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Psychological responses to the proximity of climate change

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Abstract

A frequent suggestion to increase individuals' willingness to take action on climate change and to support relevant policies is to highlight its proximal consequences, that is, consequences that are close in space and time. However, previous studies that have tested this proximising approach have not revealed the expected positive effects on individual action and support for addressing climate change. We present three lines of psychological reasoning that provide compelling arguments as to why highlighting proximal impacts of climate change might not be as effective a way to increase individual mitigation and adaptation efforts as is often assumed. Our contextualisation of the proximising approach within established psychological research suggests that, depending on the particular theoretical perspective one takes to this issue, and on specific individual characteristics suggested by these perspectives, proximising can bring about the intended positive effects, can have no (visible) effect, or can even backfire. Thus, the effects of proximising are much more complex than is commonly assumed. Revealing this complexity contributes to a refined theoretical understanding of the role psychological distance plays in the context of climate change and opens up further avenues for future research and for interventions.

Keywords

Psychological distance, personal experience, place attachment, threat, risk perception, defensiveness, mitigation, adaptation

Research on public perceptions of climate change often shows that people, at least in Western countries, typically perceive climate change as a distant threat, as something that affects strangers, and as something that happens in remote times and places, rather than in the here and now[1–7] (for an exception, see ref. [8]). This perception of climate change as a distant threat is problematic because it implies little personal relevance. Low levels of personal relevance in turn are problematic because individuals' perception of being personally at risk can be an important motivation to take action against the source of that risk[9–14].

Consistent with this analysis, it has repeatedly been suggested that highlighting the proximal consequences of climate change could be an important part of strategies to engage and mobilize publics around this issue[3,15–20]. Although the assumed psychological mechanism of proximising is often not verbalised (see also ref. [21], where the term is used to describe a discursive strategy in which the speaker presents physically and temporally distant events as close and directly relevant to the addressee), the rationale behind proximising climate change seems to be that this approach (a) decreases the psychological distance between the issue and individuals who could or should act[17,22] and, (b) makes the consequences of climate change easier to visualise[4,23] and more personally relevant[24,25]. Moreover, proximising climate change is believed to increase (emotional) concern[16,22,26,27] and the feeling of being personally vulnerable[23,27]; ultimately, these processes are expected to enhance people's motivation to act[3,4,22–24,26,28]. The idea of focusing on proximal climate change to increase engagement with the issue is also consistent with a general tendency, known as temporal discounting, whereby people attach a lesser value to the same outcome if it is seen to be further away in time[29,30].

Despite the common sense appeal of proximising[31] and the frequent propositions to use this strategy to motivate action against climate change, relatively few studies have empirically explored the effect of this strategy. Moreover, the findings from those studies that have studied proximising are inconclusive. One line of research that is useful to evaluate the

role of proximising is to focus on personal experiences of events that are related to climate change. Although climate change is by definition a statistical concept (the average weather over several decades[32]) and can therefore not be experienced directly[33], people may still experience extreme weather events and considerable change in their local environment. To illustrate, one study found that Britons who had recently experienced flooding (a weather-related phenomenon expected to occur more frequently in Britain because of climate change) perceived their local area to be more at risk from climate change, were more concerned about climate change impacts, had higher confidence in their ability to mitigate climate change, and were more willing to reduce their energy use in order to mitigate climate change than those who had not recently experienced flooding[26]. While some studies have revealed similar patterns[34–36], other work suggests that experiencing the impacts of extreme weather events does not necessarily increase concern and the willingness to respond to climate change[37,38].

The relationships between exposure to extreme weather events and the way people feel about climate change and possible response strategies becomes more consistent when an additional factor is taken into account: namely, how individuals interpret such "climate signals"[27,39]. People who report having experienced changes or events in the natural environment that they think were caused by climate change are more likely to believe that climate change is relevant to their local area and themselves[42] than people who did not report such experience. More specifically, experiencing phenomena attributed to climate change was associated with increased perceptions of personal and local risks from climate change[41–43] and higher levels of concern and worry about this threat[41,42]. Last but not least, people who felt that they had personally experienced climate change through weather-related events or changes were more likely to support mitigation[41,42] and adaptation[44] measures (for an overview, see ref. [27]). These findings support the idea that bringing climate change psychologically closer can under certain circumstances have the expected motivational effects. However, the qualification that experiencing extreme weather events only increases

levels of engagement with climate change when people attribute their experiences to climate change highlights that additional psychological or ideological processes are at work that complicate the effects of such experiences[40–42,45–47].

A crucial question that follows from this analysis is to what extent researchers and practitioners can study the relationship between experiences with phenomena that people believe to be manifestations of climate change and people's readiness to engage with climate change. Many existing studies suffer from a range of methodological constraints simply because the researchers have had to capitalise, after the event, on unpredictable phenomena that have already occurred. As an alternative, some researchers have tried to induce risk-free experiences that are consistent with climate change predictions. For example, increasing the room temperature strengthens people's belief in climate change[48] and some studies suggest that the mere activation of heat-related associations has similar effects[49–51]. However, to our knowledge there is currently no evidence available that these manipulations affect behaviour. More importantly, the finding that personal experiences have the most consistent positive effects when individuals attribute them to climate change[40–43] raises the question of how deep and enduring the positive effects of incidental bodily sensations and implicitly activated associations are.

An alternative way to bring climate change closer to people is to reduce the psychological distance that people perceive when they think about this issue. Support for this idea comes from a study that explored how people perceived climate change relative to several dimensions of psychological distance. Concern about climate change increased if people were more certain it was happening, expected it to show effects sooner, and thought it was affecting their local area and people similar to themselves[28]. However, the same study found a counter-intuitive relationship between reported psychological distance and people's motivation to act: people who thought of climate change as a distant threat were more motivated to act[28]. Findings from experiments where only psychological distance is varied

and everything else is held constant also fail to consistently reveal the expected positive effects of proximising. Of the three experimental studies we are aware of, two directly compared the effects of relatively proximal and distant descriptions of climate change (texts describing regional vs. national climate change trends[24]; texts, maps, and photographs illustrating potential flooding caused by sea-level rise either with reference to the UK city where the study was conducted or with reference to continental Europe[52]). However, these studies did not find the expected positive effects of proximising on increased individual support for addressing climate change[24,52]. A third study provided members of the general public with information posters describing either one broad global impact of climate change (sea levels rising) or a local impact specific to the area they lived in (one of the following three: forest fires, beetle infestation, rising sea levels). When climate change was described in proximal terms, it increased participants' willingness to address climate change relative to a control condition in which no information was provided[25]. In contrast, people's engagement with climate change did not differ between the globally framed poster and the control condition. Because this study did not directly compare the proximal and distant frames, it is not possible to draw any conclusions about specific advantages of describing climate change in proximal terms relative to a more distant framing.

In sum, there is some evidence suggesting that people are more concerned about climate change and more willing to take action when they have experienced extreme weather-related events or changes, and when they perceive climate change as psychologically proximal. However, attempts to capitalise on these interrelations have so far not consistently revealed the hypothesised effects on people's readiness to engage with climate change. The missing effects of such proximising may, at first glance, seem counter-intuitive theoretically, as well as disappointing practically. However, on closer inspection it becomes obvious that there is more complexity to how people engage with climate change than is commonly assumed–for example, as exemplified by the finding that the motivational effects of personal

experiences are contingent on people attributing these to climate change, something which cannot be taken for granted.

The next sections delve deeper into this complexity by applying three theoretical perspectives to the idea of proximising. We show that, depending on the particular theoretical perspective one takes to this issue, and on specific individual characteristics suggested by these perspectives, proximising can bring about the intended positive effects, can have no (visible) effect, or can even backfire.

Information for decision-making

The first theoretical perspective that can help to understand why proximising may not directly increase individuals' willingness to act on climate change is construal level theory[53]. In contrast to the underlying rationale of the proximising strategy, this theoretical perspective does not suggest that thinking about an object or event as proximal rather than distant necessarily increases personal relevance – provided that the event or decision projected into the distance will still somehow and sometime become relevant to the individual[54,55]. Instead, construal level theory argues that varying levels of psychological distance (e.g., here vs. far away, now vs. in 10 years) influence how people represent objects and events mentally and what information they consider when making decisions[53]. Importantly, this does not mean that whether people think of climate change as a proximal or distant issue is irrelevant. Distance does play a role in how people relate to climate change and possible responses – but from the perspective of construal level theory the influence of perceived distance is more complex than suggested by the rationale behind proximising.

Construal level theory is based on the assumption that humans can only directly experience the present situation, and that everything else needs to be mentally construed. To illustrate, directly experiencing a heat wave could mean standing in a crowded bus, being aware of the stale air, and feeling the sweat trickling down one's body. Experiencing a bus

ride like this offers a lot of context-specific information, including sensory reactions. In sum, the present situation is rich in details and involves little or no mental construal. In contrast, the anticipation of a heat wave in the future does not offer any context-specific information and does not create sensory reactions. In this case, it is necessary to mentally construe what experiencing a heat wave might look and feel like. The further away an object or event is from a person's present situation, the more effort is necessary to construe it, and the more abstract and generalised the resulting mental representation will be. In simpler terms, this means that when people think of an object or event as close versus distant, they form different mental representations of it.

An important function of psychological distance is that this influences what information people preferentially attend to when they think about (i.e., construe) an object or event, and when they make decisions in relation to these. For example, people who think about a policy that is to be implemented in the near future tend to consider concrete circumstantial information such as other people's opinions when they evaluate that policy. In contrast, people who expect the same policy to be implemented in the more distant future base their evaluation on more abstract considerations like their values, which are commonly regarded as broad orientations that are relatively stable across time and different situations[54]. The same pattern can also be found with regard to behavioural intentions: When intentions are represented in the near future, considerations about how convenient the behaviour is (i.e., concrete, situation-specific information) better predicts intentions, whereas personal values (i.e., more abstract and generalised information) are better at predicting intentions in the distant future[56]. In other words, construal level theory predicts that thinking about proximal versus distant climate change should interact with other things (e.g., concrete and situation-specific vs. abstract and generalised information) to determine individual responses.

Relating this line of research to the context of climate change implies that proximising can have a variety of effects, depending on what information is routinely called upon when

people make decisions that affect the environment. Importantly, working from this perspective, there are a number of reasons why proximising might actually have negative consequences for action[57]. First, the focal outcomes that motivate people when they think about climate change mitigation or adaptation generally correspond to their broader values and goals (e.g., caring about others and the natural environment)[58]. Following the above analysis, people who hold such values will act more in line with them when they think of climate change as a distant issue and think about it in abstract terms. In other words, for people who hold altruistic and biospheric values, proximising should decrease the tendency to act on climate change because it draws their attention away from their values.

Second, when people are led to think about proximal climate change, they will focus more on situation-specific and concrete aspects of possible decisions, for example the relative costs and benefits of action or inaction[57]. Shifting people's focus to these aspects is problematic because many of the concrete steps people can take to respond to climate change involve real and figurative (e.g., inconvenience, physical effort) costs[3,59] but relatively few direct or concrete benefits. In other words, if a focus on proximal climate increases the salience of costs and inconveniences of mitigation and adaptation options by comparison to benefits or conveniences, then proximising may decrease the likelihood of people taking such steps[57].

Taken together, this line of thinking offers two important insights that researchers and communicators should take notice of. First, reducing the psychological distance of climate change should not have a direct effect on people's overall willingness to act on climate change per se. Instead, and second, variations in distance framing should influence what kind of information people consider when they make decisions about possible steps to respond to climate change. Thus, the effect of proximising should depend on the information that is typically relevant when people with a proximal perspective make decisions (i.e., concrete and situation-specific information such as whether the steps are inconvenient).

From local residents to global citizens

The second line of reasoning suggests that proximising can under some circumstances be an effective strategy to increase action on climate change. More specifically, if an individual cares about a proximal place, messages that make threats to the place in question salient are likely to increase personal relevance and concern. However, it cannot be taken for granted that people care about proximal places and the things that constitute them. Reciprocally, it cannot be taken for granted that people do not care about distant places and things, and would not take action on behalf of these.

This becomes obvious, for example, when looking at research into how much people care about different places[60]. This research stems from Environmental and Social Psychology, but also cognate disciplines such as Human Geography, Sociology, and Anthropology. It shows that one person may, for example, have strong local roots and be extremely attached to his neighbourhood or town while being indifferent to regional, national, or international concerns. At the other extreme, a second person might travel the world a lot and see herself as a global citizen; this second person would be more likely to feel attached to places at larger scales such as a continent or even to the planet as a whole[31]. A third person may feel attached to multiple places at various spatial scales[61], whereas a fourth person may feel detached at all scales[62].

Thus, depending on how people relate to places at different spatial scales (e.g., neighbourhood, town, region, country, continent, earth), messages with different spatial foci will be more or less relevant to them. A person who is predominantly attached to local places will be more concerned about local (i.e., proximal) consequences and more willing to protect those places[63,64]. In contrast, a person who feels attached to the whole planet might be more concerned about what happens globally rather than more proximally[31]. And while a person who feels attached to multiple places will be concerned about each of these, a person without

any place attachments will never be particularly concerned about what happens to a specific place.

A finer-grained analysis of what a place can mean to a person reveals a similar pattern: People care to different extents about the things that constitute a place. For example, some people appreciate the natural environment of a specific place and are interested in maintaining its integrity[65,66]. People may also differ in terms of how strongly they like a place because they put different values to its symbolic meanings (e.g., its historical or religious importance)[64]. Last but not least, different degrees of fondness for a place may also vary as a function of how strongly individuals identify and feel connected with people who live in that place.

To summarize, research by psychologists as well as other social science disciplines has shown that people vary in terms of how strongly they feel attached to places and their constituents at different spatial scales. In terms of the proximising strategy, this implies that the effectiveness of this strategy depends on how closely the entities being threatened by proximal climate change correspond to what people care about. That is, the more one is attached to a specific proximal place as a whole[60], and the more this place includes natural elements[65,66], symbolic meanings[64], and people one cares about and identifies with[67,68], the more likely one is to become concerned about and respond to a message that conveys a threat to these cherished things[63,64]. By contrast, people who do not relate in any way to a place being referred to will most likely remain unaffected by proximised messages.

This second perspective challenges the expectation that bringing climate change physically closer always translates into more concern and more action. According to this perspective, proximising can in principle increase the extent to which people are concerned and willing to take action. But this effect should only occur when people care in one way or another about the proximal place.

Reacting to threats

The previous section argued that proximised climate change messages should only increase levels of concern and the motivation to act if the place in question is important to people. Somewhat paradoxically, a third line of reasoning suggests that messages could fail to increase people's motivation to act on climate change exactly when these messages are personally relevant. Different lines of research within psychology suggest that threatening information can be overwhelming when it is made personally relevant. This feeling of being overwhelmed can then trigger defensive reactions – which are helpful to reduce negative feelings but do not reduce the threat itself[11,69,70].

There are several arguments that support the idea that climate change may be perceived as a potentially overwhelming threat. First of all, even though some positive consequences of climate change are expected (e.g., increased agricultural yields in northern latitudes), globally and on the whole, negative consequences are likely to significantly outweigh any positive benefits. This view is not only presented in scientific reports[71,72] but also in news coverage of climate change[73,74]. This negative view is amplified by frequent portrayals of climate change as an impending catastrophe[73,74]. More importantly, the conception of climate change as a negative issue corresponds with the typically negative associations and feelings individuals report with regard to climate change[6,7,17]. This negative connotation of climate change implies that proximising this issue increases the salience of possible threats to the place in question (including everything that constitutes this place). To the extent that people care about at least some things or people that are threatened by proximal climate change, proximising seems to be an effective strategy to make people realize that these things are at stake. Evidently, this realisation will most likely conflict with what people also desire, for instance to know that they, their friends and family members, their homes and possessions are safe, and evoke a state of aversive arousal[69,70].

So far, this analysis is consistent with the rationale underlying the proximising approach: to increase action via higher levels of (emotional) concern[16,22,27,28].While people may indeed change their behaviours when confronted with a threat, however, there are several reasons why they may respond to climate change in ways other than increased efforts to mitigate and adapt. For example, individuals may not always be clear about what they can do to effectively mitigate climate change[75,76]. As a consequence, they may decide not to act at all[11]. Further, people may not believe their actions can make a difference[3,59], or may find that the required actions and changes are too difficult[59,77,78]. Thus, if people have insufficient confidence in the effectiveness of possible responses or their personal ability to act, behaviour change is unlikely[11,12,79,80]. In this case, people need to employ other strategies to deal with the unpleasant feelings that proximal climate change entails[11,69,70].

One solution would be to change one's existing expectations and desires[70]. For example, to stop caring about one's own safety or the safety of close others would resolve the conflict between safety concerns and knowing that climate change may adversely affect these important referents. However, because people are typically motivated to retain their existing beliefs[81], and because safety concerns for self and close others are a strong motivational forces, using strategies to defend their beliefs is more likely than abandoning or revising them. For instance, people may intentionally avoid threatening information about climate change[82] or avoid making inferences about its personal relevance[83]. Another strategy that people may use to deal with threatening messages is to question or even reject them[70,81] (i.e., they may adopt sceptical beliefs about climate change; see for example ref. [84]).

Last but not least, when people see climate change action as undesirable or when they feel that they are not able to mitigate or to adapt, they may deny responsibility for causing climate change (e.g., "My contribution to climate change is miniscule") or for acting on climate change (e.g., "It's up to large companies and governments to act")[85]. Importantly, defensive reactions to climate change are not mere assumptions derived from related fields of

research. There is empirical evidence suggesting that people use these strategies when they are confronted with threatening information about climate change[3,6,84,86–88]. In other words, it is suggested here that the use of proximising as a strategy may exacerbate existing tendencies to use these defensive strategies among people who care about the things, people or places threatened by proximal climate change.

Note that negative physical consequences to things people care about (e.g., the integrity of the natural environment or the safety of friends) are not the only way in which proximal climate change can threaten people and trigger defensive reactions. Climate change may also threaten psychological resources such as a positive self-view and the desire for stability. The implications for people's self-view may not be obvious at first. But consider, for example, that the contribution of individuals' actions to climate change and their potential role in mitigating climate change is emphasized in campaigns, media coverage, and even in films (e.g., "An Inconvenient Truth"). It can therefore be assumed that people are aware that their own past and current behaviour contributes to the negative consequences threatening their proximal environment. Sharing responsibility for causing harm implies that one is an irresponsible, uncaring, and morally questionable person[89,90]. These implications may not only lead to unpleasant feelings such as guilt[80,91], they also conflict with people's desire to maintain a positive self-view[92].

Related to this, proximising climate change implies increased pressure for individuals to take personal actions. However, many responses to climate change may be interpreted as sacrifices and displeasing changes from individuals (e.g., lifestyle changes such as reducing the consumption of goods or spending holidays at home rather than at remote destinations[3,59]). Moreover, and maybe even more importantly, changing the practices and habits that cause greenhouse gas emissions is also difficult[59] (see also ref. [77]), and something that people feel is beyond their individual capacity[3]. Thus, sticking to one's routines and habits is more

appealing than taking on difficult and inconvenient lifestyle changes and less problematic for the self than acknowledging the harmful consequences of one's actions[89,90].

Defensiveness around one's self and one's choices is not only relevant when it comes to the personal self. Many people exhibit a similar defensiveness and reluctance to change with regard to the place[93,94], the social group[90], and the society[95] they are part of. People are generally attached to the socioeconomic status quo and motivated to justify and maintain it, a tendency that becomes stronger when people are faced with a threat[88,95]. It is therefore likely that focusing on the negative consequences of proximal climate change, and one's own role in producing these[90], will also bolster the tendency to adhere to the status quo and to reject appeals for change. This tendency might be further stimulated when one's socioeconomic system is being criticised for its role in causing climate change[88], for assuming (co-) responsibility for the adverse effects of climate change would be difficult to reconcile with the view of one's system as just, fair, and beneficial[88].

Thus, climate change can also pose a psychological threat[96], for example in the form of guilt[80,91], image threats to oneself[92], to one's social group[90], and to one's socioeconomic system[88,95]. Similar to physical threats from climate change, these psychological threats are likely to cause discomfort and to trigger coping strategies intended to reduce negative feelings[69,70]. These coping strategies can in principle be "corrective" in nature, that is, they can lead people to make amends for what they feel guilty for,[91,97] or to change the aspects of the self[98] or one's social group[90] that are causing the discomfort. However, various preconditions need to be met for these corrective responses to kick in (e.g., people need to assume responsibility[90,98,99], be aware of response options[75,76] and believe in their efficacy[3,11,59]). Moreover, the difficulties and inconveniences associated with the steps required to tackle climate change[3,59,77] suggest that embracing steps to deal with it will not necessarily be the preferred reaction of most people who receive proximised climate change messages. In essence, this means that the threats proximising poses to psychological

resources[69] may also trigger defensive strategies such as avoiding information about climate change or denying its relevance[87].

In sum, this third perspective suggests that focusing on proximal climate change increases the saliency of negative consequences for a specific place. To the extent that one cares about the place in question, or about the people who are implicated by that place, the outlook of negative impacts will elicit a state of aversive arousal[69,70]. Because this aversive arousal is unpleasant, people are motivated to reduce it[69,70]. In line with the rationale underlying the proximising approach[16,22,27,28], people would ideally respond with increased mitigation and adaptation efforts and thereby tackle the threat itself. However, because people may see the changes required from them as ineffective, inconvenient, or too demanding[3,59], they may turn to other strategies that effectively reduce unpleasant feelings[11,69,70] but do not contribute to alleviating the negative consequences of climate change.

Thus, somewhat paradoxically, when people realise that climate change threatens things they care about, instead of taking measures to protect these things, they may alternatively ignore the threat and risk losing what they hold dear. In other words, increasing the personal relevance of climate change by highlighting its proximal consequences can backfire.

Close to home

Despite being a plausible and common sense approach to increase individuals' motivation to act on climate change[57], bringing climate change closer psychologically has so far not lived up to expectations[24,52]. Clearly, more research is needed in this area to form a coherent picture of the consequences of proximising climate change. However, in the absence of further empirical tests – and as a framework for stimulating these – we offer three theoretical perspectives as possible explanations for why this strategy may fall short of its promise.

First, rather than directly affecting people's motivation to act, proximising changes how people mentally represent climate change and what information they base their decisions on. Second, proximising only works if the places and things (encompassing people, flora, fauna, and symbolic meanings) at risk from proximal climate change mean something to people – a precondition that cannot be taken for granted. Third, even if the things that are at risk from proximal climate change mean something to people, proximising will only increase action on climate change if people think of possible actions as acceptable, feasible, and effective.

The key lesson to be learned from these perspectives is simple: proximising climate change is complex. Focussing on proximal climate change is likely to trigger various psychological processes that are expected to interact with people's existing thoughts, beliefs, and preferences. At best, proximising will be successful in encouraging people to take steps to mitigate or adapt to climate change. At worst, this strategy will lead to defensive reactions such as increased scepticism about the reality and relevance of climate change. In between these options, it is also possible that proximising will change the frame of reference through which people think about climate change, but with no consequence for their level of action – thus rendering this strategy inert.

Despite these possibly undesired outcomes, our analysis is not suggesting that researchers and communicators should abandon the idea of motivating action through proximising climate change. Each one of the three perspectives presented above suggests that under some circumstances the proximising strategy can be an effective tool to increase action on climate change. However, to effectively employ this strategy, its complexity must be acknowledged and more research efforts need to be undertaken to better understand the individual and situational factors that facilitate and impede the success of the proximising approach.

In this sense, we hope that our reflections will contribute to more differentiated – and thereby more realistic – expectations about how proximising affects people's motivation to act on climate change. This, in turn, should not only open promising avenues for future research but also help to avoid disappointment about unsuccessful research projects and ineffective interventions.

Additional information

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Author contributions

A.B. wrote the first draft of the paper. All authors commented on the paper and participated in the process of refinement of the paper in response to the peer reviews.

Competing financial interests

The authors declare no competing financial interests.

References

1. Bord, R. J., Fisher, A. & O'Connor, R. E. Public perceptions of global warming: United States and international perspectives. Clim. Res. **11,** 75–84 (1998).
2. Lorenzoni, I., Leiserowitz, A., De Franca Doria, M., Poortinga, W. & Pidgeon, N. F. Cross-national comparisons of image associations with 'global warming' and 'climate change' among laypeople in the United States of America and Great Britain. J. Risk Res. **9,** 265–281 (2006).
3. Lorenzoni, I., Nicholson-Cole, S. & Whitmarsh, L. Barriers perceived to engaging with climate change among the UK public and their policy implications. Glob. Environ. Change **17,** 445–459 (2007).
4. Lorenzoni, I. & Pidgeon, N. F. Public views on climate change: European and USA perspectives. Clim. Change **77,** 73–95 (2006).
5. Milfont, T. L. in Psychological approaches to sustainability: Current trends in theory, research and practice (eds. Corral-Verdugo, V., García-Cadena, C. H. & Frías-Arment, M.) 19–42 (Nova Science, 2010).
6. O'Neill, S. & Nicholson-Cole, S. 'Fear won't do it': Promoting positive engagement with climate change through visual and iconic representations. Sci. Commun. **30,** 355–379 (2009).
7. Leiserowitz, A. Climate change risk perception and policy preferences: The role of affect, imagery, and values. Clim. Change **77,** 45–72 (2006).
8. The World Bank. Public attitudes toward climate change: Findings from a multi-country poll. (2009). at http://siteresources.worldbank.org/INTWDR2010/Resources/Background-report.pdf
9. Floyd, D. L., Prentice-Dunn, S. & Rogers, R. W. A meta-analysis of research on protection motivation theory. J. Appl. Soc. Psychol. **30,** 407–429 (2000).
10. Zaalberg, R., Midden, C. J. H., Meijnders, A. & McCalley, T. Prevention, adaptation, and threat denial: Flooding experiences in the Netherlands. Risk Anal. **29,** 1759–1778 (2009).
11. Witte, K. & Allen, M. A meta-analysis of fear appeals: Implications for effective public health campaigns. Health Educ. Behav. **27,** 591 –615 (2000).
12. Brody, S. D., Grover, H. & Vedlitz, A. Examining the willingness of Americans to alter behaviour to mitigate climate change. Clim. Policy **12,** 1–22 (2012).
13. Brügger, A., Morton, T. A. & Dessai, S. Hand in hand: Public endorsement of climate change mitigation and adaptation. PLoS ONE **10,** e0124843 (2015).
14. Dietz, T., Dan, A. & Shwom, R. Support for climate change policy: Social psychological

and social structural influences. Rural Sociol. **72,** 185–214 (2007).

15. Nicholson-Cole, S. Representing climate change futures: A critique on the use of images for visual communication. Comput. Environ. Urban Syst. **29,** 255–273 (2005).
16. Weber, E. U. Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). Clim. Change **77,** 103–120 (2006).
17. Leviston, Z., Price, J. & Bishop, B. Imagining climate change: The role of implicit associations and affective psychological distancing in climate change responses. Eur. J. Soc. Psychol. **44,** 441–454 (2014).
18. Moser, S. C. Communicating climate change: History, challenges, process and future directions. Wiley Interdiscip. Rev. Clim. Change **1,** 31–53 (2010).
19. Hulme, M. Geographical work at the boundaries of climate change. Trans. Inst. Br. Geogr. **33,** 5–11 (2008).
20. Kerr, R. A. Amid worrisome signs of warming, 'climate fatigue' sets in. Science **326,** 926–928 (2009).
21. Cap, P. Proximization: The pragmatics of symbolic distance crossing. **232,** (John Benjamins Publishing Company, 2013).
22. Evans, L., Milfont, T. L. & Lawrence, J. Considering local adaptation increases willingness to mitigate. Glob. Environ. Change **25,** 69–75 (2014).
23. Ebi, K. L. & Semenza, J. C. Community-based adaptation to the health impacts of climate change. Am. J. Prev. Med. **35,** 501–507 (2008).
24. Shwom, R., Dan, A. & Dietz, T. The effects of information and state of residence on climate change policy preferences. Clim. Change **90,** 343–358 (2008).
25. Scannell, L. & Gifford, R. Personally relevant climate change: The role of place attachment and local versus global message framing in engagement. Environ. Behav. **45,** 60–85 (2013).
26. Spence, A., Poortinga, W., Butler, C. & Pidgeon, N. F. Perceptions of climate change and willingness to save energy related to flood experience. Nat. Clim. Change **1,** 46–49 (2011).
27. Reser, J. P., Bradley, G. L. & Ellul, M. C. Encountering climate change: 'Seeing' is more than 'believing'. Wiley Interdiscip. Rev. Clim. Change **5,** 521–537 (2014).
28. Spence, A., Poortinga, W. & Pidgeon, N. F. The psychological distance of climate change. Risk Anal. **32,** 957–972 (2012).
29. Frederick, S., Loewenstein, G. & O'Donoghue, T. Time discounting and time preference: A critical review. J. Econ. Lit. **40,** 351–401 (2002).
30. Hardisty, D. J. & Weber, E. U. Discounting future green: Money versus the environment.

J. Exp. Psychol. Gen. **138,** 329–340 (2009).
31. Devine-Wright, P. Think global, act local? The relevance of place attachments and place identities in a climate changed world. Glob. Environ. Change **23,** 61–69 (2013).
32. Hulme, M., Dessai, S., Lorenzoni, I. & Nelson, D. R. Unstable climates: Exploring the statistical and social constructions of 'normal' climate. Geoforum **40,** 197–206 (2009).
33. Weber, E. U. What shapes perceptions of climate change? Wiley Interdiscip. Rev. Clim. Change **1,** 332–342 (2010).
34. Lujala, P., Lein, H. & Rød, J. K. Climate change, natural hazards, and risk perception: The role of proximity and personal experience. Local Environ. **20,** 489–509 (2015).
35. Taylor, A., de Bruin, W. B. & Dessai, S. Climate change beliefs and perceptions of weather-related changes in the United Kingdom. Risk Anal. **34,** 1995–2004 (2014).
36. Van der Linden, S. On the relationship between personal experience, affect and risk perception: The case of climate change. Eur. J. Soc. Psychol. **44,** 430–440 (2014).
37. Dessai, S. & Sims, C. Public perception of drought and climate change in southeast England. Environ. Hazards **9,** 340–357 (2010).
38. 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).
39. Hamilton, L. C. & Keim, B. D. Regional variation in perceptions about climate change. Int. J. Climatol. **29,** 2348–2352 (2009).
40. Myers, T. A., Maibach, E. W., Roser-Renouf, C., Akerlof, K. & Leiserowitz, A. A. The relationship between personal experience and belief in the reality of global warming. Nat. Clim. Change **3,** 343–347 (2013).
41. Reser, J. P., Bradley, G. L., Glendon, A. I., Elul, M. C. & Callaghan, R. Public risk perceptions, understandings and responses to climate change and natural disasters in Australia: 2010-2011. (National Climate Change Adaptation Research Facility, 2012). at http://www.nccarf.edu.au/publications/public-risk-perceptions-second-survey
42. Reser, J. P., Bradley, G. L., Glendon, A. I., Elul, M. C. & Callaghan, R. Public risk perceptions, understandings and responses to climate change in Australia and Great Britain. (National Climate Change Adaptation Research Facility, 2012). at http://www.nccarf.edu.au/publications/public-risk-perceptions-final
43. Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y. & Neuman, A. Do people 'personally experience' global warming, and if so how, and does it matter? Glob. Environ. Change **23,** 81–91 (2013).
44. Blennow, K., Persson, J., Tomé, M. & Hanewinkel, M. Climate change: Believing and

seeing implies adapting. PLoS ONE **7,** e50182 (2012).

45. McCright, A. M., Dunlap, R. E. & Xiao, C. The impacts of temperature anomalies and political orientation on perceived winter warming. Nat. Clim. Change **4,** 1077–1081 (2014).
46. Capstick, S. B. & Pidgeon, N. F. Public perception of cold weather events as evidence for and against climate change. Clim. Change **122,** 695–708 (2014).
47. Zehr, S. The sociology of global climate change. Wiley Interdiscip. Rev. Clim. Change **6,** 129–150 (2015).
48. Risen, J. L. & Critcher, C. R. Visceral fit: While in a visceral state, associated states of the world seem more likely. J. Pers. Soc. Psychol. **100,** 777–793 (2011).
49. Lewandowski, G. W. J., Ciarocco, N. J. & Gately, E. L. The effect of embodied temperature on perceptions of global warming. Curr. Psychol. **31,** 318–324 (2012).
50. Joireman, J., Truelove, H. B. & Duell, B. Effect of outdoor temperature, heat primes and anchoring on belief in global warming. J. Environ. Psychol. **30,** 358–367 (2010).
51. Zaval, L., Keenan, E. A., Johnson, E. J. & Weber, E. U. How warm days increase belief in global warming. Nat. Clim. Change **4,** 143–147 (2014).
52. Spence, A. & Pidgeon, N. F. Framing and communicating climate change: The effects of distance and outcome frame manipulations. Glob. Environ. Change **20,** 656–667 (2010).
53. Trope, Y. & Liberman, N. Construal-level theory of psychological distance. Psychol. Rev. **117,** 440–463 (2010).
54. Ledgerwood, A., Trope, Y. & Chaiken, S. Flexibility now, consistency later: Psychological distance and construal shape evaluative responding. J. Pers. Soc. Psychol. **99,** 32–51 (2010).
55. Ledgerwood, A., Wakslak, C. J. & Wang, M. A. Differential information use for near and distant decisions. J. Exp. Soc. Psychol. **46,** 638–642 (2010).
56. Eyal, T., Sagristano, M. D., Trope, Y., Liberman, N. & Chaiken, S. When values matter: Expressing values in behavioral intentions for the near vs. distant future. J. Exp. Soc. Psychol. **45,** 35–43 (2009).
57. Fujita, K., Clark, S. L. & Freitas, A. L. in Encouraging sustainable behavior: Psychology and the environment (ed. van Trijp, H. C. M.) 81–100 (Psychology Press, 2014).
58. Corner, A., Markowitz, E. & Pidgeon, N. F. Public engagement with climate change: The role of human values. Wiley Interdiscip. Rev. Clim. Change **5,** 411–422 (2014).
59. Gifford, R. The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. Am. Psychol. **66,** 290–302 (2011).
60. Altman, I. & Low, S. M. Place attachment. (Plenum Press, 1992).

61. Devine-Wright, P., Price, J. & Leviston, Z. My country or my planet? Exploring the influence of multiple place attachments and ideological beliefs upon climate change attitudes and opinions. Glob. Environ. Change **30,** 68–79 (2015).
62. Lewicka, M. On the varieties of people's relationships with places Hummon's typology revisited. Environ. Behav. **43,** 676–709 (2011).
63. Devine-Wright, P. & Howes, Y. Disruption to place attachment and the protection of restorative environments: A wind energy case study. J. Environ. Psychol. **30,** 271–280 (2010).
64. Scannell, L. & Gifford, R. Defining place attachment: A tripartite organizing framework. J. Environ. Psychol. **30,** 1–10 (2010).
65. Brügger, A., Kaiser, F. G. & Roczen, N. One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. Eur. Psychol. **16,** 324–333 (2011).
66. Hartig, T., Kaiser, F. G. & Bowler, P. A. Psychological restoration in nature as a positive motivation for ecological behavior. Environ. Behav. **33,** 590–607 (2001).
67. Buchan, N. R. et al. Global social identity and global cooperation. Psychol. Sci. **22,** 821–828 (2011).
68. Tu, L., Khare, A. & Zhang, Y. A short 8-item scale for measuring consumers' local-global identity. Int. J. Res. Mark. **29,** 35–42 (2012).
69. Jonas, E. et al. in Advances in Experimental Social Psychology (ed. James M. Olson and Mark P. Zanna) **49,** 219–286 (Academic Press, 2014).
70. Proulx, T., Inzlicht, M. & Harmon-Jones, E. Understanding all inconsistency compensation as a palliative response to violated expectations. Trends Cogn. Sci. **16,** 285–291 (2012).
71. IPCC. Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of working group II to the fifth assessment report of the Intergovernmental Panel on Climate Change. (Cambridge University Press, 2014).
72. IPCC. Climate change 2014: Impacts, adaptation, and vulnerability. Part B: Regional aspects. Contribution of working group II to the fifth assessment report of the Intergovernmental Panel on Climate Change. (Cambridge University Press, 2014).
73. Doulton, H. & Brown, K. Ten years to prevent catastrophe?: Discourses of climate change and international development in the UK press. Glob. Environ. Change **19,** 191–202 (2009).
74. Boykoff, M. T. The cultural politics of climate change discourse in UK tabloids. Polit. Geogr. **27,** 549–569 (2008).

75. Truelove, H. B. & Parks, C. Perceptions of behaviors that cause and mitigate global warming and intentions to perform these behaviors. J. Environ. Psychol. **32,** 246–259 (2012).
76. Whitmarsh, L. Behavioural responses to climate change: Asymmetry of intentions and impacts. J. Environ. Psychol. **29,** 13–23 (2009).
77. Maio, G. R. et al. Social psychological factors in lifestyle change and their relevance to policy. Soc. Issues Policy Rev. **1,** 99–137 (2007).
78. Marshall, N. A., Fenton, D. M., Marshall, P. A. & Sutton, S. G. How resource dependency can influence social resilience within a primary resource industry. Rural Sociol. **72,** 359–390 (2007).
79. 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. **40,** 72–95 (2008).
80. Moser, S. C. in Creating a climate for change: Communicating climate change and facilitating social change (eds. Moser, S. C. & Dilling, L.) 64–80 (Cambridge University Press, 2007).
81. Kunda, Z. The case for motivated reasoning. Psychol. Bull. **108,** 480–498 (1990).
82. Sweeny, K., Melnyk, D., Miller, W. & Shepperd, J. A. Information avoidance: Who, what, when, and why. Rev. Gen. Psychol. **14,** 340 (2010).
83. Good, A. & Abraham, C. Measuring defensive responses to threatening messages: A meta-analysis of measures. Health Psychol. Rev. **1,** 208–229 (2007).
84. Poortinga, W., Spence, A., Whitmarsh, L., Capstick, S. & Pidgeon, N. F. Uncertain climate: An investigation into public scepticism about anthropogenic climate change. Glob. Environ. Change **21,** 1015–1024 (2011).
85. Gosling, P., Denizeau, M. & Oberle, D. Denial of responsibility: A new mode of dissonance reduction. J. Pers. **90,** 722–733 (2006).
86. Shepherd, S. & Kay, A. C. On the perpetuation of ignorance: System dependence, system justification, and the motivated avoidance of sociopolitical information. J. Pers. Soc. Psychol. **102,** 264–280 (2012).
87. Feinberg, M. & Willer, R. Apocalypse soon? Dire messages reduce belief in global warming by contradicting just-world beliefs. Psychol. Sci. **22,** 34 –38 (2011).
88. Feygina, I., Jost, J. T. & Goldsmith, R. E. System justification, the denial of global warming, and the possibility of 'system-sanctioned change'. Pers. Soc. Psychol. Bull. **36,** 326–338 (2010).
89. Butler, C. Morality and climate change: Is leaving your TV on standby a risky behaviour?

Environ. Values **19,** 169–192 (2010).

90. Knowles, E. D., Lowery, B. S., Chow, R. M. & Unzueta, M. M. Deny, distance, or dismantle? How white Americans manage a privileged identity. Perspect. Psychol. Sci. **9,** 594–609 (2014).
91. Ferguson, M. A. & Branscombe, N. R. Collective guilt mediates the effect of beliefs about global warming on willingness to engage in mitigation behavior. J. Environ. Psychol. **30,** 135–142 (2010).
92. Steele, C. M. in Advances in Experimental Social Psychology (ed. Leonard Berkowitz) **21,** 261–302 (Academic Press, 1988).
93. Hugh-Jones, S. & Madill, A. The air's got to be far cleaner here: A discursive analysis of place-identity threat. Br. J. Soc. Psychol. **48,** 601–624 (2009).
94. Devine-Wright, P. Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action. J. Community Appl. Soc. Psychol. **19,** 426–441 (2009).
95. Jost, J. T. & Hunyady, O. Antecedents and consequences of system-justifying ideologies. Curr. Dir. Psychol. Sci. **14,** 260–265 (2005).
96. Weintrobe, S. Engaging with Climate Change: Psychoanalytic and Interdisciplinary Perspectives (Routledge, 2013)
97. O'Keefe, D. J. in The persuasion handbook: Developments in theory and practice (eds. Dillard, J. P. & Pfau, M.) (SAGE, 2002).
98. Sherman, D. K. & Cohen, G. L. in Advances in Experimental Social Psychology (ed. Zanna, M. P.) **38,** 183–242 (Academic Press, 2006).
99. Basil, D. Z., Ridgway, N. M. & Basil, M. D. Guilt appeals: The mediating effect of responsibility. Psychol. Mark. **23,** 1035–1054 (2006).