

Perceptions of climate change and willingness to save energy related to flood experience

A. Spence^{1*}, W. Poortinga², C. Butler³ and N. F. Pidgeon^{3*}

One of the reasons that people may not take action to mitigate climate change is that they lack first-hand experience of its potential consequences. From this perspective, individuals who have direct experience of phenomena that may be linked to climate change would be more likely to be concerned by the issue and thus more inclined to undertake sustainable behaviours. So far, the evidence available to test this hypothesis is limited, and in part contradictory^{1–4}. Here we use national survey data collected from 1,822 individuals across the UK in 2010, to examine the links between direct flooding experience, perceptions of climate change and preparedness to reduce energy use. We show that those who report experience of flooding express more concern over climate change, see it as less uncertain and feel more confident that their actions will have an effect on climate change. Importantly, these perceptual differences also translate into a greater willingness to save energy to mitigate climate change. Highlighting links between local weather events and climate change is therefore likely to be a useful strategy for increasing concern and action.

Climate change targets for reductions in greenhouse-gas emissions have now been instituted across many developed and developing nations. Research demonstrates that these targets are unlikely to be met without major changes in societal structures that will necessarily require engagement of the wider public, for example to achieve more efficient or reduced energy use^{5,6}. Although for many years a majority of individuals have expressed concern about climate change in the UK, as elsewhere, an examination of polling data in recent years actually reveals a small decline in concern, alongside an increase in scepticism regarding its seriousness and anthropogenic causes^{7–9}. Indeed, public perceptions typically reflect a much lower concern about climate change than is expressed by climate scientists, potentially owing, in part, to the public's lack of personal experience with climate impacts^{10,11}. Psychological research indicates that one reason for a lack of concern about climate change may be the perception that it is a distant issue. Lay people tend to perceive areas that are vulnerable to climate change impacts as geographically distant—at least in Western countries^{12,13}. This relates to research within the domain of embodied social cognition that links distance, and in particular spatial distance, with the dampening of reactions and judgements¹⁴.

These observations logically lead to the idea that highlighting the links between local events and climate change may encourage people to engage with the issue¹⁵ and to take action to mitigate potential impacts. Indeed, personal experience is thought to be a key driver of risk perceptions, and the perceived likelihood of a risk is found to increase if it has recently been experienced or can readily be imagined¹⁶. Relating local events to climate change may also have perceptual and behavioural impacts to the extent that these help to

make the issues less distant and more tangible. It might be expected that experiencing some kind of (generally negative) event that could be attributed to climate change would leave people feeling helpless. However, goal-setting theory¹⁷ highlights the benefits of setting concrete, specific goals in increasing instrumentality (that is, an individual's belief that actions will lead to outcomes) and the likelihood of subsequent action being taken. In line with this, if people are better able to relate to the potential consequences of climate change impacts, they may also be more likely to feel that their behaviour can lead to changes in these impacts.

Climate change itself is not directly observable by individuals, it being a reference to average climate conditions over a long period of time rather than that observed on a daily or seasonal basis, and is perhaps really understood only through mathematical models and scientific measurement¹⁸. However, given that seasonal events and the weather are the primary means by which individuals can experience and observe the climate, it is understandable that this is a means by which people may judge climate change. Note that phenological research (the recording of seasonal events), for example the early arrival of swifts in summer in the UK, and indigenous observations within key areas, for example reduction in numbers of seals within Arctic regions, have proved useful in verifying, clarifying and documenting impacts of climate change¹⁹.

Major extremes in weather, and ecosystem changes, are already being experienced across multiple geographical regions (for example, droughts in Uganda and Sudan) and are expected to increase in frequency and severity as a result of climate change²⁰. In particular, for many places including the UK, it is observed that periods of intense rainfall have increased in frequency over the past 40–60 years, resulting in a greater number of floods, and indeed recent research has explicitly linked anthropogenic greenhouse-gas emissions to an increase in flood risk in England and Wales²¹. It is important to acknowledge that climate change predictions highlight the increasing risk of particular weather patterns and events²². Hence, attributing any one event to climate change is highly complex, and as a consequence it is particularly difficult for communicators or the public to link actual experiences with the more abstract notions of risk derived from climate science. On this issue, some commentators have suggested that the substantial changes to the composition of the world's atmosphere mean that it is perhaps now more appropriate to discuss weather events in terms of hybrid weather; that is, as the result of a new co-produced natural-cultural climate system²³.

Existing research indicates that environmental views and perceptions of climate change can be related to individuals' physical surroundings and experiences. People who inhabit places recognized as physically vulnerable to climate change impacts in certain overt ways, for example living in low-lying coastal areas,

¹Horizon Digital Economy Research/School of Psychology, University of Nottingham, Nottingham NG7 2TU, UK, ²Welsh School of Architecture/School of Psychology, Cardiff University, Cardiff CF10 3AT, UK, ³Understanding Risk Research Group, School of Psychology, Cardiff University, Cardiff CF10 3AT, UK. *e-mail: alexa.spence@nottingham.ac.uk; PidgeonN@Cardiff.ac.uk.

have been identified as having a heightened sense of personal risk³. Furthermore, there is some evidence that experience of an ecological disaster, for example an oil spill, or an environmental problem, for example drought, can impact environmental views of the local community affected^{2,24,25}. So far, there is little and mixed evidence on whether living in a place physically vulnerable to climate change impacts, or with experiences that could be attributable to climate change, leads to changes in perceptions of climate change and in support for related policies on mitigation or adaptation^{2,4}. In relation to flooding specifically, existing data link flood experiences to a heightened awareness of flood risks²⁶; however, such experiences have not previously been found to relate to perceptions of, or related action on, climate change. For example, data collected in 2003 that examined experiences of flooding within two UK communities indicated that climate change perceptions and self-reported actions on climate change between those who had and had not experienced flooding were very similar¹. Indeed, flood victims interviewed as part of the aforementioned research tended to view flooding as a largely distinct issue from climate change and identified local observable causes for flooding, for example lack of maintenance of water courses.

This previous research was conducted after major flooding events in 1998 and 2000. Since then the UK has experienced a further series of high-profile flooding events, affecting hundreds of thousands of people across diverse parts of the country, including large-scale flooding across many parts of the UK in 2007, localized flash flooding (for example Boscastle, Cornwall in 2004) and widespread flooding across Cumbria and southwest Scotland in 2009, making flooding a key media and political concern. These floods were mainly caused by extremes of rainfall that led to river flooding, surface-water runoff and inundation of drainage systems, rather than being coastal floods. Although they have not been directly attributed to climate change, an increase in rainfall intensity and flood risk in the UK is consistent with results from climate-modelling experiments^{21,27}. In conjunction with this, climate change has increased in salience over the past decade (exemplified by increasing media coverage²⁸, the publication of the Intergovernmental Panel on Climate Change fourth assessment report as well as the Stern review, and major international events such as the Copenhagen climate summit). Given this, it is timely to re-examine potential relationships between experiences of flooding and perceptions of climate change. This study used a large representative UK population to explore this relationship.

We designed a survey to examine public perceptions of climate change and related issues (for example, energy), with aims partly to track historical changes in perceptions and partly to provide greater theoretical insight into underlying reasons for perceptions held. Questions used examined a range of socio-cognitive constructs relating to energy and climate change, related behavioural intentions and key demographic variables: the relevant items for the analysis are detailed in Table 1. Within the full sample of 1,822, a total of 363 people (19.92%) reported that they had experienced flooding in their local area recently and 1,444 (79.25%) reported they had not (15 people reported that they did not know). We conducted multiple-mediation analyses²⁹ to examine differences in climate change perceptions and preparedness to reduce energy use to tackle climate change between those who had and those who had not reported experiencing flooding. Key demographic variables of age, gender and social grade were included as covariates within the analysis, to ensure effects found were not due to their influence; all results reported are therefore net of the influence of demographic variables. Multiple mediation was carried out using a product-of-coefficients approach with an SPSS script developed for this

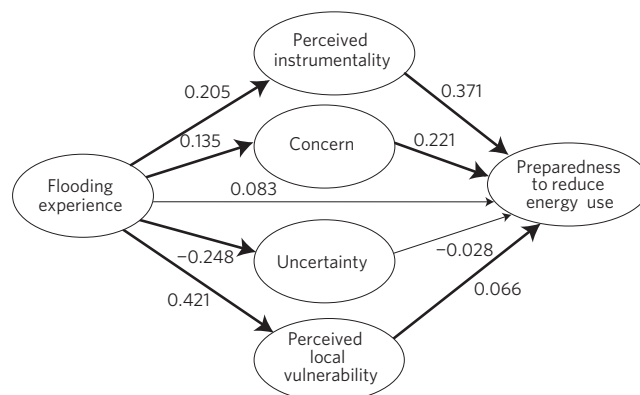


Figure 1 | Impact of flooding experience on preparedness to reduce energy use mediated by perceived instrumentality, concern, uncertainty and perceived local vulnerability. Note that demographic variables of age, gender and socio-economic grade were included as covariates within the analysis and effects observed are net of their impact. Values provided are beta weights indicating the strength of the relationship between variables. Heavy lines indicate significant pathways ($P < 0.05$).

purpose³⁰. Our method allowed all mediator residuals to covary and estimated (rather than constrained) the direct effect of the independent variable on the dependent variable so that indirect effects were not overestimated. Furthermore, owing to the strict assumption of normally distributed data within the product-of-coefficients approach to mediation, this method used bootstrapping to resample the data (1,000 times) in estimating the indirect effects. Given the low proportion of missing data (0–4% per factor), we used listwise deletion within analyses. Variables were coded so that higher values indicated greater levels of that factor, for example greater concern, perceived instrumentality or perceived vulnerability.

Reported flooding experiences had a significant relationship with perceptions relating to climate change and a significant indirect relationship with behavioural intentions (Fig. 1). Importantly, without including mediating perceptual links in the analysis, flooding seems to have only a minor impact on behavioural intentions, which may help to explain why previous studies have found mixed and null effects. Most of the effect is observed when a more rigorous model is constructed including key perceptual factors, indicating that the relationship is primarily transmitted through the changes in perceptions observed. In comparison with people who reported not experiencing flooding, those who had, showed significantly higher levels of perceived instrumentality (ability to have an effect) on climate change ($b = 0.21$, $t = 3.31$, $P < 0.01$), higher levels of concern about climate-change impacts ($b = 0.14$, $t = 2.54$, $P < 0.05$), were less uncertain about whether climate change existed ($b = -0.25$, $t = -3.44$, $P < 0.001$) and perceived their local area to be more vulnerable to climate change impacts ($b = 0.42$, $t = 6.22$, $P < 0.001$; Supplementary Figs S1 and S2). Note that unstandardized coefficients (b) are reported here (and in Fig. 1), which describe the extent to which a one-unit change in the predicting factor will influence differences observed in the related factor. Furthermore, perceived instrumentality, concern and perceived local vulnerability operate as significant mediators of the relationship between flooding experience and preparedness to reduce energy use (95% confidence intervals (0.03, 0.12), (0.01, 0.06) and (0.01, 0.05), respectively). Therefore, those who felt they were more able to have an impact on climate change, those who were more concerned about climate change and those who perceived greater local vulnerability to climate change impacts were more prepared to reduce their energy use. Although flooding experiences were also linked with lower levels of

Table 1 | Questions assessing perceptions and behavioural intentions relating to climate change.

Construct	Question	Response options	Flooded mean (s.d.)	Not flooded mean (s.d.)
Flooding experience	'Have you personally experienced flooding in your local area recently or not?'	Yes/No/Don't know		
Perceived instrumentality ($\alpha = 0.77$)	'I can personally help to reduce climate change by changing my behaviour.' 'I personally feel that I can make a difference with regard to climate change.'	Five-point scale (strongly disagree–strongly agree)	3.49 (1.04)	3.34 (1.08)
Concern about climate change	'How concerned, if at all, are you about climate change, sometimes referred to as 'global warming'?'	Four-point scale (not at all concerned–very concerned)	3.03 (0.89)	2.90 (0.90)
Uncertainty over climate change	'I am uncertain that climate change is really happening.'	Five-point scale (strongly disagree–strongly agree)	2.27 (1.19)	2.56 (1.24)
Perceived local vulnerability	'My local area is likely to be affected by climate change.'	Five-point scale (strongly disagree–strongly agree)	3.63 (1.06)	3.25 (1.16)
Preparedness to reduce energy use	'I am prepared to greatly reduce my energy use to help tackle climate change.'	Five-point scale (strongly disagree–strongly agree)	3.65 (1.05)	3.57 (1.05)

uncertainty regarding climate change, uncertainty did not translate into preparedness to reduce energy use (95% confidence interval (−0.00, 0.02)). Overall, indirect effects significantly mediated the relationship between flooding experience and preparedness to reduce energy use (95% confidence interval (0.07, 0.21)) where the model can explain 30% of variance in preparedness to reduce energy use (adjusted $R^2 = 0.30$, $F(8, 1663) = 89.04$, $P < 0.001$).

We acknowledge that data examined in this article are cross-sectional and therefore causality is assumed. Hence, it is plausible that some people who are more concerned about climate change (*a priori*) might also tend to report more local flooding. To control for this possibility, the multiple-mediation analysis conducted here examined each mediator while controlling for the others included in the model. Therefore, concern about climate change was held constant in the examination of the other factors included, indicating that effects observed were over and above any impact of concern *per se*. This means that any potential for people who are highly concerned about climate change *a priori* to be more likely to report experiences of flooding in their local area is held constant in the examination of other factors. Notwithstanding this, we conclude that longitudinal designs are needed to elucidate the strength of causal relationships proposed in this analysis.

The role of events that are potentially attributable to climate change in promoting concern and action on related issues is repeatedly highlighted in theory, debate, climate policy and media campaigns. However, the way in which this type of experience may actually affect the individual is relatively unknown. Our data provide the first known support for a relationship between flooding experience and perceptions of climate change in a UK, representatively sampled, population and provide some insight into how people are impacted by these experiences. Importantly, not only are those who experienced flooding more certain and concerned about climate change, but they also perceive greater instrumentality. Compatible with goal-setting theory, it seems that the experience of an event that may be interpreted as being due to climate change confers to the individual a greater feeling of being able to have a personal impact, and perceptions also translate into a greater preparedness to act in ways that help tackle the issue. Interestingly, although flooding experience was

linked with lower uncertainty regarding climate change, this did not subsequently relate to behavioural intentions, implying that recent increases in uncertainty observed in public opinion may not translate to a reduction in sustainable behaviour. It is possible however that any associations between uncertainty and behavioural intentions may be overshadowed by the accompanying associations observed between concern and intentions; these ideas warrant further examination in future research endeavours.

We suggest that relationships observed in our study may have developed in people's understandings through an interaction between the series of major flooding events in the UK and the increasing salience accorded to climate change in public life and discourse in recent years (through the media, science, education, politics and so on). Further research is now warranted to investigate whether people's own narrative explanations and mental models do indeed spontaneously attribute multiple flooding events to a changing climate in this way. Our findings indicate that severe, locally salient environmental changes and events, such as flooding, present significant opportunities to engage people with climate change and encourage action.

Methods

The survey instrument was developed by a panel of four academic researchers and refined after input from the partner social research company, Ipsos MORI, and an expert advisory panel ($N = 15$), comprised of academic researchers, members of relevant government departments and members of third-sector groups. A full report of the survey data is available³¹. Ipsos MORI collected data using Computer-Assisted Personal Interviews between 5 January and 2 March 2010. A nationally representative quota sample ($N = 1,822$) of the population of Great Britain (that is, England, Scotland and Wales), aged 15 years and older was obtained based on a core sample of 1,436 and additional booster samples from Scotland and Wales. Interviews were conducted by fully trained and supervised market and opinion research interviewers at 315 sample points across Great Britain, with each interview taking approximately 30 min to complete.

Sample points were selected randomly from a stratified sample of output areas sorted by Government Office and council area. Output areas containing fewer than 80 postal address files were excluded from the sample. Interviewers approached selected addresses within the sample points until quotas were reached (gender and age figures were based on Office for National Statistics 2007 mid-year population estimates and working status was based on 2001 Census data). Interviewers left at least three addresses between each call and conducted a maximum of one interview per address. No incentives were offered for participation.

Received 24 November 2010; accepted 22 February 2011;
published online 20 March 2011

References

- Whitmarsh, L. Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *J. Risk Res.* **11**, 351–374 (2008).
- Dessai, S. & Sims, K. Public perception of drought and climate change in Southeast England. *Environ. Hazards* **9**, 340–357 (2010).
- Brody, S. D., Zahran, S., Vedlitz, A. & Grover, H. Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States. *Environ. Behav.* **41**, 72–95 (2008).
- Zahran, S., Brody, S. D., Grover, H. & Vedlitz, A. Climate change vulnerability and policy support. *Soc. Nat. Resour.* **19**, 771–789 (2006).
- Spence, A. & Pidgeon, N. F. Psychology, climate change and sustainable behaviour. *Environment* **52**, 9–18 (2010).
- UK Energy Research Centre *Making the Transition to a Secure and Low-carbon Energy System: UKERC Energy 2050 Project* (UKERC, 2009).
- Eurobarometer *Europeans' Attitudes Towards Climate Change* (Special Eurobarometer 322, European Commission, 2009).
- Leiserowitz, A., Maibach, E. & Roser-Renouf, C. *Climate Change in the American Mind: Americans' Global Warming Beliefs and Attitudes in January 2010* (Yale University and George Mason University, 2010); available at <http://environment.yale.edu/uploads/AmericansGlobalWarmingBeliefs2010.pdf> (accessed 28 October 2010).
- YouGov/EDF *Energy Survey Results* (2010); available at <http://www.yougov.com> (accessed 28 October 2010).
- Weber, E. What shapes perceptions of climate change? *Wiley Interdiscip. Rev. Clim. Change* **1**, 332–342 (2010).
- Weber, E. & Stern, P. Public understanding of climate change in the United States. *Am. Psychol.* doi:10.1037/a0023253 (in the press).
- Swim, J. *et al.* *Psychology and Global Climate Change: Addressing a Multi-Faceted Phenomenon and Set of Challenges* (American Psychological Association, 2009); available at <http://www.apa.org/science/climate-change>.
- Lorenzoni, I. & Pidgeon, N. F. Public views on climate change: European and USA perspectives. *Clim. Change* **77**, 73–95 (2006).
- Williams, L. E. & Bargh, J. A. The influence of spatial distance cues on affect and evaluation. *Psychol. Sci.* **19**, 302–308 (2008).
- Weber, E. Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Clim. Change* **77**, 103–120 (2006).
- Tversky, A. & Kahneman, D. Availability: A heuristic for judging frequency and probability. *Cognitive Psychol.* **5**, 207–232 (1973).
- Locke, E. A. & Latham, G. P. Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *Am. Psychol.* **57**, 705–717 (2002).
- Kollmuss, A. & Agyeman, J. Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour. *Environ. Educ. Res.* **8**, 239–260 (2002).
- Lawrence, A. The first cuckoo in winter: Phenology, recording, credibility and meaning in Britain. *Glob. Environ. Chang.* **19**, 173–179 (2009).
- IPCC, *Climate Change 2007: Synthesis Report* (eds Pachauri, R. K. & Reisinger, A.) (Cambridge Univ. Press, 2007).
- Pall, P. *et al.* Anthropogenic greenhouse gas contribution to flood risk in England and Wales in autumn 2000. *Nature* **470**, 382–386 (2011).
- Pidgeon, N. F. & Butler, C. Risk analysis and climate change. *Environ. Polit.* **18**, 670–688 (2009).
- Hulme, M. Cosmopolitan climates: Hybridity, foresight and meaning. *Theor. Cult. Soc.* **27**, 267–276 (2010).
- Arcury, T. A. & Christinason, E. H. Environmental worldview in response to environmental problems: Kentucky 1984 and 1988 compared. *Environ. Behav.* **22**, 387–407 (1990).
- Marshall, B. K., Picou, J. S. & Bevc, C. A. Ecological disaster as contextual transformation: Environmental values in a renewable resource community. *Environ. Behav.* **37**, 706–728 (2005).
- deMan, A. & Simpson-Housley, P. Correlates of responses to two potential hazards. *J. Soc. Psychol.* **128**, 385–391 (1988).
- Pitt, M. *The Pitt Review, Learning Lessons from the 2007 Floods* (Cabinet Office, 2008).
- Boycoff, M. We speak for the trees: Media reporting on the environment. *Annu. Rev. Environ. Resour.* **34**, 431–457 (2009).
- Preacher, K. J. & Hayes, A. F. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav. Res. Meth.* **40**, 879–891 (2008).
- Preacher, K. J. & Hayes, A. F. *SPSS Macro for Multiple Mediation* (2008); available at <http://www.comm.ohio-state.edu/ahayes/>.
- Spence, A., Venables, D., Pidgeon, N. F., Poortinga, W. & Demski, C. *Public Perceptions of Climate Change and Energy Futures in Britain: Summary Findings of a Survey Conducted in January–March 2010 (Technical Report)* (Understanding Risk Working Paper 10-1, Cardiff University, 2010); available at <http://www.understanding-risk.org>.

Acknowledgements

This research was supported by a research grant from the Economic and Social Research Council (RES-062-23-1134) as well as a Climate Change Leader Fellowship (RES-066-27-0013) and a major grant to the Understanding Risk research group from the Leverhulme Trust (F/00 407/AG). Further support was received from Horizon Digital Economy Research, RCUK grant (EP/G065802/1). The authors also wish to thank D. Venables, N. Vaughan and Ipsos MORI for assistance with the survey.

Author contributions

All authors contributed to the design of the survey used within the work presented. A.S., N.F.P. and W.P. organized and managed the data collection. A.S. analysed the data. A.S. led in writing the paper, developing this with input from all authors.

Additional information

The authors declare no competing financial interests. Supplementary information accompanies this paper on www.nature.com/natureclimatechange. Reprints and permissions information is available online at <http://npg.nature.com/reprintsandpermissions>. Correspondence and requests for materials should be addressed to A.S. or N.F.P.