

Extreme weather experience and climate change opinion

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1 Extreme weather experience and climate change opinion

3 Abstract

4 Climate change continues to expose more of the global population to more frequent and
5 severe extreme weather events. Recent research shows that these changes in extreme weather
6 have not, as yet, consistently motivated changes in opinions about climate change or changes in
7 climate-related behavior. Extreme weather may reinforce opinions among people who are
8 already worried about climate change, yet be misattributed or misperceived by those who are
9 unconcerned. However, the characteristics and severity of personal experience may influence its
10 impacts on climate opinions. Future research should consider appropriate research designs, such
11 as matching or panel data, to disentangle the effects of experience from other factors, while also
12 respecting ethical considerations for research among disaster survivors. As the impacts of
13 climate change become increasingly evident at the local level, it becomes increasingly important
14 to understand how these experiences interact with other factors to shape mitigation and
15 adaptation decisions.

17 Keywords

18 Public perceptions; extreme weather; climate change; experience; opinion; beliefs

19 Highlights

- 20 • Experience with extreme weather does not consistently change climate change opinions
- 21 • Existing opinions shape the effect of experience on climate beliefs
- 22 • More severe personal experiences may prompt broader shifts in opinions
- 23 • Future research could benefit by using matched or panel data

Introduction

Ongoing human-caused climate change exposes more people to more frequent and more severe extreme weather events, including severe heat waves, wildfires, floods, and severe storms [1,2]. Shifts in the frequency and severity of these acute hazards are coupled with growing chronic hazards, such as long-term drought and sunny-day flooding caused by sea-level rise [2]. People are now living through local weather events that are outside the range of their previous experiences and will continue to do so as long as the global climate continues to warm [3]. What do these new experiences mean for our opinions about climate change, our support for addressing it, and our own behaviors? In this review, I focus on recent empirical research published since 2019 that explores the relationship between experiences with the impacts of climate change and climate-related opinion and behavior.

A growing body of literature in the environmental social sciences has focused on the links between experience, opinion, and behavior in the context of climate change. Previous reviews find some evidence that abnormal temperature and other extreme weather can shift climate opinion in some cases, although variation in research design across contexts and disciplinary perspectives has limited generalizability of these findings [4–9]. The questions of *if* and *how* experience with weather that is being pushed outside its historical range by human-caused climate change causes changes in beliefs and behaviors merit further investigation, both to clarify existing inconsistencies and for practical purposes to inform communication and policymaking. Experience with the effects of climate change may be an important part of a feedback that could amplify mitigation and adaptation behaviors or policy support [10]. Alternatively, if extreme weather does not motivate durable opinion change [11], this could threaten the potential for effective mitigation and adaptation if decision makers rely on public

support to be catalyzed by personal experience with climate impacts. Figure 1 illustrates these potential causal relationships and feedbacks addressed in this research area.

A major focus of past research has been on detecting any evidence for an association between extreme weather experience and climate-related opinion. However, some more recent studies have adopted a more comprehensive model to disentangle how experience interacts with other factors—including prior beliefs, contexts, and norms—as one type of information some people use to inform their climate change opinions and related behaviors [12–15]. For instance, people who are unconcerned about climate change may misattribute or misperceive their experience with extreme weather and consequently take inadequate measures to adapt to such risks at the household level or vote against climate policies [16,17].

In this brief review, I first summarize recent empirical evidence for an association between personal experience with extreme weather on climate-related opinions. I include studies that have addressed acute extreme weather events, such as floods, alongside those have focused on longer-term changes in weather conditions, like rising mean temperature. Next, I summarize evidence that illustrates a weak or non-existent relationship between climate opinions and extreme weather. I finally describe several recent studies that have focused on links between climate-related behavioral outcomes and extreme weather. I conclude by providing an overview of these recent findings and suggest future directions for research in this area.

Exposure to extreme weather as a driver of climate opinion change

Several studies published since 2019 have identified relationships between various metrics of exposure to extreme weather and measures of opinion about climate change. For example, among 12 Western European countries short-term differences in temperature at the country level were associated with differences in a six-item index of climate change risk

perceptions [18]. In the U.S. at the national scale, state-level concern about climate change was also moderately sensitive to changes in temperature [19]. Another U.S. study using eight years of nationally representative survey data provides evidence that at the individual level, people were more likely to report having directly experienced the effects of climate change after experiencing abnormally hot and dry weather over the past year in their immediate area [20]. Likewise, in New York there was some relationship between variation in local daily minimum temperature and perceived personal experience with climate change [21].

One study provides ostensibly counterintuitive results to these broad-scale findings: among survey respondents in Norway, self-reported personal experience with extreme weather events was related to decreased concern about climate change [22]. However, a possible pattern between the intensity of negative effects from extreme weather events and their relationship to climate opinion can also be found in some other recent studies. In another Norwegian study using different panel survey data, direct individual flooding experience at the household level was related to elevated climate concern, but there was no effect from indirect local experience of flooding [23]. Similarly, only self-reported direct personal harm from extreme weather events (including floods, wildfires, tornadoes, a hurricane, and a landslide) rather than indirect neighborhood-level impacts predicted increased support for climate policy across 10 U.S. communities [24].

Insensitivity of climate opinion to extreme weather

Counter to the studies described above, other recent papers have found little to no evidence for a relationship between experience with extreme weather and climate opinion. For example, across a large five-year survey in Australia there was no association between experiences with unusually high temperature at the postcode level and six different climate

change opinion items, and a small association between experience with decreased precipitation and a subset of four climate opinion items [25]. Similarly, an analysis of a large US election survey dataset from 2016 found no relationship between a four-item index of climate change concern and extreme heat, extreme precipitation, or drought at the congressional district level [26]. Across six other US national surveys there was also no effect of climate extremes—measured in a regional-level index combining temperature, drought, precipitation, and tropical storms—on belief that global warming is affecting weather in the US [27]. In the UK, self-reported direct personal experience with flooding was only associated with climate change risk perceptions among those who attributed the flooding to climate change [13].

Other studies at finer geographic scales have also found little to no direct effect of extreme weather experience on climate-related opinions. In communities affected by flooding in the US state of Colorado there was no relationship between climate change opinions and self-reported flood damage or geographic location in a flooded area [28]. In Florida, geographic variation in trends in temperature and precipitation had no relationship with variation in climate change opinions [29].

Extreme weather and climate-related behavior

A growing trend in recent scholarship has focused on relationships between experiences of climate change and behavioral outcomes. Whereas many previous studies use outcomes of stated climate change opinions in surveys, a focus on behavioral measures may help to resolve some of the inconsistencies found among previous efforts. For example, one recent study showed that votes for climate-related ballot measures in California were associated with proximity to a recent wildfire, an effect that diverged between Democratic-leaning areas (where it was strongest) and Republican-leaning areas (where it was nearly nonexistent) [17]. A similar pattern

was reported in another study focused on the decisions of US state legislators to sponsor climate policy-related bills, which found an association between bill sponsorship and local temperature anomalies only among Democratic and not Republican legislators [30]. Such research using direct behavioral outcomes supports previous findings from survey research that have identified a motivated reasoning or biased assimilation effect in how the experience of extreme weather events shapes climate opinions [13,16]. Likewise, partisan polarization was apparent in another recent case study across 15 US communities that found that experiencing an extreme weather event had little relationship to community engagement or discussion about climate change, as measured by content analysis of local media and local stakeholder interviews; where such a relationship existed, it was in primarily Democratic and highly educated communities [31,32]. Little generalizable direct effect of extreme weather experience has also been shown in a recent meta-analysis of adaptation-related behavior [14], or, regarding mitigation, in a recent study of short-term temperatures on pro-environmental behavior [33].

Broad-scale studies of news media and social media content are a related method for understanding how extreme weather influences behavioral outcomes such as coverage decisions or public discussion. For example, an analysis of a large dataset of news articles in 28 EU countries from 2014-2019 found that media coverage about climate change was strongly influenced by short-term country-level temperature anomalies, especially when anomalies were extreme relative to a recent rather than historical base period [34]. Similarly, on social media, an analysis of Twitter posts in Spain related to climate change showed strong relationships with extreme temperatures [35]. Another analysis of US Twitter posts showed that unusual temperatures may prompt short-term changes in public discussion about weather and climate, but

discussion quickly adjusts such that previously unusual weather no longer elicits increased discussion—a phenomenon that suggests acclimatization to changing weather extremes [11].

Conclusions and future research directions

The pattern of inconsistent findings on the relationship between climate change opinions and behaviors and weather extremes identified in previous reviews [4,7] has continued in recent work. Some of these differences are likely attributable to varying question wording, types of extreme weather measured, differences between self-reported and objective metrics of experience, population characteristics, and interactions with prior climate beliefs [4].

However, the generally mixed results on the relationship between extreme weather experience and climate-related opinion or behavior do suggest some broad trends and directions for future research. Most importantly, there is growing evidence against the hypothesis that experience with more extreme weather has so far caused people previously unconcerned about climate change to become concerned, support mitigation and adaptation policy, and change their own behavior. Rather, extreme weather has tended to reinforce opinions and behaviors among people who are already concerned about climate change. This evidence, however, may not necessarily be extrapolated to future extreme weather experiences, which will be more severe and widespread across the population under most future climate scenarios [2,36]. Coupled with an asymmetry of effect due to existing polarization over climate change is some evidence that severe personal experience with extreme weather events may change opinions even in those predisposed to be less concerned about climate change [23,24]; the *intensity* and *type* of extreme weather experience seems to matter in how it relates to climate change opinions [23]. This finding has possible implications for one common research design of related studies that use large representative survey datasets. These studies have been typically unlikely, in any one cross-

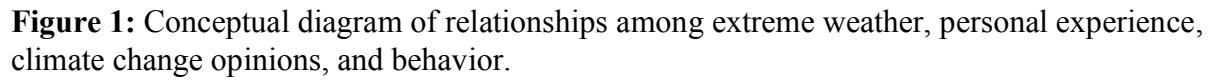
sectional representative sample, to include many respondents who have had severe direct negative experiences from extreme weather events, such as property damage or health effects. The number of people who have had recent severe experience—such as major property damage or personal or family injury from flooding, wildfire, drought, storms, or heat—is relatively low as a proportion of total national or state-level population in the countries where most existing research has been conducted. Furthermore, people who have experienced substantial harm from an extreme event, such as those who have just lost a home in a wildfire, may be under-sampled in commonly-used methods such as mail surveys and web panels because the disaster’s impact itself is likely to increase nonresponse and present ethical considerations associated with research with disaster survivors [37–39]. Keeping in mind these considerations, researchers could overcome some limitations with existing datasets by developing purpose-driven data collection efforts, such as longitudinal panel surveys (e.g. [40]). Another promising technique would be to use matched samples that directly compare climate opinions among those with previous direct extreme event experience to similar individuals who lack such experience. Such methods should also account for previously identified issues related to spatial dependence in extreme weather phenomena that can limit causal inference from cross-sectional survey data [4].

In addition to these methodological considerations, future research would benefit by explicitly stating hypotheses that are grounded in theory. Brügger et al. [12] provide a thorough treatment that connects a range of theoretical perspectives grounded in psychology to testable hypotheses that would further understanding of how personal experience affects climate opinions. In particular, more explicit attention could be paid to defining and measuring different types of climate- and weather-related experiences. The conceptual relationships outlined in Figure 1 illustrate that the relationships among experience, beliefs, and behaviors may be

184 influenced by additional intervening factors (such as causal attribution [23]) that should
185 themselves be tested. Lastly, an increasing focus on measuring behavioral outcomes adds to the
186 relevance of research in this area for communication and policy. This relevance can be
187 encouraged by moving from research questions focused on finding any detectable relationship
188 between extreme weather experiences and climate opinions, to questions focused on
189 understanding how extreme weather experiences promote or hinder effective mitigation and
190 adaptation.

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Conflict of interest statement

The author declares no conflict of interest.

Annotated references

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Across four years of five cross-sectional national surveys in Australia there was no association between experiences with unusually high temperatures at the postal code level and climate change opinions, but there was some relationship between precipitation deficits and climate concern.

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