

Table 1 also shows the mean number of tokens allocated to each impact, across participants. Bonferroni-corrected one-sample *t*-tests examined whether mean allocation for each impact significantly diverged from the equal distribution point of 1.5 per impact (15 tokens divided by the 10 impacts each participant evaluated). While the average number of allocated tokens was relatively low for all impacts, clear patterns in prioritisation do emerge, with resource allocation mirroring anticipated concern. We see that participants allocated more resources to addressing threats than taking advantage of opportunities, with mean allocation to opportunities being significantly below 1.5. The highest mean allocation went to threats related to food supply, water supply and residential flood risk. In contrast, allocation to opportunities and threats related to wildlife, coastal flooding and impacts on infrastructure and dwellings from heat extremes were either significantly below or failed to exceed the 1.5 threshold.

3.2. How do UK residents' expectations of potential climate change impacts compare to expert assessments?

Consistent with expert assessments of high-negative consequence for: 'More homes being flooded as a result of heavy rainfall' and 'Droughts causing serious water shortages' in the 2012 CCRA, participant ratings of anticipated concern were particularly strong for these impacts. We also find that, consistent with an expert ranking of Low Negative Consequence, participants expressed lower concern about 'Disruption to trains, roads, and public transport due to more frequent heatwaves' than other threats. However, participants expected 'More people's health suffering in extreme heat...' (high-negative consequence) and 'Increased demand for energy for cooling...' (medium-negative consequence) to be substantially less likely to occur in future than threats related to rainfall, flooding and biodiversity, suggesting that they expected the threat posed by these potential impacts to be lower than did experts.

With respect to adaptation priorities, we see that the number of tokens allocated to impacts by survey participants were often consistent with the urgency ratings used in the recent 2017 CCRA, with threats related to flooding of homes and infrastructure, food supply and water supply being both prioritised

by participants and given the highest urgency rating in the 2017 CCRA. Likewise, opportunities related to demand for goods and services were awarded few tokens by participants, and received the lowest urgency rating in the 2017 CCRA, on the grounds that businesses are used to responding to changes in consumer demand. There were, however, notable differences. While token allocation indicated 'Cities and large towns, which trap heat, becoming unbearably hot due to heatwaves' was not a priority for participants, the 2017 CCRA incorporates the urban heat island effect into 'Risks to public health and wellbeing from high temperatures': a set of threats receiving the highest urgency rating due to a current lack of policy regarding the adaptation of buildings to cope with heat extremes (Committee on Climate Change 2016).

3.3. To what extent do expected impact likelihood, anticipated concern about impacts, and concern about climate change predict willingness to allocate resources to specific impacts?

Examining the inter-correlations between expected likelihood, anticipated concern, and climate change belief for each impact (Table 2), we find a moderately strong association between these variables for each threat ($r > .30$). For opportunities, weaker associations were observed (Table 2).

To assess the independent contribution of these variables to willingness to allocate resources (tokens) to specific impacts¹ a series of ordinary least squares linear regression analyses were conducted. These analyses controlled for demographic characteristics (age, gender, education). Pearson correlations showed that both perceived likelihood and anticipated concern were associated with willingness to allocate resources, while climate change belief was associated with slightly greater willingness to allocate resources to impacts related to wildlife (see Supplementary Material). However, when all three variables were entered, only anticipated concern was consistently the independent predictor of willingness to allocate resources (see Table 2 for summary and Supplemental Materials for simple correlations and full information on all regression models). When entered into the regression, climate change belief was no longer positively associated with willingness to allocate resources to any of the impacts after taking into account expected likelihood and anticipated concern regarding impacts.

4. Discussion

Below, we discuss our three main findings, pertaining to: (1) UK residents' expectations and priorities for potential climate change impacts; (2) how those compare to expert assessments and (3) the extent to which perceptions of future impacts and climate change belief predict resource allocation to address threats and taking advantage of opportunities.

4.1. Climate change impacts: expectations and priorities

Our first main finding is that UK residents tend to expect future threats related to wet weather, flooding and biodiversity to be more likely and more potentially concerning than either opportunities or threats to infrastructure from heat. However, while not necessarily perceived to be the most likely threats to occur, drought and threats to vulnerable groups (e.g. the elderly) from heat did elicit high concern. Overall, impacts that elicited greater anticipated concern were also expected to be more likely and received a greater priority for investment. This finding is consistent with work on the affect heuristic, which suggests that threats that elicit stronger negative feelings or more concern (or 'affect') are judged to pose a greater risk than those that elicit weaker negative affect or less concern (Slovic et al. 2004). In the UK, it has been found that many residents have relatively positive feelings towards hot weather (Palutikof, Agnew, and Hoar 2004), which can reduce willingness to undertake protective weather behaviours (Bruine de Bruin et al. 2016; Lefevre et al. 2015). This may in part explain the lower expected risk from threats related to hot weather, and the lower willingness to invest resources in them. The fact that threats related to wet weather and flooding were expected to be most likely to occur and were prioritised for investment is also in keeping with previous findings regarding the availability heuristic

Table 2. Inter-correlation between expected likelihood of climate change impacts and climate change belief (Pearson's *R*) and linear regression examining the predictors of willingness to allocate resources to impacts.

Impact (ordered by strength of association between perceived likelihood and climate change belief)	Correlation (Pearson's <i>r</i>)			Regression coefficient (standardised β) showing independent contribution to willingness to allocate resources to impacts ^a			ΔR^2
	Likelihood with concern	Likelihood with climate change belief	Concern with climate change belief	Expected likelihood	Expected concern	Climate change belief	
A reduction in marine wildlife...	.51*	.54*	.52*	.08	.29*	-.04	.10
More homes being flooded as a result of heavy rainfall	.51*	.50*	.42*	.08	.11	-.05	.02
Some types of wildlife are lost or decline in number...	.52*	.49*	.49*	.06	.21*	-.03	.07
Low lying coasts being permanently flooded or eroded...	.50*	.48*	.39*	-.01	.22*	-.06	.04
Poor harvests, due to extreme weather, pushing up food prices	.43*	.46*	.39*	.01	.16*	-.12*	.03
Air pollution gets worse from hotter weather...	.46*	.44*	.41*	.06	.21*	-.06	.05
Public services...being disrupted as a result of heavy rainfall	.47*	.43*	.47*	-.01	.14*	-.14*	.02
Droughts causing serious water shortages...	.43*	.43*	.44*	.04	.17*	-.14*	.03
New pests and diseases... become common in the UK	.48*	.37*	.39*	.08	.21*	-.05	.06
Cities and large towns ... becoming unbearably hot due to heatwaves	.43*	.35*	.35*	.14*	.15*	-.04	.06
Disruption to ... transport due to more frequent heatwaves	.40*	.31*	.34*	.03	.13*	-.09	.02
Increased demand for energy for cooling...	.42*	.31*	.34*	.06	.15*	-.07	.03
More people's health suffering in extreme heat...	.42*	.30*	.33*	.10	.21*	-.10	.06
New crops previously grown abroad become more common in the UK...	.13*	.24*	.20*	.13*	.01	-.05	.02
More people living in the UK take their holidays in the UK...	.20*	.17*	.10	.09	.12*	-.07	.03
More people permanently move to the UK...	.23*	.17*	-.01	.03	.31*	-.05	.10
More tourists choosing to visit the UK...	.14*	.15*	<.01	.10*	.13*	-.12*	.04
Lower demand for energy due to warmer winters...	.20*	.13*	.13*	-.05	.16*	.02	.03
Fewer vulnerable people dying in the cold due to milder winters...	.17*	.08	.12*	-.04	.13*	-.06	.02

*Significant at Bonferroni-corrected value of $p < .0008$ (for Pearson's *r*) or $p < .003$ (for linear regression). Bonferroni corrections have been applied to control for number of tests used to address each research question.

^aRegression analysis controls for age, gender and education. ΔR^2 represents unique contribution of expected likelihood, concern and climate change belief. See supplementary material for details of all full regression models including the contribution of control variables.

(Tversky and Kahneman 1973), whereby the ease with which examples of threats are recalled is used as a guide to the risk they pose. At the time when the survey was conducted (January/February 2013), the UK had recently experienced above average seasonal rainfall and highly publicised flooding (Met Office 2012), likely making these threats particular salient to respondents.

Similarly, the finding that participants expected threats to be more likely than opportunities, is in keeping with prior work suggesting that negative information about potential losses tends to be more salient than positive information about potential gains (Kahneman and Tversky 1979; Siegrist and Cvetkovich 2001; Taylor 1991). Thus, lay participants' assessments diverged from those of experts participating in the UK government's 2012 CCRA exercise, who expected that both threats and opportunities would be likely to emerge as a result of a changing climate. In line with these patterns, we also found that UK residents are less supportive of expending public resources to take advantage of opportunities than to protect against threats.

4.2. Public expectations and expert assessment

Our second main finding pertains to the differences between public expectations and expert assessments of climate change impacts. As noted above, our participants expected threats to be relatively more likely than opportunities, as compared to experts. However, expectations for specific threats varied. Both experts' and participants' assessments of threats were relatively consistent with respect to the threats posed by flooding. In contrast, participants' perceptions of the likelihood of threats to humans from hot weather indicated that they perceived these to pose less of a risk than expert assessments of 'Consequence' in the 2012 Climate Change Risk Assessment (CCRA) would suggest. Furthermore, while participants' adaptation priorities were often consistent with the ratings of 'Urgency' set out in the 2017 CCRA, threats from urban heat island effects were judged to be a low priority by participants, while the 2017 CCRA places these within highest urgency category. Again, this finding is in keeping with our prior finding that positive feelings towards hot weather amongst UK residents may diminish perceived threat from heat extremes (Bruine de Bruin et al. 2016; Lefevre et al. 2015).

4.3. Predicting impact priorities

Our third main finding relates to predictors of participants' impact prioritisations. Our results show consistent, if modest, associations between participants' anticipated concern about impacts and willingness to allocate resources to them. After taking into account this role of anticipated concern about impacts, climate change belief made no additional positive contribution to resource allocations, while expected likelihood only made a positive contribution to three impacts. This is consistent with previous findings that, when it comes to making judgements about risk, people often focus on the magnitude of potential harms, rather than the likelihood of them occurring (March and Shapira 1987). This insensitivity to probability may be especially high when potential harms evoke strong negative emotions (Sunstein 2002).

4.4. Limitations

As with all secondary data analyses, ours has its limitations. First, participants made hypothetical decisions about resource allocation, such that they did not actually have to invest money, implement their chosen adaptation strategies or bear the consequences of not choosing others. Second, participants were not shown the same set of impacts, and may have allocated tokens differently to specific impacts had they been part of a different set. The large sample size, combined with the fact that the impacts were randomly assigned, means that we nevertheless had sufficient ability to generalise across choice sets. Third, our study is specific to the UK Residents in other parts of the world may have different expectations for climate change impacts, and preferences for resource allocations.

4.5. Conclusions

Taken together, our findings suggest three key conclusions. Firstly, while opportunities may arise as a result of a changing climate, these are not perceived to be as important as equivalent threats. Taking advantage of them is, therefore, not likely to be perceived as a priority, even where experts project that they will have high positive consequence. Secondly, while both experts and members of the wider public expect future increases in flooding to pose a high risk to the UK, UK residents do not appear to expect future increases in heat extremes to pose as strong a risk as experts. As noted, this may be attributable to wet weather being perceived as both unpleasant and memorable, while hot weather evokes more positive emotions (Lefevre et al. 2015). It does, however, raise the concern that those living in temperate climates may be less prepared – and less willing to prepare – for future heat extremes than for future flood risks. Previous research has suggested that stressing the unpleasant aspects of hot weather can increase intention to protect oneself against short-term weather extremes amongst UK residents (Bruine de Bruin et al. 2016). However, as of yet this strategy has not been tested with respect to increasing preparedness for longer term changes in climate. Lastly, our findings suggest that support for measures to prepare for specific climate change impacts may be driven more by perceived magnitudes of the threats posed, than by the stated likelihood of them occurring. Additionally, while climate change beliefs are linked to greater concern about specific impacts, they do not predict willingness to prioritise any specific type of impact.

Our findings have implications for climate risk communication and policy. When promoting support for adaptation measures, highlighting the potential consequences of specific threats may be more effective than emphasising climate change in general or the likelihood of specific climate change impacts by a particular point in time. For instance, it has been suggested that emphasising local flood risks can increase support for flood risk adaptation measures across groups with polarised beliefs about climate change (Bruine de Bruin, Wong-Parodi, and Morgan 2014). Such communication approaches would seem to be supported by research on the ‘time to emergence’ of climate signals. Specifically, that while there is uncertainty as to when the signal from anthropogenic climate change will exceed natural variability in different climate variables, exceedance of these thresholds is expected to be linked to major climate change impacts (Hawkins and Sutton 2012). Hence, communicators who aim to increase public support for adaptation measures may therefore need to stress the point in time at which it is virtually certain that specific impacts will have occurred, rather than the likelihood of them having occurred by a particular date. Indeed, support for climate change mitigation is higher among recipients of communications that discuss the seriousness of climate change impacts ‘when’ (rather than ‘if’) they occur under different emissions scenarios (Ballard and Lewandowsky 2015). More research is needed to test whether this also applies to communications about adaptation. Our findings also underscore the importance of taking a region-specific approach to exploring public expectations about climate change impacts. Hence, we suggest that a similar approach might be taken in comparing expert impact assessments to public expectations in other countries.

Note

1. As all participants were assigned 10 out of 19 impacts, they were not asked to distribute resources amongst the same set of impacts. This means individual participants may have allocated a different number of resource units to any given impact had it been part of a different set of 10. However, combined with the large sample size, the fact that impact assignment was randomised means that this will not have led to any systematic biasing of the responses in the data-set as a whole.

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References

- Ballard, Timothy, and Stephan Lewandowsky. 2015. "When, Not If: The Inescapability of an Uncertain Climate Future." *Philosophical Transactions of the Royal Society a: Mathematical, Physical and Engineering Sciences* 373 (2055): 20140464.
- Broomell, Stephen B., David V. Budescu, and Han-Hui Por. 2015. "Personal Experience with Climate Change Predicts Intentions to Act." *Global Environmental Change* 32: 67–73.
- Bruine de Bruin, Wändi, Carmen Lefevre, Andrea L. Taylor, Suraje Dessai, Baruch Fischhoff, and Sari Kovats. 2016. "Promoting Protection against a Threat That Evokes Positive Affect: The Case of Heatwaves in the UK." *Journal of Experimental Psychology: Applied* 22: 261.
- Bruine de Bruin, Wändi, and Ann Bostrom. 2013. "Assessing What to Address in Science Communication." *Proceedings of the National Academy of Sciences* 110 (Supplement 3): 14062–14068.
- Bruine de Bruin, Wändi, Gabrielle Wong-Parodi, and M. Granger Morgan. 2014. "Public Perceptions of Local Flood Risk and the Role of Climate Change." *Environment Systems and Decisions* 34 (4): 591–599.
- Committee on Climate Change. 2016. "UK Climate Change Risk Assessment 2017". Accessed January 9, 2017. <https://www.theccc.org.uk/UK-climate-change-risk-assessment-2017/>
- Defra. 2012. "The UK Climate Change Risk Assessment 2012 Evidence Report". Accessed January 9, 2017. https://randd.defra.gov.uk/Document.aspx?Document=10067_CCRAEvidenceReport16July2012.pdf
- Defra. 2013. "Adapting to Climate Change: National Adaptation Programme". Accessed January 9, 2017. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209866/pb13942-nap-20130701.pdf
- Hawkins, E., and R. Sutton. 2012. "Time of Emergence of Climate Signals." *Geophysical Research Letters* 39 (1).
- Hultman, Nathan E., David M. Hassenzahl, and Steve Rayner. 2010. "Climate Risk." *Annual Review of Environment and Resources* 35: 283–303.
- Intergovernmental Panel on Climate Change. 2014. *Climate Change 2014 – Impacts, Adaptation and Vulnerability: Regional Aspects*. Cambridge: Cambridge University Press.
- Ipsos MORI. 2013. *PREPARE – Climate Risk Acceptability Findings from a Series of Deliberative Workshops and Online Survey*. Accessed January 9, 2017. https://randd.defra.gov.uk/Document.aspx?Document=11261_PREPARECA0513Publicclimateiskacceptability-Finalreport.pdf
- Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica* 47: 263–291.
- Lefevre, Carmen E., Wändi Bruine de Bruin, Andrea L. Taylor, Suraje Dessai, Sari Kovats, and Baruch Fischhoff. 2015. "Heat Protection Behaviors and Positive Affect about Heat during the 2013 Heat Wave in the United Kingdom." *Social Science & Medicine* 128: 282–289.
- Lorenzoni, Irene, and Nick F. Pidgeon. 2006. "Public Views on Climate Change: European and USA Perspectives." *Climatic Change* 77 (1–2): 73–95.
- March, James G., and Zur Shapira. 1987. "Managerial Perspectives on Risk and Risk Taking." *Management Science* 33 (11): 1404–1418.
- Met Office. 2012. "Weather Summaries: Annual 2012". Accessed January 9, 2016. <https://www.metoffice.gov.uk/climate/uk/summaries/2012/annual>
- Moss, R. H., G. A. Meehl, M. C. Lemos, J. B. Smith, J. R. Arnold, J. C. Arnett, D. Behar, G. P. Brasseur, S. B. Broomell, and A. J. Busalacchi. 2013. "Hell and High Water: Practice-Relevant Adaptation Science." *Science* 342: 696–698.
- Palutikof, Jean P., Maureen D. Agnew, and Mark R. Hoar. 2004. "Public Perceptions of Unusually Warm Weather in the UK: Impacts, Responses and Adaptations." *Climate Research* 26 (1): 43–59.
- Porter, James J., Suraje Dessai, and Emma L. Tompkins. 2014. "What Do We Know about UK Household Adaptation to Climate Change? A Systematic Review." *Climatic Change* 127 (2): 371–379.
- Siegrist, Michael, and George Cvetkovich. 2001. "Better Negative than Positive? Evidence of a Bias for Negative Information about Possible Health Dangers." *Risk Analysis* 21 (1): 199–206.

- Slovic, Paul, Melissa L. Finucane, Ellen Peters, and Donald G. MacGregor. 2004. "Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality." *Risk Analysis* 24 (2): 311–322.
- Slovic, Paul, Melissa L. Finucane, Ellen Peters, and Donald G. MacGregor. 2007. "The Affect Heuristic." *European Journal of Operational Research* 177 (3): 1333–1352.
- Sunstein, Cass R. 2002. "Probability Neglect: Emotions, Worst Cases, and Law." *The Yale Law Journal* 112 (1): 61–107.
- Swim, Janet, Susan Clayton, Thomas Doherty, Robert Gifford, George Howard, Joseph Reser, Paul Stern, and Elke Weber. 2009. *Psychology and Global Climate Change: Addressing a Multi-Faceted Phenomenon and Set of Challenges. a Report by the American Psychological Association's Task Force on the Interface between Psychology and Global Climate Change*. Washington, DC: American Psychological Association.
- Taylor, Shelley E. 1991. "Asymmetrical Effects of Positive and Negative Events: The Mobilization-minimization Hypothesis." *Psychological Bulletin* 110 (1): 67–85.
- Taylor, Andrea, Wändi Bruine de Bruin, and Suraje Dessai. 2014. "Climate Change Beliefs and Perceptions of Weather-related Changes in the United Kingdom." *Risk Analysis* 34 (11): 1995–2004.
- Tversky, Amos, and Daniel Kahneman. 1973. "Availability: A Heuristic for Judging Frequency and Probability." *Cognitive Psychology* 5 (2): 207–232.
- Whitmarsh, Lorraine. 2009. "What's in a Name? Commonalities and Differences in Public Understanding of 'Climate Change' and 'Global Warming'." *Public Understanding of Science* 18 (4): 401–420.