Does extreme climate event exposure influence climate-related opinions? The case of the 2019–2020 Australian Black Summer bushfires

Matthew Andreotta[1], Fabio Boschetti[1], Simon Farrell[2], Cécile Paris[3], Iain Walker[4], and Mark J. Hurlstone[5]

[1]Environment, CSIRO, Australia

[2]School of Psychological Science, University of Western Australia, Australia

[3]Data61, CSIRO, Australia

[4]School of Psychological Sciences, University of Melbourne, Australia

[5]Department of Psychology, Lancaster University, UK

Author Note

Matthew Andreotta https://orcid.org/0000-0002-2996-6031

Fabio Boschetti https://orcid.org/0000-0001-8999-6913

Simon Farrell https://orcid.org/0000-0001-7452-8789

Cécile Paris https://orcid.org/0000-0003-3816-0176

Iain Walker https://orcid.org/0000-0002-1020-5873

Mark J. Hurlstone https://orcid.org/0000-0001-9920-6284

Correspondence concerning this article should be addressed to Mark Hurlstone, Department of Psychology, Lancaster University, Lancaster, United Kingdom, LA1 4YW. email: m.hurlstone@lancaster.ac.uk

Data availability statement. Data for this research are available online at: https://github.com/matt-lab/bushfire-audience-segmentation.

Code availability statement. Analysis scripts are available online, at: https://github.com/matt-lab/bushfire-audience-segmentation.

CRediT authorship contribution statement. Matthew Andreotta: Conceptualisation, Data curation, Formal analysis, Investigation, Methodology, Visualisation, Writing—original draft, Writing—review and editing. **Fabio Boschetti, Simon Farrell, Cécile Paris, Iain Walker**: Conceptualisation, Methodology, Writing—review and editing, Supervision. **Mark Hurlstone**: Conceptualisation, Formal analysis, Investigation, Methodology, Visualisation, Writing—original draft, Writing—review and editing, Supervision.

Funding. This research was supported by an Australian Government Research Training Program (RTP) Scholarship from the University of Western Australia and a scholarship from the Commonwealth Scientific and Industrial Research Organisation Research Office awarded to **Matthew Andreotta**.

Competing Interests. All authors declare no other financial or non-financial competing interests.

Abstract

We report three studies examining the impact of the 2019-2020 Australian bushfires, known as the Black Summer, on Australians' climate-related opinions. Study 1 was conducted before the peak of the bushfires, whereas Studies 2 and 3 were conducted afterwards. In all studies, respondents completed a Q-sort task ranking opinion statements about climate change by degree of endorsement. Study 3 also incorporated measures of bushfire perceptions and climate policy support. Q-sort responses consistently revealed evidence for three opinion segments: climate-change Acceptors, Fencesitters, and Sceptics. Over time, the proportion of Acceptors decreased, the proportion of Fencesitters increased, while Sceptics remained stable. Perceptions of the bushfires varied across segments. Although all segments perceived the fires as severe, Acceptors tended to attribute them to climate change, whereas Fencesitters and Sceptics attributed them to mass arson. However, even many Acceptors endorsed the mass-arson claim. On climate policy, Acceptors favoured stronger action, Fencesitters were evenly divided, and Sceptics mostly opposed change. Our results suggest the Black Summer bushfires did not elicit greater acceptance of anthropogenic climate change or heightened concern. Instead, misinformation, particularly conservative media narratives attributing the fires to mass arson, may have influenced beliefs about the fires' causes, especially among undecided and sceptical individuals.

Keywords: Black Summer bushfires · climate change · climate opinion · personal experience · extreme events · event attribution · misinformation

Does extreme climate event exposure influence climate-related opinions? The case of the 2019–2020 Australian Black Summer bushfires

In October 2019, lightning ignited the largest fire in Australia's recent history (Rural Fire Service, 2020). The 'megafire', so-called for its intensity, size, and difficulty to control, endured for fifteen weeks, burning 512,000 hectares of land, including the Blue Mountains World Heritage Area (Rural Fire Service, 2020). Accompanying the megafire were bushfires in all Australian states and territories throughout the unprecedented 2019-2020 bushfire season (Boer et al., 2020), which became known as the Black Summer. Together, these fires directly killed at least 33 people, burnt over 24 million hectares, destroyed over 3,000 homes, killed or displaced nearly three billion animals, and affected nearly 80% of Australians either directly or indirectly (Hughes et al., 2020; The Royal Commission into National Natural Disaster Arrangements, 2020). On a local scale, the fires trapped thousands of Australians without essential goods and services (The Royal Commission into National Natural Disaster Arrangements, 2020). On a national and international scale, the fires transformed the usually festive season into one of grief and vigilance (Head, 2020).

Given the extended time scale over which the bushfires raged, the harrowing and sustained media reporting of the devastation caused, and the large proportion of Australians affected by the events, a natural question to ask is whether this Black Summer of crisis altered Australians' climate-related opinions. More generally, the Black Summer presents an opportunity to examine how extreme events of this magnitude may shape public opinions about climate change. In this article, we address this question by presenting three studies comparing Australians' climate-related opinions before and after the peak of the Black Summer bushfires.

Effects of extreme climate events on climate-related opinions

There are several theoretical and empirical reasons for expecting that extreme climate events, such as megafires, may prompt shifts in people's climate-related opinions. First, an often-cited barrier to climate change concern and action is psychological distance

(McDonald et al., 2015; Spence et al., 2012; van der Linden et al., 2015; Wang et al., 2019). It is frequently assumed that many people are unconcerned about climate change because they are uncertain about whether it is happening (hypothetical distance) and think that, if it is happening, it will affect other people (social distance), in other places (spatial distance), in the distant future (temporal distance; for critiques of this idea, see van Valkengoed et al., 2023; Wang et al., 2018, 2021). Thus, personal experience of extreme climate events should reduce the psychological distance to climate change, increasing concern about the issue and willingness to act. Second, although belief in anthropogenic climate change is generally high amongst the public, there are indications that the issue is not as salient as other problems (Crawley et al., 2022). Personal experience of extreme climate events may trigger community discussions that place the issue "top-of-mind" in the public's consciousness (Boudet et al., 2020; Demski et al., 2017), making the problem more salient and increasing support for relevant policies (Bromley-Trujillo & Poe, 2020). Third, personal experience of extreme climate events makes the abstract risks of climate change concrete and may provoke negative affective responses that could increase people's willingness to mitigate the problem (Bergquist et al., 2019; Marx et al., 2007; E. U. Weber, 2006). Indeed, it is well-established that the experience of negative affect associated with climate change is a key predictor of climate risk perceptions and policy support (Leiserowitz, 2006; van der Linden, 2014, 2015). We refer to these three mechanisms by which extreme event experiences might influence climate-related opinions as the psychological distance, issue salience, and affect activation accounts, respectively (Sisco, 2021).

Over the past decade or so, a burgeoning literature has sought to establish whether personal experience of extreme climate events influences climate-related opinions (for reviews, see Howe, 2021; Howe et al., 2019; Reser & Bradley, 2020; Reser et al., 2014; Sambrook et al., 2021; Sisco, 2021). The results of this literature have been somewhat mixed. On the one hand, and consistent with the precedents just reviewed, several studies

have shown that self-reported or objectively recorded personal experience of extreme climate events, including drought (Carmichael & Brulle, 2017), flooding (Demski et al., 2017; Ogunbode et al., 2020; Osberghaus & Demski, 2019; Spence et al., 2011; Taylor et al., 2014), heatwaves (Dai et al., 2015), storms (Bergquist et al., 2019; Lang & Ryder, 2016), and, notably, forest fires (Lacroix et al., 2020; Zanocco et al., 2018), increases belief in and concern about climate change. For example, Spence et al. (2011) found that UK households who reported experiencing flooding were more concerned about climate change, perceived it as less uncertain, and felt more confident that their actions would make a difference, compared to households that did not experience flooding. On the other hand, other studies have failed to document an association between climate-related opinion measures and personal experience of climate extremes (Cutler et al., 2020; Shao & Hao, 2020), drought (Carlton et al., 2016), flooding (Albright & Crow, 2019; Whitmarsh, 2008), storms (Lyons et al., 2018), and multiple disasters including a bushfire, cyclone, and drought (Boon, 2016). A recent meta-analysis using data from 302 studies found that personal experience of climate events only has a weak positive association with climate change awareness, with effect sizes varying considerably across different climate events (Xia et al., 2022).

There are a few known moderators of the effect of personal experience of extreme climate events on climate-related opinions (see e.g., Sambrook et al., 2021; Sisco, 2021) that are especially relevant to the current work. First, personal experience of an extreme event may only influence climate-related opinions when individuals causally attribute that event to climate change (E. U. Weber, 2010). Empirical support for this proposition has been provided in numerous studies (McCright et al., 2014; Ogunbode et al., 2019, 2020; Wong-Parodi & Rubin, 2022). For example, Ogunbode et al. (2019) found that personal experience of flooding only predicted climate risk perceptions for individuals who attributed the flooding to climate change.

Second, the effect of personal experience of extreme climate events on climate-related opinions depends on people's pre-existing climate change beliefs, a pattern

consistent with motivated reasoning—the tendency for individuals to interpret information in ways that protect or reinforce their prior beliefs (Druckman & McGrath, 2019; Kunda, 1990). Exposure to extreme climate events tends to increase climate risk perceptions primarily among people who already accept climate change, whereas those who are more sceptical show little or no change (Lacroix et al., 2020). A complementary line of research uses political ideology as a proxy for these pre-existing climate change beliefs, based on the well-established association between liberalism and acceptance of climate science and conservatism and climate scepticism (Hornsey et al., 2016). This work shows that liberals are more likely than conservatives to perceive or interpret extreme events in ways consistent with climate change (Lyons et al., 2018; Zanocco et al., 2018). Other work demonstrates that whether people attribute extreme events to climate change is itself shaped by their prior beliefs and political ideology (Ogunbode et al., 2019, 2020).

Third, media attention to an extreme event may also be necessary for it to shape climate-related opinions. Extreme climate events can serve as "focusing events" (Birkland, 1998; Birkland & Schwaeble, 2019)—sudden, uncommon, and attention-grabbing occurrences that attract increased media coverage (Kirilenko et al., 2015; Marquart-Pyatt et al., 2014; Sisco et al., 2017) and create opportunities to highlight the links between such events and ongoing climate change. Media attention to climate change has been shown to influence climate attitudes (Carmichael et al., 2017) and increase public conversations about the issue (King et al., 2017). However, the effect of media attention may depend on its frequency and prominence, whether the event is causally attributed to climate change, and on the presence of competing narratives or misinformation that undermine the connection between climate change and the extreme event.

Divergent mass media and social media bushfire narratives

Because media coverage can shape causal attributions and amplify motivated reasoning, understanding how the bushfires were portrayed in the media is necessary for interpreting how Australians made sense of the Black Summer. Mocatta and Hawley

(2020) charted the content and evolution of media coverage of the Black Summer, which focused predominantly on the causes of the fires and what or who was to blame. Scientists had been quick to confirm that the scale and severity of the fires were unprecedented (Shine, 2020) and had been worsened by climate change (Climate Council, 2019; Gourlay et al., 2020). Accordingly, much mass media coverage initially attributed the cause of the fires to climate change and presented apocalyptic images and descriptions of the devastation caused. However, as the fires intensified, mass-media reporting of their causes quickly diverged along ideological lines. Public broadcasters and liberal media outlets continued to emphasise the connection between climate change and the bushfires, whereas conservative media outlets sought to downplay the severity of the fires and cast doubt on the link with climate change. A key argumentation strategy in the conservative media at this time was the claim that the fires were "nothing new" and in keeping with historic bushfires in terms of their severity (Johnstone, 2019). Additionally, some conservative media argued that the Black Summer was worsened by "Greens policies" that prevented firefighters from reducing fuel loads (G. Brown & Caisley, 2019), despite the Greens' platform's overt support for hazard reduction (Australian Greens, 2020).

Coinciding with the emergence of these narratives in the conservative mass media, misinformation began to ferment on the social media platform formally known as Twitter (now X) in Australia and internationally. Under the hashtag #ArsonEmergency, false claims began to circulate that the bushfires were caused by arson, that preventative backburning efforts had been reduced due to green activism, that Australia commonly experienced such bushfires, and that climate change is unrelated to the bushfires (D. Weber et al., 2020, 2022). Social media researchers agree that the activities were likely a deliberate disinformation campaign (Keller et al., 2020; D. Weber et al., 2020).

Online misinformation spread under the #ArsonEmergency hashtag, notably the claim that arsonists were a major cause of the fires, subsequently infected conservative mass-media reporting of the bushfires. A prominent example was an article published in

The Australian under the title "Bushfires: firebugs fuelling crisis as national arson toll hits 183" claiming that "more than 180 alleged arson cases have been recorded since the start of the bushfire season" (Ross & Reid, 2020). The article played a prominent role in fuelling online climate change denial narratives and was shared by prominent conservatives, such as Donald Trump Jr., to his audience of four million followers on Twitter, thus propelling the misinformation to a much larger online audience. The arson claims were grossly exaggerated (NSW Bushfire Inquiry, 2020), calculated based on a range of fire-related offences other than arson, and relied on annual figures rather than the Black Summer bushfire season (Council, 2021).

In summary, media coverage of the Black Summer bushfires focused predominantly on the causes of the fires and was characterised by a power struggle between two competing narratives. One narrative emphasised a relationship between climate change and bushfires, supported by scientists' assessments of the bushfires (Boer et al., 2020; van Oldenborgh et al., 2021). The other narrative, fuelled by misinformation, refuted the connection between climate change and the bushfires, notably by making exaggerated claims about arson. This polarised and divisive mass media and social media landscape could have persuaded those undecided about climate change to become more accepting or sceptical about the issue. Thus, whether the Black Summer bushfires and accompanying media narratives altered the climate-related opinions of those undecided about climate change is an open empirical question.

Current research

In the following, we report the results of three audience segmentation studies of Australian climate-related opinions. The studies were undertaken to identify distinct sub-groups of the Australian population that hold different views about climate change. All three studies employed the Q methodology (S. R. Brown, 1982; Stephenson, 1986), in which participants completed a Q-sort task by rank-ordering a series of opinion statements about climate change, derived from a large-scale analysis of Australian Twitter climate

commentary (Andreotta et al., 2019, 2022), according to how similar each was to their point of view. Participants' rank-orderings of the statements were then subjected to Q-factor analysis to identify distinct audience segments of climate-related opinions.

In Study 1 (September 2019), which took place before the peak of the Black Summer bushfires, participants completed the Q-sort task along with a battery of measures of prominent psychological characteristics to help facilitate interpretation of the different audience segments. We found evidence for a three-segment solution comprising Acceptors, Fencesitters, and Sceptics, ordered from the highest to the lowest belief in anthropogenic climate change, trust in climate science, concern about the issue, and motivation to tackle it. Segments also differed in their climate change concern and scepticism, mental models of climate change, political ideology, and worldviews, as assessed using the auxiliary psychological characteristic measures.

In Study 2 (February 2020), which took place after the peak of the bushfires, participants completed the Q-sort task followed by a series of belief-updating tasks to determine whether segments differed in their receptivity to climate science information. We replicated the three-segment solution of Study 1 and found considerable heterogeneity in the belief-updating tendencies of the three segments. Acceptors updated their beliefs the most towards the scientific estimates, closely followed by Fencesitters, whereas Sceptics did not update their beliefs at all.

These two studies were part of a planned program of research that predated the bushfires but coincided with their occurrence, affording us a natural experiment, so to speak, to determine whether the bushfires catalysed a change in Australian climate-related opinions. The results of these two studies have been reported elsewhere (Andreotta et al., 2022), but have not yet been systematically compared to determine whether the occurrence of the bushfires influenced Australian climate-related opinions. In the current paper, we undertake this comparison and report the results of a third study conducted one month after our second study, near the end of the Black Summer. In Study 3 (March 2020),

participants completed the Q-sort task and the same battery of psychological characteristic measures used in Study 1. Additionally, participants completed a measure of bushfire perceptions assessing their endorsement of various media and political claims about the bushfires—for example, that climate change worsened them, that the fires were severe, and that arsonists contributed to their occurrence—and a measure of the degree to which the bushfires warranted a change in Australia's climate policy.

Whereas our earlier research focused on identifying the number, nature, and psychological characteristics of Australia's climate change audience segments (Andreotta et al., 2022), the present work leverages a longitudinal cross-sectional design to examine whether climate-related opinions shifted across different stages of the Black Summer bushfires. Using data from all three studies, we first confirmed that the three-segment solution and the pattern of psychological characteristic differences between segments reported by Andreotta et al. (2022) generalised to Study 3. Next, we explored whether climate-related opinions varied in response to the Black Summer bushfires, by testing for between-study differences in the proportion of respondents assigned to each segment (Studies 1, 2, & 3) and in climate change cognition and affect (Study 1 vs. Study 3). Finally, to better understand any observed shifts or stability in climate-related opinions, we analysed segment-specific perceptions and preferred policy responses to the Black Summer bushfires (Study 3). Of particular interest was the degree to which respondents causally attributed the bushfires to climate change versus alternative explanations based on the erroneous causal claim that the fires were deliberately ignited by arsonists, and whether these patterns of causal attribution could be understood in terms of motivated reasoning.

From an empirical standpoint, the mixed evidence on how extreme climate events influence climate-related opinions makes it difficult to specify directional hypotheses. However, from a theoretical standpoint, the psychological distance, issue salience, and affect activation accounts introduced at the outset predict that—to the extent that people interpreted the bushfires as having been worsened by climate change—personal experience

of the bushfires should make climate change feel more psychologically proximal, heighten the salience of the issue, and elicit affective responses (e.g., worry) that increase perceived climate risk. Accordingly, a strong prediction is that the proportion of Fencesitters would decrease and the proportion of Acceptors would increase across studies. A weaker prediction is that, even if segment composition remains stable, scores on the continuous measures of climate change cognition and affect would change in a manner that reflects greater acceptance of, and concern about, the issue (e.g., increased worry and reduced scepticism).

These effects, however, depend on Australians' perceptions of the causes of the bushfires. If misinformation narratives gained traction, then individuals may have attributed the fires to arson rather than to climate change, in which case the psychological mechanisms identified above would not have been activated. Instead, such narratives could offset or even reverse the predicted pattern, leading not only to an increase in the proportion of Fencesitters at the expense of Acceptors, but also to declining concern and greater scepticism on the continuous climate change cognition and affect measures. On this misinformation account, climate-related opinions might remain unchanged overall or instead shift towards greater scepticism.

Method

Data and analysis scripts for this research are available online at https://github.com/matt-lab/bushfire-audience-segmentation. This research was approved by the Human Research Ethics Committees of the University of Western Australia (reference: 2019/RA/4/20/5104) and the Commonwealth Scientific and Industrial Research Organisation (reference: 026/19).

Participants

Table 3 provides an overview of the key characteristics of the study samples and the materials they completed. Data were collected at three time periods. Study 1 was conducted in September ($n = 387$, 88.97% of Study 1 participants), October ($n = 42$,

9.66% of Study 1 participants), and November ($n = 6$, 1.38% of Study 1 participants) of 2019, prior to the peak of the Black Summer bushfires. Study 2 was conducted in February ($n = 403$, 97.58% of Study 2 participants) and March ($n = 10$, 2.42% of Study 2 participants) of 2020, after the peak of the bushfires. Study 3 was conducted in March 2020 ($n = 213$), approaching the end of the Black Summer bushfires.

In total, 1,061 Australian adults participated in the studies. Participants were recruited using Qualtrics' (Provo, UT) online research panel service using a targeted and stratified sampling approach to match the age and gender distribution of the general population (as per the national 2016 census). The age and gender distributions were comparable across samples, as indicated by regression models (see Supplementary Methods). These models do not identify statistically significant differences between the mean age of participants across studies or the (log odds) ratio of female to male participants across studies. We excluded extremely fast responders who were identified using a preregistered threshold (see Supplementary Methods).

Materials

Q-sort task

To segment participants into climate change audiences, we used the Q-sort task (S. R. Brown, 1982; Stephenson, 1986). This task requires a set of opinion statements capturing the breadth of conversational possibilities around an issue, elicited through a bottom-up process. To create our statements, we drew upon previous work that used an inductive process to identify the structure of climate change commentary of Australian tweets (Andreotta et al., 2019). This research revealed five enduring themes of public discourse on climate change: climate change action, climate change consequences, climate change conversations, climate change denial, and the legitimacy of climate science and climate change. For each theme, we selected six tweets that captured the heterogeneity of the theme (see Andreotta et al., 2022). The resulting 30 tweets were transcribed as statements that could be understood without the social context of the original tweet.

Where possible, language, sentiment, and tone were preserved. Statements included: "It is important to vote for leaders who will combat climate change" (climate change action), "Climate change is a threat to the health and safety of our children" (climate change consequences), "It is shameful that climate change, the greatest problem of our time, is barely discussed in the media" (climate change conversations), "Climate change sceptics ignore basic climate science facts" (climate change denial), and "Scientists should stop falsely claiming that climate change is a settled science" (legitimacy of climate science and climate change).

The Q-sort task was divided into three parts. In part 1, to encourage reflection, participants began by reading each statement and determining if it was: (1) like their point of view; (2) unlike their point of view; or (3) neutral or unsure. In part 2, participants ranked each statement according to how closely it matched their point of view, assigning a rank from -4 (most unlike their point of view) to +4 (most like their point of view). The distribution of possible ranks was forced and non-uniform, such that participants had to consider the few statements to place at the extremes (see Figure 1). This encourages participants to carefully reflect on their views while completing the task (S. R. Brown, 1982; Stephenson, 1986). Finally, in part 3, participants were asked to justify their placement of statements assigned extreme ranks.

Auxiliary psychological scales

A battery of 28 auxiliary psychological characteristic measures was assembled (Table 1). Among these, the most relevant to the current research were state-based psychological scales of climate change cognition and affect. Specifically, we measured general belief in anthropogenic climate change, with scales concerning epistemic scepticism (doubt about anthropogenic climate change), response scepticism (doubt about the effectiveness of climate change mitigation), perceived human contribution (belief that humans have altered the global climate), knowledge volume (self-perceived confidence in climate change knowledge), and worry about climate change. Additionally, we included higher-resolution

inventories to quantify participants' mental models of specific climate change causes, climate change consequences, and the effectiveness of climate change mitigation policies.

Other psychological scales pertained to trait-based concepts found to be associated with climate change beliefs. This includes inventories of: cognitive styles; ideology, worldviews, and values; and personality.

Fire Perception Scale

To measure perceptions of the Black Summer bushfires, we developed the Fire Perception Scale. Drawing on our collective observations of the media and political discourses surrounding the fires, we identified three prominent themes: climate change attribution (the extent to which the bushfires were perceived as attributable to climate change), perceived severity (the perceived magnitude or seriousness of the bushfires), and human responsibility and preventability (beliefs about whether societal or policy changes could reduce future fire risk, or whether other human factors such as arson were to blame). We created seven declarative statements reflecting these themes. Example items include "Climate change made the 2019-20 Australian bushfires more severe" (climate change attribution), "The 2019-20 Australian bushfires are severe" (perceived severity), and "Over one hundred arsonists have contributed to the 2019-20 Australian bushfires" (human responsibility and preventability). Participants rated their agreement with each statement on a five-point Likert scale: (1) disagree, (2) slightly disagree, (3) neither agree nor disagree, (4) slightly agree, and (5) agree.

Policy direction preferences

To measure participants' views on the policy consequences of the Black Summer bushfires, they responded to two items. First, participants were asked: "Do the 2019-20 Australian bushfires justify a change in Australia's climate change policy?". Participants could respond with one of four options: (1) "Yes, the Australian government should be taking further action to mitigate climate change"; (2) "No, the Australian government should not modify the current climate change policy"; (3) "Yes, the Australian government

should be taking less action to mitigate climate change"; and (4) "Yes, the Australian government should be taking no action at all to mitigate climate change". Next, participants were asked to justify their response ("Why?") through writing an open-ended response.

Procedure

All studies were conducted as online surveys using Qualtrics (Provo, UT). To begin, participants read an information sheet, provided informed consent, and supplied basic demographic information. The procedure subsequently varied across studies (summarised in Table 3). In Study 1, participants completed the Q-sort task followed by the auxiliary psychological scales. In Study 2, participants completed the Q-sort task followed by a belief-updating task unrelated to the current research. In Study 3, participants completed all materials: the Q-sort task, auxiliary psychological scales, the Fire Perception Scale, and policy direction preference items. To control for potential order effects, the presentation sequence of materials was counterbalanced across participants (see Supplementary Methods).

Sample size justification

Sample sizes and the statistical power of our analyses were determined by practical constraints (Lakens, 2022). Studies 1 ($n = 435$) and 2 ($n = 413$) were undertaken prior to the current research, with their sample sizes being chosen based on their original objectives (Andreotta et al., 2022). Study 3 ($n = 213$) was made possible by remaining grant funds from the earlier studies. Although smaller than the first two studies, this sample represented the maximum feasible sample size given the available budget and the need for rapid data collection following the bushfires. To determine the power of tests to detect study differences in climate change audience segments, cognition, and affect, we conducted a sensitivity power analysis with the G*Power program (Faul et al., 2007, 2009). We found our analyses had sufficient power ($\geq .80$) to detect the expected small effects of study differences in audience segment membership (for effect sizes of Cohen's $\omega \geq 0.106$ for a

likelihood-ratio χ^2 test) and climate change cognition and affect measures (for effect sizes of Cohen's $d \geq 0.235$ for t tests of mean differences).

Results

The results are structured into four sections. First, we assess whether the three-segment solution and the pattern of psychological characteristic differences between segments documented in our original analysis of Studies 1 and 2 (Andreotta et al., 2022) generalise to Study 3. Second, we examine whether the proportion of respondents in each segment (Studies 1, 2, & 3) and their responses on the climate change cognition and affect measures (Studies 1 & 3) changed over time. Third, we investigate segment differences in bushfire perceptions (Study 3), and fourth, we analyse segment differences in policy preferences (Study 3). All analyses were completed with the *R* programming language (R Core Team, 2023).

Replication of the three-segment solution

As per our previous research, we used the Q methodology to identify distinct views on climate change (S. R. Brown, 1982). The Q methodology transposes traditional dimension reduction techniques to reduce the dimensions of *people* rather than *items*. For each study, we used principal components analysis with varimax rotation to group individuals with similar Q-sort ranks. We extracted a single factor, as the second component accounted for only a minor amount of variance in each study. The extracted factor represented a dimension of anthropogenic climate-change acceptance. Based on factor loadings, we divided individuals into one of three segments: (1) *Acceptors* ($n = 653$, 61.55%), whose positive factor loading was statistically significant from zero ($p < .05$); (2) *Sceptics* ($n = 97$, 9.14%), whose negative factor loading was statistically significant from zero ($p < .05$); and (3) *Fencesitters* ($n = 311$, 29.31%), whose factor loading was not statistically significant from zero ($p \geq .05$).

Although the number of segments was consistent across studies, the nature of the segments may vary. To explore this possibility, we constructed an average Q sort for

Acceptors and Sceptics in each study (S. R. Brown, 1982). The ranks assigned to each statement were averaged (weighted by participants' factor loading). These averages were then ranked to align with the Q-sort structure, generating a set of values known as factor scores. For example, the statement with the lowest average corresponded to a factor score of -4 and the statement with the highest average corresponded to a factor score of +4 (see Supplementary Results for all factor scores). We did not build a representative Q sort for Fencesitters as the sorting behaviour of this segment is more heterogenous than the other two segments (otherwise Fencesitters would have emerged as a separate factor). In all three studies, the greatest factor score for Acceptors corresponded to the statement "It is important to vote for leaders who will combat climate change", whereas the greatest factor score for Sceptics corresponded to the statement "Scientists should stop falsely claiming that climate change is a settled science."

We found minimal differences in each segment's factor scores across studies. Acceptor factor ranks from the three studies were strongly correlated (all Spearman's ρ correlations $> .95$, all p's $< .001$). Likewise, Sceptic factor ranks across studies were strongly correlated (all Spearman's ρ correlations $> .94$, all p's $< .001$). Consistently across studies, Acceptors and Sceptics held divergent views (all Spearman's ρ correlations $< -.81$, all p's $< .001$). In sum, the number and nature of segments' climate change views were consistent across time.

We also explored whether segments were distinguished by a consistent pattern of psychological characteristics by replicating the regression analysis of Andreotta et al. (2022). This analysis was complicated by multicollinearity, which can lead to unstable coefficient estimates in traditional regression approaches. Instead, we sought to produce stable estimates with a ridge regression model. A ridge regression reduces the variance of estimates caused by multicollinearity by shrinking the coefficients towards zero (a bias-variance tradeoff; James et al., 2021). With the *glmnet* package (Friedman et al., 2010), we fitted a multinomial logistic ridge regression model to predict segment

membership as a function of psychological characteristics for Study 1 and Study 3. The degree of shrinkage, controlled by a hyperparameter λ, was chosen by a cross-validation process (k-fold) that minimised multinomial deviance. Prior to analysis, we converted responses to z scores for each predictor in each study. Confidence intervals were estimated by repeating the modelling procedure via bootstrapping with 10,000 samples (sampled with replacement; Efron & Tibshirani, 1994).

The ridge regression model demonstrated good fit for both Study 1 (83.22% accuracy, accounting for 49.07% of null deviance) and Study 3 (88.26% accuracy, accounting for 66.39% of null deviance). As seen in Table 2, the models' coefficients were generally consistent (same sign) across studies, indicating a robust association between psychological characteristics and segment membership. Regarding climate change cognition and affect, Acceptors and Sceptics were distinguished by opposing patterns of climate change scepticism and belief in anthropogenic climate change. In contrast, the Fencesitters of Study 3 were characterised by response scepticism and perceptions that carbon-emitting activities cause climate change. Turning to cognitive styles, conspiracist ideation was positively associated with Fencesitter membership, and negatively associated with Acceptor membership (both studies), whereas Sceptics were characterised by a reduced orientation towards future consequences (Study 3). Generally, Acceptors and Sceptics were distinguished by opposing patterns of ideologies, worldviews, and values. Lastly, personality tended not to be a robust predictor of segment membership, although evidence from Study 3 indicated that Fencesitters were characterised by greater extraversion and conscientiousness, whereas Sceptics were characterised by greater introversion.

Change in climate change segment membership, cognition, and affect

To explore whether climate change views changed during the Black Summer bushfires, we investigated the relative proportions of segments across studies (Figure 2). Numerically, the proportion of Acceptors fell across time (from 64.60% of the Study 1 sample to 54.46% of the Study 3 sample), whereas the proportion of Fencesitters increased

across time (from 27.13% of the Study 1 sample to 37.09% of the Study 3 sample). In comparison, the proportion of Sceptics was relatively stable across studies (from 8.28% of the Study 1 sample to 8.45% of the Study 3 sample). To investigate whether the relative proportion of segments differed across studies, we created a multinomial logistic regression model to predict segment membership as a function of study (coefficients reported in Supplementary Results), using the *multinom* function from the *nnet* package (Venables & Ripley, 2002). A likelihood-ratio test did not indicate a statistically reliable improvement in model fit when study was included as a predictor, compared to a model with only an intercept term (χ^2 (4) = 8.85, p = .07, Cohen's ω = 0.09). Although the effect approached significance, segment membership did not reliably differ across study samples.

In addition to segment membership, we tested for differences in climate change cognition and affect between Study 1 (September 2019) and Study 3 (March 2020) using t tests. To guard against Type I errors, we applied a Holm (1979) p value adjustment (Table 4). Participants in Study 3 reported a significantly higher endorsement of natural cycle causes of climate change (e.g., volcanic eruptions, solar fluctuations) than those in Study 1 (Cohen's d = 0.25). However, no other climate change cognition and affect characteristics reliably differed between Study 1 and Study 3. Furthermore, there was no evidence that participants from Study 1 and Study 3 reliably differed in their dispositional attributes of: cognitive styles; ideology, worldviews and values; or personality (all $p > .05$; see Supplementary Results for t tests).

Bushfire perceptions

To explore perceptions of the Black Summer bushfires, we performed a principal components analysis with varimax rotation on the Fire Perception Scale (see Table 5). We extracted three factors, as these accounted for the majority of scale variance (78.31%; see Supplementary Results for scree plot). The first factor, labelled *Climate Processes*, was characterised by four items (items 1, 3, 5, 6) that linked climate change to the bushfires and accounted for 41.22% of scale variance. The second factor, labelled *Fire Appraisal*, was

characterised by two items (items 2 and 4), with the two most extreme (maximum and minimum) mean item scores and accounted for 19.97% of scale variance. The third factor, labelled *Arson Causes*, was characterised by a single item (item 7) stating that the Black Summer was caused by hundreds of arsonists and accounted for 17.12% of scale variance. We created subscales corresponding to each factor by averaging item scores. Items that negatively loaded onto factors were reverse-coded. The multi-item factors of Climate Processes and Fire Appraisal had an internal consistency of Cronbach's $\alpha = .86$ (four items; mean inter-item $r = .60$) and Cronbach's $\alpha = .42$ (inter-item $r = .29$), respectively. Given the low internal consistency of Fire Appraisal, we analysed its two component items separately. For brevity, we refer to these items using abbreviated labels—"Climate change made bushfires less likely" (item 2) and "Bushfires were severe" (item 4)—in the following analysis.

To test segment differences in bushfire perceptions, we fitted linear regression models predicting Climate Processes, the two Fire Appraisal items, and Arson Causes from segment membership (coefficients reported in Supplementary Results). All models accounted for a significant amount of bushfire perception variance compared to intercept-only models, indicating that segment membership was a significant predictor of Climate Processes ($F(2, 210) = 47.44$, $p < .001$, $R^2 = 0.31$, $R^2_{adjusted} = 0.30$), the two Fire Appraisal items ("Climate change made bushfires less likely": $F(2, 210) = 18.30$, $p < .001$, $R^2 = 0.15$, $R^2_{adjusted} = 0.14$; "Bushfires were severe": $F(2, 210) = 19.71$, $p < .001$, $R^2 = 0.16$, $R^2_{adjusted} = 0.15$), and Arson Causes ($F(2, 210) = 12.69$, $p < .001$, $R^2 = 0.11$, $R^2_{adjusted} = 0.10$).

To quantify specific segment differences, we conducted pairwise comparisons of marginal means using the *marginaleffects* package (Arel-Bundock et al., n.d.), with a Holm (1979) p value adjustment for multiple comparisons. As seen in Figure 3, Acceptors reported higher endorsement of Climate Processes than Fencesitters (difference = 0.53, $SE = 0.14$, 95% CI = [0.26, 0.80], $z = 3.87$, $p < .001$, $p_{adjusted} < .001$), who in turn endorsed

Climate Processes more than Sceptics (difference = 1.76, SE = 0.25, 95% CI = [1.28, 2.24], $z = 7.14$, $p < .001$, $p_{adjusted} < .001$). For the first Fire Appraisal item ("Climate change made bushfires less likely"), Fencesitters showed higher endorsement than both Acceptors (difference = 1.04, SE = 0.17, 95% CI = [0.70, 1.38], $z = 6.05$, $p < .001$, $p_{adjusted} < .001$) and Sceptics (difference = 0.64, SE = 0.31, 95% CI = [0.04, 1.25], $z = 2.08$, $p = .037$, $p_{adjusted} = .074$). Acceptors and Sceptics did not significantly differ (difference = -0.40, SE = 0.30, 95% CI = [-0.99, 0.19], z = -1.33, $p = .182$, $p_{adjusted} = .182$). For the second Fire Appraisal item ("Bushfires were severe"), Acceptors reported greater endorsement than both Fencesitters (difference = 0.65, SE = 0.11, 95% CI = [0.44, 0.85], $z = 6.05$, $p < .001$, $p_{adjusted} < .001$) and Sceptics (difference = 0.56, SE = 0.19, 95% CI = [0.20, 0.93], z = 3.04, $p = .002$, $p_{adjusted} = .005$), whereas Fencesitters and Sceptics did not significantly differ (difference = -0.08, SE = 0.19, 95% CI = [-0.46, 0.29], z = -0.43, $p = .664$, $p_{adjusted}$ = .664). Finally, for Arson Causes, the pattern of Climate Processes endorsement was reversed. Specifically, Sceptics showed higher endorsement than Fencesitters (difference = 0.74, SE = 0.30, 95% CI = [0.15, 1.32], $z = 2.47$, $p = .014$, $p_{adjusted} = .014$), who in turn showed higher endorsement than Acceptors (difference = 0.55, SE = 0.17, 95% CI = [0.23, 0.88], $z = 3.32$, $p < .001$, $p_{adjusted} = .002$).

We investigated causal perceptions by examining responses to claims that mass arson (item 7 of the Fire Perception Scale) and climate change (item 1 of the Fire Perception Scale) contributed to the Black Summer bushfires. The results reveal a striking pattern of misinformation endorsement. Despite segment differences, participants seldom rejected the claim that over one hundred arsonists contributed to the Black Summer bushfires ($n = 38$; 17.84% responded with 'disagree' or 'strongly disagree' to item 7). In fact, a majority of Fencesitters (56.96%) and Sceptics (88.89%) endorsed the mass-arson explanation, compared with 38.79% of Acceptors. This widespread endorsement of an unsupported causal claim underscores how misinformation narratives surrounding the fires gained substantial traction—particularly amongst those who are uncertain or sceptical

about the scientific consensus on climate change.

In contrast, endorsement of the climate-change causal claim showed the opposite pattern. A majority of Acceptors ($n = 101$; 87.07%) agreed that climate change worsened the severity of the bushfires, whereas agreement was much lower among Fencesitters (41.77%) and entirely absent among Sceptics. Overall, endorsement of the mass-arson causal claim was negatively associated with endorsement of the climate-change causal claim ($r = –.21$, 95% CI = [–.33, –.08], $p = .002$), consistent with the notion that belief in misinformation displaced acceptance of scientifically grounded explanations.

To test a motivated-reasoning account of perceptions of the bushfires, we examined the association between political liberalism-conservatism (as indexed by the single-item measure of political ideology)—a proxy for pre-existing climate change beliefs—and endorsement of the climate-change and mass-arson causal claims. Political liberalism was associated with stronger endorsement of the climate-change causal claim ($r = –.34$, 95% CI = [-0.45, -0.21], $p < .001$), whereas political conservatism was associated with stronger endorsement of the mass-arson causal claim ($r = .27$, 95% CI = [0.15, 0.41], $p < .001$). However, both correlations were relatively weak, indicating that the perception that climate change exacerbated the fires was not tied solely to pre-existing political beliefs, and that the mass-arson causal claim meshed with a broad range of respondents—including some who accept anthropogenic climate change—providing only limited support for a motivated-reasoning explanation (see Supplementary Results for correlations between the other auxiliary psychological characteristic measures and the Fire Perception Scale causal items).

Policy direction preferences

Policy direction preferences in response to the Black Summer differed among participants. Most participants desired more governmental climate change mitigation policies ($n = 145$, 68.08%), or no change to existing policies ($n = 54$, 25.35%). Only a small minority desired less or no governmental climate change mitigation policies ($n = 14$,

6.57%). However, policy direction preferences differed markedly across segments. The majority of Acceptors and Fencesitters preferred more mitigation policies, whereas most Sceptics preferred no change (Figure 4).

To test whether these segment differences were statistically reliable, we estimated a binomial logistic regression model predicting the odds of preferring more mitigation policies as a function of segment membership (see Supplementary Results for full model outcomes). Sceptics were excluded from the analysis because none expressed this preference. A likelihood-ratio test indicated that segment membership significantly predicted policy direction preferences (χ^2 (1) = 35.45, $p < .001$, Cohen's $\omega = 0.43$). Acceptors demonstrated a markedly greater preference for more mitigation policies than Fencesitters, with 89.66% ($n = 104$) endorsing this option compared with 51.90% of Fencesitters ($n = 41$), corresponding to an odds ratio of 8.03 (95% CI = [3.92, 17.49], $p < .001$).

We explored participants' text-based justifications for their policy direction preferences using an emotion analysis. Emotional associations for each word were detected using the NRC Word–Emotion Association Lexicon (Mohammad & Turney, 2013), a crowdsourced lexicon in which words are manually annotated for their association with eight emotions: anger, fear, anticipation, trust, surprise, sadness, joy, and disgust. For each response, we coded the presence of each emotion dichotomously (present/not present) if the response contained at least one word associated with that emotion.

The most common emotion expressed by participants was fear ($n = 67$, 31.46%), which appeared in justifications for both more action (e.g., "the recent bushfire is a wake-up call. how much more *worse* do we want to experience?", fear words italicised) and for no change or less action (e.g., "…100 arsonists were charged as a starter and it was the fuel left on the ground for decades that made the fires so much *worse* and caused the *disaster*").

To test whether emotional content varied across segments, we estimated a binomial logistic regression model for each emotion with segment membership as the predictor (see Supplementary Results for full model outcomes). We found no statistically significant

differences between segments for most emotions, except for fear. Acceptors were more likely than Fencesitters to use at least one fear-related word, with 40.52% ($n = 47$) doing so compared with 17.72% of Fencesitters ($n = 14$), corresponding to an odds ratio of 3.16 (95% CI = [1.59, 6.28], $p = .001$). Sceptics fell between these two segments, with 33.33% ($n = 6$) using at least one fear-related word, and did not reliably differ from either Acceptors or Fencesitters.

Discussion

In this paper, we reported three audience segmentation studies of Australian climate-related opinions employing the Q methodology that were conducted at different stages of the Australian Black Summer bushfires. Study 1 was conducted before the peak of the bushfires (September 2019), whereas Studies 2 and 3 took place after the peak (February and March 2020, respectively). This afforded us a natural experiment to determine whether the occurrence of the bushfires catalysed a change in Australian climate-related opinions. All studies required participants to complete a Q-sort task ranking opinion statements about climate change by degree of endorsement. Studies 1 and 3 additionally incorporated auxiliary measures of prominent psychological characteristics, including measures of climate change cognition and affect. Study 3 also incorporated measures of bushfire perceptions and support for climate policy. We examined whether the three-segment solution and pattern of psychological characteristic differences between segments reported previously (Andreotta et al., 2022) replicated across studies, whether the proportion of respondents in each segment and their climate change cognition and affect differed before versus after the peak of the Black Summer bushfires, and how segments differed in their bushfire perceptions and policy preferences.

Summary of key findings

Across all three studies, we find consistent support for a three-segment solution of Australian climate-related opinions. The three segments are the Acceptors, Fencesitters, and Sceptics—ordered from the highest to the lowest belief in anthropogenic climate

change, trust in climate science, concern about the issue, and motivation to tackle it. The segments are remarkably robust, with near-perfect correlations between the archetypal sorting styles of Acceptors of all studies and Sceptics of all studies. This is impressive given that the archetypal sorting styles depend on the correlations between the rank orderings of 30 statements, which have several thousand unique permutations. It appears that the Black Summer bushfires did not change the definitional point of view of an Acceptor, Fencesitter, or Sceptic.

Further evidence for the stability of audience segments across studies was derived from the consistent relationship between segments and psychological characteristics in Studies 1 and 3. Acceptors were characterised by low epistemic and response scepticism, high worry about climate change, a high belief that carbon-emitting human activities cause climate change, a high belief in the societal consequences of climate change, a politically liberal ideology, and an "environment-as-ductile" worldview, meaning they think the environment has a limited capacity to recover from damage. Sceptics, by contrast, were characterised by high epistemic and response scepticism, low worry about climate change, a low belief in the environmental harms of climate change, high confidence in their knowledge about climate change, a politically conservative ideology, and an "environment-as-elastic" worldview, meaning they think the environment can easily recover from damage. In comparison to these two segments, Fencesitters were more neutral concerning political ideology and environmental worldviews. However, they scored higher on a measure of general conspiratorial thinking than both Acceptors and Sceptics.

We found little evidence to suggest that the Black Summer bushfires catalysed a shift in climate-related opinions toward greater acceptance and concern. Instead, across the three studies, the proportion of Acceptors decreased slightly and the proportion of Fencesitters increased, while Sceptics remained stable. Although the changes in segment membership over time did not reach conventional levels of statistical significance, the effect was only marginally non-significant and may reflect the smaller sample size in Study 3

compared to Studies 1 and 2.

The auxiliary measures of psychological characteristics incorporated in Studies 1 and 3 included several measures of climate change knowledge (viz., knowledge volume, mental models of climate change, epistemic and response scepticism) and affect (viz., worry about climate change), affording us an additional set of indicators to determine if the bushfires provoked a change in beliefs about, and emotional responses towards, climate change. However, consistent with the results derived from the Q-sort task, we generally found no statistically reliable change in responses on these measures between Studies 1 and 3. The only exception was a small increase in Australians' perceptions of natural cycles (e.g., volcanic eruptions, solar fluctuations) as a cause of climate change. Again, this evidence contradicts the claim that the Black Summer bushfires catalysed greater acceptance and concern about anthropogenic climate change. It is unclear why the Black Summer bushfires might have strengthened belief in the role of natural cycles in climate change. One possibility is that participants recognised the greenhouse gases released by the bushfires and perceived them—along with weather events more broadly—as part of a natural fluctuation, leading to greater endorsement of natural cycles as a cause of climate change.

We did not find any statistically reliable differences between Studies 1 and 3 in a range of dispositional measures of cognitive style, ideology, worldviews, values, and personality. This outcome was not unexpected as these are measures of more enduring psychological traits that tend to remain stable over time.

Perceptions of the bushfires in Study 3 varied across segments. Acceptors were most likely to endorse the view that climate change worsened the fires, followed by Fencesitters, with Sceptics showing the lowest endorsement. The reverse pattern was observed for the misinformation-based arson explanation. Sceptics most strongly endorsed the mass-arson claim, Fencesitters showed moderate endorsement, and even a large minority of Acceptors endorsed it. Endorsement of the mass-arson explanation was negatively correlated with endorsement of the climate-change explanation. All segments agreed with the claim that

the bushfires were severe, with Acceptors showing the strongest endorsement. However, Fencesitters were uniquely likely to endorse the counterfactual claim that climate change made the bushfires less likely—more so than both Acceptors and Sceptics.

Finally, support for climate policy in Study 3 also varied by segments. Acceptors almost universally agreed that the bushfires warranted more action by Australia to address climate change, whereas Fencesitters were roughly evenly split between favouring more action and no change in action. Sceptics mostly favoured no change in action by Australia to address climate change. Fear was routinely used by all segments, but in particular, Acceptors, to justify their policy position.

Why the Black Summer did not lead to greater climate change concern

Our results add to the mixed findings on the relationship between climate-related opinions and personal experience of extreme climate events (Howe, 2021; Howe et al., 2019; Xia et al., 2022). At the outset, we identified three moderators of the effect of extreme-event exposure on climate-related opinions—event attribution, motivated reasoning, and media attention (Sisco, 2021). Taken together, these moderators may offer a coherent explanation of why the Black Summer bushfires did not lead to greater acceptance and concern about climate change.

The first and most important moderator is event attribution. Previous work shows that extreme-event exposure influences climate-related opinions only among individuals who believe the event was caused by climate change (McCright et al., 2014; Ogunbode et al., 2019, 2020; Wong-Parodi & Rubin, 2022). In Study 3, this key precondition was not met for the vast majority of respondents—and critically, it was not achieved for Fencesitters, the segment most theoretically open to changing their opinions in response to personal experience. Most Fencesitters and all Sceptics rejected the notion that climate change contributed to the fires and instead attributed the bushfires primarily to arson. Although Acceptors were more likely to endorse a climate-change explanation, even within this segment, a sizeable minority also attributed the fires to arson. Thus, because most

respondents—including the Fencesitters most amenable to opinion change—did not interpret the fires as climate-related, the chief mechanism that links extreme-event exposure to increased climate change concern was not engaged.

The second moderator, motivated reasoning, partially helps to explain why these attribution patterns emerged. Consistent with previous research (Ogunbode et al., 2019, 2020), political ideology influenced causal attributions—liberals were more likely to attribute the fires to climate change, whereas conservatives were more likely to endorse the arson explanation. However, motivated reasoning alone cannot fully account for the findings, as belief in the arson narrative was evident across all three segments—including among some Acceptors—suggesting that wider informational influences were at play.

The third moderator that captures these wider informational influences is media attention. Extreme-climate events can serve as "focusing events" (Birkland, 1998; Birkland & Schwaeble, 2019), increasing public and media attention and generating opportunities to highlight the links between such events and climate change (Kirilenko et al., 2015; Marquart-Pyatt et al., 2014; Sisco et al., 2017). Although the Black Summer bushfires received substantial coverage, the media environment was highly contested. After an initial period emphasising the role of climate change, the narrative quickly became politicised (Mocatta & Hawley, 2020). Liberal media outlets continued to stress the role of climate change in worsening the fires, whereas conservative outlets were dismissive of this connection. During the peak of the bushfires, misinformation—particularly exaggerated claims about widespread arson—proliferated across social media and conservative media outlets. Such misinformation is notoriously difficult to correct (Ecker et al., 2022; Lewandowsky et al., 2012), and it is possible that despite officials' efforts to dismiss the arson claims (Knaus, 2020; Readfearn, 2019), these narratives had already taken hold by the time Studies 2 and 3 were conducted. The widespread acceptance of the mass-arson explanation among Fencesitters and Sceptics, in particular, is consistent with this interpretation. It may also help explain why the proportion of Acceptors decreased while

the proportion of Fencesitters increased over time. Misinformation exposure may have rendered some Acceptors more sceptical of the scientific consensus on climate change.

However, misinformation is not the only media-related explanation. A content analysis of Australian news coverage by Burgess et al. (2020) found that although nearly half of articles mentioned climate change, only 16% explicitly attributed the bushfires to climate change—even though climate scientists and scientific bodies made this connection during the fires (Climate Council, 2019; Hughes et al., 2020; Readfearn, 2020; World Weather Attribution Consortium, 2020)—and even fewer explained how climate change contributed to the fires. Similar results were observed in a study examining how Australian climate-action non-governmental organisations framed the link between the Black Summer bushfires and climate change on the social media platform Twitter (now X; Ettinger et al., 2023). These results indicate that climate-communication stakeholders may not have provided the public with sufficiently clear explanations of the relationship between climate change and bushfire risk, limiting opportunities for accurate event attribution.

Finally, Studies 2 and 3 were undertaken after the World Health Organisation (WHO) declared the COVID-19 outbreak a Public Health Emergency of International Concern in January 2020, and Study 3 coincided with the WHO characterising the outbreak as a pandemic in March 2020. The abrupt nature of the pandemic meant that it quickly became the centre of global media and public attention, diverting the spotlight away from the bushfires and climate change (Evensen et al., 2021; Loureiro & Alló, 2021; Rauchfleisch et al., 2023; Smirnov & Hsieh, 2022; Stoddart et al., 2023). Accordingly, the absence of a shift towards greater climate-change concern may reflect a redirection of attention and worry towards the rapidly escalating global health crisis.

It is important to acknowledge that these explanations remain tentative, as our study was not a true experiment. Specifically, we lack the relevant counterfactual conditions to facilitate causal inference—for example, a less polarised media environment, an absence of misinformation, or a scenario in which the bushfires did not coincide with a

global health crisis.

Implications for theoretical accounts of the effects of extreme-event experiences

At first blush, the results appear at variance with the psychological distance, issue salience, and affect activation accounts introduced at the outset. According to these accounts, personal experience of the bushfires should have made climate change feel more psychologically proximal, heightened the salience of the issue, and elicited affective responses that increased perceived climate risk. Consequently, we would expect to observe an increase in the proportion of Acceptors and a decrease in the proportion of Fencesitters over time, and/or shifts on the continuous climate change cognition and affect measures towards greater acceptance and concern about the issue. Yet, contrary to these predictions, we found a slight decrease in Acceptors and a corresponding increase in Fencesitters, and no reliable changes on the continuous cognition and affect measures.

However, these findings must be interpreted in light of the moderating variables just considered. A tacit assumption of the above theoretical accounts is that people perceived the bushfires as a causal consequence of climate change or as an event exacerbated by climate change. As our results show, this assumption did not hold for a substantial proportion of respondents. Many attributed the bushfires primarily to mass arson causes, and endorsement of this claim was associated with rejection of the climate-change causal explanation. Accordingly, the key preconditions required for the psychological distance, issue salience, and affect activation accounts to generate the predicted changes in climate-related opinions were unlikely to have been met. This limits the extent to which strong inferences can be drawn about the validity of these theories in this context.

Beyond these psychological accounts, the findings have implications for the focusing-events framework (Birkland, 1998; Birkland & Schwaeble, 2019). Extreme events can serve as focusing events that increase public attention to an issue and create opportunities for attitude change. However, the Black Summer bushfires did not appear to have this effect. Media narratives surrounding the fires quickly became contested and

politicised, with climate-change interpretations competing against misinformation-based arson narratives, while the emerging COVID-19 crisis eventually hijacked the spotlight of public and media attention. This suggests that focusing events are vulnerable to politicisation, alternative causal narratives, and competing, attention-grabbing events. Such conditions may prevent the expected increase in climate-change concern or even produce shifts toward greater scepticism if misinformation about the event dominates media and public discourse.

Implications for climate change communication

Our results have implications for how climate-communication stakeholders frame extreme climate events. Providing clear statements attributing such events to climate change is important, given evidence that event attribution is a key moderator of the effect of extreme-event exposure on climate-related opinions. However, an even more critical step is to explain, in simple terms, how climate change contributed to the event. Doing so makes the causal claim more credible and memorable because the underlying mechanism is understood (Hastie, 1984) and may help to stave off misconceptions fuelled by misinformation. For instance, if individuals understand that climate change did not ignite the fires but rather created the unusually hot and dry conditions that enabled them to burn intensely and spread rapidly, they may be less likely to be swayed by claims that the fires were caused by arson rather than climate change. In other words, they will recognise that the source of ignition is largely inconsequential—climate change does not start bushfires, rather it creates conditions that worsen them once ignited. It is clear from the content analyses of mass media and social media coverage of the Black Summer by Burgess et al. (2020) and Ettinger et al. (2023), respectively, described earlier, that such explanatory links were frequently missing—even though climate scientists and scientific bodies explicitly connected the fires to climate change at the time (Climate Council, 2019; Hughes et al., 2020; Readfearn, 2020; World Weather Attribution Consortium, 2020)—suggesting that more could have been done to communicate clearly how climate

change exacerbated the fires.

When misinformation about the causes of an extreme climate event circulates in mass and social media, timely correction may be crucial to prevent it from taking root. During the Black Summer bushfires, state fire services, the police, and journalists all played roles in countering misinformation about the fires. However, not all corrections are equally effective in debunking misinformation. Cognitive psychologists have identified numerous best practices for debunking misinformation (Ecker et al., 2022; Lewandowsky et al., 2012), and these strategies have been distilled into an accessible handbook for non-experts (Lewandowsky et al., 2020). A core principle is that effective corrections should not simply retract a false claim but provide a plausible alternative explanation for the cause of an event (Ecker et al., 2022). For instance, when countering the claim that "the bushfires were caused by arsonists," a correction that offers an alternative causal account (e.g., "the bushfires were ignited by lightning") is more effective than one that merely states that the claim is false (e.g., "there is no evidence of arson"). Climate-communication stakeholders should incorporate these best-practice insights into their messaging to increase the effectiveness of their debunking efforts. Even members of the public can help limit the spread of misinformation. For example, in their analysis of the #ArsonEmergency tweets on Twitter, Weber and colleagues (D. Weber et al., 2020, 2022) identified two different communities, one involved in the propagation of the false claims and another that sought to debunk those claims.

Finally, our results have implications for engaging with the three audience segments. Acceptors and Sceptics may be relatively low priorities for public engagement campaigns, albeit for different reasons. Acceptors already strongly believe in anthropogenic climate change, are highly trusting of climate science, and are strongly supportive of climate action. Accordingly, additional messaging is unlikely to appreciably shift their views. Sceptics, by contrast, have firmly entrenched beliefs. Their conservative political ideology and environment-as-elastic worldviews render them motivated to discount climate science,

meaning they are highly resistant to belief revision in the face of climate science information (Andreotta et al., 2022). Combined with the fact that they are few in number, these characteristics suggest there may be little merit in trying to shift the opinions of this segment (although see Andreotta et al., 2022, for a more nuanced account). By comparison, Fencesitters represent a more promising group for public engagement. They are more neutral in terms of political ideology and environmental worldviews, meaning they are not politically motivated to oppose climate science, in contrast to Sceptics. Indeed, Fencesitters update their beliefs in response to climate science information almost as much as Acceptors do (Andreotta et al., 2022). They are a relatively large segment with more intermediate climate-related opinions, meaning that with the right messaging strategy, they could perhaps be transformed into Acceptors.

Accordingly, we suggest that public engagement campaigns should target the Fencesitters. Unfortunately, we know little about the characteristics of this segment. This is, in part, because, given the inherent variability of individuals within this segment, we cannot construct an archetypal Q sort of their statement rankings. However, what we do know is that, compared to the Acceptors and Sceptics, they are more likely to endorse conspiracy theories[1]. This curious result, first documented in our original report of Studies 1 and 2 (Andreotta et al., 2022), was replicated in Study 3, suggesting it is a robust feature of this segment. Given that much climate misinformation is grounded in conspiracy theories (Coan et al., 2021; Cook, 2020), our key piece of advice for climate-communication stakeholders is that debunking efforts should pay particular attention to exposing how climate misinformants employ conspiracy theories and related deception techniques to mislead the public. Such refutation techniques may be necessary to prevent climate

[1] It is unclear why Fencesitters scored higher on conspiracist ideation than Acceptors and Sceptics. If anything, we would have expected Sceptics to score higher on this psychological attribute, based on previous evidence showing an association between conspiracy theory endorsement and climate-change scepticism (Lewandowsky et al., 2013). One possibility is that the heightened responses of Fencesitters on this measure reflect a broader psychological attribute, such as openness to alternative viewpoints—the willingness to consider alternative ideas, suggestions, or explanations of events (Tsai & Li, 2023).

misinformation from transforming Fencesitters into Sceptics.

Potential limitations

Before closing, some potential limitations of the current work merit comment. First, Studies 2 and 3 were undertaken after the peak in the bushfires, which occurred between December 2019 and January 2020. Therefore, we cannot rule out the possibility that had data been collected during the most intense period of the crisis, a transient increase in climate change acceptance and concern may have been detected. Nevertheless, even if this were so, our longitudinal comparison suggests such a change in opinions would have been temporary and short-lived.

Second, although around 80% of the Australian population was affected either directly or indirectly by the fires (Hughes et al., 2020), we did not ask respondents about the nature of their experiences. The distinction between direct and indirect experience is important because studies have shown that direct experience of an extreme event is more predictive of climate-related opinions than indirect experience (Ogunbode et al., 2020; Zanocco et al., 2019). Accordingly, changes in climate-related opinions are more likely to be observed among individuals who had severe direct negative experiences of the fires, such as those who suffered property damage. However, we note that even if we had measured the nature of our respondents' experiences, individuals who had a severe personal experience of the fires are likely under-represented in Studies 2 and 3, as the disaster's impact would have precluded them from responding to our web-panel surveys (Howe, 2021).

Third, and relatedly, we did not collect respondents' state or region of residence. Because the timing, intensity, and immediacy of the bushfires varied across Australia, regional variation could have shaped respondents' levels of exposure and perceptions. Although indirect exposure—in the form of smoke, extensive media coverage, and national political debate—was widespread across the country, the absence of geographic information means we cannot rule out the possibility that regional differences contributed to some of the observed trends.

Finally, we note that power is always a concern when retaining the null hypothesis. Our sample size had sufficient power to detect even very weak omnibus effects, such as study differences in segment membership and climate change cognition and affect. We had less power to detect post hoc effects between specific segments and specific studies, such as the increase in Fencesitters between Study 1 and Study 3. However, our studies detected some key segment differences, such as Fencesitters endorsing arson-based explanations of the Black Summer bushfires at a greater rate than Acceptors.

Conclusions

Previous research examining the association between personal experience of extreme climate events and climate-related opinions has produced contradictory findings. It is therefore perhaps unsurprising that we found no evidence that the Black Summer bushfires prompted a shift towards greater acceptance of, and concern about, anthropogenic climate change. A key determinant of whether extreme-event exposure influences climate-related opinions is whether people attribute the event to climate change. Accordingly, the failure of Fencesitters to attribute the bushfires to climate change is the most credible explanation for the lack of a positive shift in climate-related opinions. This lack of attribution may reflect the divergent mass-media and social-media narratives surrounding the bushfires. In particular, misinformation dismissing the connection between climate change and the bushfires may have "crowded out" messages linking the fires to climate change. That such misinformation influenced perceptions is evidenced by the sizeable minority of Acceptors who did not reject the arson claim, and by the majority of Fencesitters and Sceptics who endorsed it. Although some mass-media coverage mentioned climate change, relatively few articles explicitly linked the bushfires to climate change, and fewer still explained the mechanism by which climate change intensifies bushfire conditions—another likely reason why attribution rates were low among Fencesitters. Motivated reasoning also played a role, but its influence appeared limited. While politically conservative respondents were more likely to endorse the arson explanation, belief in the mass-arson narrative was found across

all three segments, indicating that misinformation narratives exerted widespread influence. The implications of these observations are twofold. First, climate-communication stakeholders may need to emphasise not only the connection between an extreme event and climate change but also explain clearly how climate change contributed to that event. Second, where misinformation about the cause of an extreme event circulates, proactive efforts must be undertaken to debunk the misleading claims. This requires that climate-communication stakeholders are aware of best practices for refuting misinformation so that their interventions can achieve maximal impact.

References

Albright, E. A., & Crow, D. (2019). Beliefs about climate change in the aftermath of extreme flooding. *Climatic Change*, *155*(1), 1–17.

Andreotta, M., Boschetti, F., Farrell, S., Paris, C., Walker, I., & Hurlstone, M. (2022). Evidence for three distinct climate change audience segments with varying belief-updating tendencies: Implications for climate change communication. *Climatic Change*, *174*(3-4), 32.

Andreotta, M., Nugroho, R., Hurlstone, M. J., Boschetti, F., Farrell, S., Walker, I., & Paris, C. (2019). Analyzing social media data: A mixed-methods framework combining computational and qualitative text analysis. *Behavior research methods*, *51*, 1766–1781.

Arel-Bundock, V., Greifer, N., & Heiss, A. (n.d.). How to interpret statistical models using `marginaleffects` in `R` and `Python`. *Journal of Statistical Software*. https://marginaleffects.com

Australian Greens. (2020, November). A burning issue.

Bergquist, M., Nilsson, A., & Schultz, P. (2019). Experiencing a severe weather event increases concern about climate change. *Frontiers in psychology*, *10*, 220.

Birkland, T. A. (1998). Focusing events, mobilization, and agenda setting. *Journal of public policy*, *18*(1), 53–74.

Birkland, T. A., & Schwaeble, K. L. (2019). Agenda setting and the policy process: Focusing events. In *Oxford research encyclopedia of politics*.

Boer, M. M., Resco de Dios, V., & Bradstock, R. A. (2020). Unprecedented burn area of Australian mega forest fires. *Nature Climate Change*, *10*(3), 171–172. https://doi.org/10.1038/s41558-020-0716-1

Boon, H. J. (2016). Perceptions of climate change risk in four disaster-impacted rural australian towns. *Regional environmental change*, *16*, 137–149.

Bostrom, A., O'Connor, R. E., Böhm, G., Hanss, D., Bodi, O., Ekström, F., Halder, P., Jeschke, S., Mack, B., Qu, M., Rosentrater, L., Sandve, A., & Sælensminde, I. (2012). Causal thinking and support for climate change policies: International survey findings. *Global Environmental Change*, *22*(1), 210–222. https://doi.org/10.1016/j.gloenvcha.2011.09.012

Boudet, H., Giordono, L., Zanocco, C., Satein, H., & Whitley, H. (2020). Event attribution and partisanship shape local discussion of climate change after extreme weather. *Nature Climate Change*, *10*(1), 69–76.

Bromley-Trujillo, R., & Poe, J. (2020). The importance of salience: Public opinion and state policy action on climate change. *Journal of Public Policy*, *40*(2), 280–304.

Brown, G., & Caisley, O. (2019, November). *Greens policies increasing bushfire threat.* https://www.theaustralian.com.au/nation/politics/deputy-pmmichael-%20mccormack-slams-raving-innercity-lunatics-for-linkingclimate-%20change-to-fires/newsstory/%205c3ba8d3e72bc5f10fcf49a94fc9be85

Brown, S. R. (1982). *Political subjectivity: Applications of q methodology in political science*. Yale University Press, New Haven; London.

Burgess, T., Burgmann, J. R., Hall, S., Holmes, D., & Turner, E. (2020). Black summer: Australian newspaper reporting on the nation's worst bushfire season. *Monash climate change communication research hub*, *30*.

Capstick, S. B., & Pidgeon, N. F. (2014). What is climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change*, *24*, 389–401. https://doi.org/10.1016/j.gloenvcha.2013.08.012

Carlton, J. S., Mase, A. S., Knutson, C. L., Lemos, M. C., Haigh, T., Todey, D. P., & Prokopy, L. S. (2016). The effects of extreme drought on climate change beliefs, risk perceptions, and adaptation attitudes. *Climatic change*, *135*, 211–226.

Carmichael, J. T., & Brulle, R. J. (2017). Elite cues, media coverage, and public concern: An integrated path analysis of public opinion on climate change, 2001–2013. *Environmental Politics*, *26*(2), 232–252.

Carmichael, J. T., Brulle, R. J., & Huxster, J. K. (2017). The great divide: Understanding the role of media and other drivers of the partisan divide in public concern over climate change in the usa, 2001–2014. *Climatic change*, *141*, 599–612.

Climate Council. (2019, November). *The facts about bushfires and climate change*. https://www.climatecouncil.org.au/not-normal-climate-change-bushfire-web/

Coan, T. G., Boussalis, C., Cook, J., & Nanko, M. O. (2021). Computer-assisted classification of contrarian claims about climate change. *Scientific Reports*, *11*(1), 22320.

Cook, J. (2020). Deconstructing climate science denial. *Research Handbook on Communicating Climate Change*, 62–78.

Council, A. P. (2021, February). *Adjudication 1792* (tech. rep.). Australian Press Council.

Crawley, S., Coffé, H., & Chapman, R. (2022). Climate belief and issue salience: Comparing two dimensions of public opinion on climate change in the eu. *Social Indicators Research*, *162*(1), 307–325.

Cutler, M. J., Marlon, J., Howe, P., & Leiserowitz, A. (2020). 'is global warming affecting the weather?'evidence for increased attribution beliefs among coastal versus inland us residents. *Environmental Sociology*, *6*(1), 6–18.

Dai, J., Kesternich, M., Löschel, A., & Ziegler, A. (2015). Extreme weather experiences and climate change beliefs in china: An econometric analysis. *Ecological Economics*, *116*, 310–321.

Demski, C., Capstick, S., Pidgeon, N., Sposato, R. G., & Spence, A. (2017). Experience of extreme weather affects climate change mitigation and adaptation responses. *Climatic Change*, *140*, 149–164.

Druckman, J. N., & McGrath, M. C. (2019). The evidence for motivated reasoning in climate change preference formation. *Nature Climate Change*, *9*(2), 111–119.

Ecker, U. K., Lewandowsky, S., Cook, J., Schmid, P., Fazio, L. K., Brashier, N., Kendeou, P., Vraga, E. K., & Amazeen, M. A. (2022). The psychological drivers of misinformation belief and its resistance to correction. *Nature Reviews Psychology*, *1*(1), 13–29.

Efron, B., & Tibshirani, R. (1994). *Introduction to the Bootstrap*. Chapman & Hall.

Enzler, H. B. (2015). Consideration of future consequences as a predictor of environmentally responsible behavior: Evidence from a general population study. *Environment and Behavior*, *47*(6), 618–643. https://doi.org/10.1177/0013916513512204

Ettinger, J., Sanford, M., Walton, P., Holmes, D., & Painter, J. (2023). Social media messaging by climate action ngos: A case study of the 2019–2020 australian black summer bushfires. *Oxford Open Climate Change*, *3*(1), kgad011.

Evensen, D., Whitmarsh, L., Bartie, P., Devine-Wright, P., Dickie, J., Varley, A., Ryder, S., & Mayer, A. (2021). Effect of "finite pool of worry" and covid-19 on uk climate change perceptions. *Proceedings of the National Academy of Sciences*, *118*(3), e2018936118.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146

Friedman, J., Tibshirani, R., & Hastie, T. (2010). Regularization paths for generalized linear models via coordinate descent. *Journal of Statistical Software*, *33*(1), 1–22. https://doi.org/10.18637/jss.v033.i01

Gourlay, C., Leslie, T., Martino, M., & Spraggon, B. (2020, February). *How heat and drought turned australia into a tinderbox*. https://www.abc.net.au/news/2020-02-19/australia-bushfires-how-heat-and-drought-created-a-tinderbox/11976134

Hastie, R. (1984). Causes and effects of causal attribution. *Journal of Personality and Social Psychology*, *46*(1), 44.

Head, L. (2020). Transformative change requires resisting a new normal. *Nat. Clim. Chang.*, *10*(3), 173–174. https://doi.org/10.1038/s41558-020-0712-5

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, *6*(2), 65–70. Retrieved September 20, 2024, from http://www.jstor.org/stable/4615733

Hornsey, M. J., Harris, E. A., Bain, P. G., & Fielding, K. S. (2016). Meta-analyses of the determinants and outcomes of belief in climate change. *Nature climate change*, *6*(6), 622–626.

Howe, P. D. (2021). Extreme weather experience and climate change opinion. *Current Opinion in Behavioral Sciences*, *42*, 127–131.

Howe, P. D., Marlon, J. R., Mildenberger, M., & Shield, B. S. (2019). How will climate change shape climate opinion? *Environmental Research Letters*, *14*(11), 113001.

Hughes, L., Steffen, W., Mullins, G., Dean, A., Weisbrot, E., & Rice, M. (2020). *Summer of crisis*. Climate Council.

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning: With Applications in R*. Springer US. https://doi.org/10.1007/978-1-0716-1418-1

Johnstone, C. (2019, December). *History of disasters shows there is nothing new about nation's destructive blazes*. https://www.theaustralian.com.au/nation/history-of-disastersshows-there-is-nothing-new-about-nations-destructive-blazes/newsstory/%20f43c2a6037a8b0e422a69880bce10139

Kay, A. C., & Jost, J. T. (2003). Complementary justice: Effects of "Poor But Happy" and "Poor but Honest" stereotype exemplars on system justification and implicit activation of the justice motive. *Journal of personality and social psychology*, *85*(5), 823–837. https://doi.org/10.1037/0022-3514.85.5.823

Keller, T., Graham, T., Angus, D., Bruns, A., Nijmeijer, R., Nielbo, K. L., Bechmann, A., Neudert, L.-M., Marchal, N., Bradshaw, S., Rossini, P., Stromer-Galley, J., Baptista, E. A., & de Oliveira, V. V. (2020). 'Coordinated inauthentic behaviour' and other online influence operations in social media spaces. *AoIR Sel. Pap. Internet Res.* https://doi.org/10.5210/spir.v2020i0.11132

King, G., Schneer, B., & White, A. (2017). How the news media activate public expression and influence national agendas. *Science*, *358*(6364), 776–780.

Kirilenko, A. P., Molodtsova, T., & Stepchenkova, S. O. (2015). People as sensors: Mass media and local temperature influence climate change discussion on twitter. *Global Environmental Change*, *30*, 92–100.

Knaus, C. (2020, January). *Disinformation and lies are spreading faster than australia's bushfires.* https://www.theguardian.com/australia-news/2020/jan/12/disinformation-and-lies-are-spreading-faster-than-australias-bushfires

Kunda, Z. (1990). The case for motivated reasoning. *Psychological bulletin*, *108*(3), 480.

Lacroix, K., Gifford, R., & Rush, J. (2020). Climate change beliefs shape the interpretation of forest fire events. *Climatic Change*, *159*, 103–120.

Lakens, D. (2022). Sample Size Justification (D. van Ravenzwaaij, Ed.). *Collabra: Psychology*, *8*(1), 33267. https://doi.org/10.1525/collabra.33267

Lang, C., & Ryder, J. D. (2016). The effect of tropical cyclones on climate change engagement. *Climatic change*, *135*, 625–638.

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change*, *77*(1), 45–72.

Lewandowsky, S., Cook, J., Ecker, U., Albarracin, D., Kendeou, P., Newman, E. J., Pennycook, G., Porter, E., Rand, D. G., Rapp, D. N., et al. (2020). The debunking handbook 2020.

Lewandowsky, S., Ecker, U. K., Seifert, C. M., Schwarz, N., & Cook, J. (2012). Misinformation and its correction: Continued influence and successful debiasing. *Psychological science in the public interest*, *13*(3), 106–131.

Lewandowsky, S., Oberauer, K., & Gignac, G. E. (2013). NASA faked the moon landing—therefore, (climate) science is a hoax: An anatomy of the motivated rejection of science. *Psychological Science*, *24*(5), 622–633. https://doi.org/10.1177/0956797612457686

Lindeman, M., & Verkasalo, M. (2005). Measuring values with the Short Schwartz's Value Survey. *Journal of Personality Assessment*, *85*(2), 170–178. https://doi.org/10.1207/s15327752jpa8502_09

Lins de Holanda Coelho, G., Hanel, P. H., & Wolf, L. J. (2018). The very efficient assessment of need for cognition: Developing a six-item version. *Assessment*, *27*(8), 1870–1885. https://doi.org/10.1177/1073191118793208

Loureiro, M. L., & Alló, M. (2021). How has the covid-19 pandemic affected the climate change debate on twitter? *Environmental Science & Policy*, *124*, 451–460.

Lyons, B. A., Hasell, A., & Stroud, N. J. (2018). Enduring extremes? polar vortex, drought, and climate change beliefs. *Environmental Communication*, *12*(7), 876–894.

Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis*, *29*(5), 633–647. https://doi.org/10.1111/j.1539-6924.2009.01220.x

Marquart-Pyatt, S. T., McCright, A. M., Dietz, T., & Dunlap, R. E. (2014). Politics eclipses climate extremes for climate change perceptions. *Global environmental change*, *29*, 246–257.

Marx, S. M., Weber, E. U., Orlove, B. S., Leiserowitz, A., Krantz, D. H., Roncoli, C., & Phillips, J. (2007). Communication and mental processes: Experiential and analytic processing of uncertain climate information. *Global Environmental Change*, *17*(1), 47–58.

McCright, A. M., Dunlap, R. E., & Xiao, C. (2014). The impacts of temperature anomalies and political orientation on perceived winter warming. *Nature climate change*, *4*(12), 1077–1081.

McDonald, R. I., Chai, H. Y., & Newell, B. R. (2015). Personal experience and the 'psychological distance'of climate change: An integrative review. *Journal of Environmental Psychology*, *44*, 109–118.

Mocatta, G., & Hawley, E. (2020). Uncovering a Climate Catastrophe? Media Coverage of Australia's Black Summer Bushfires and the Revelatory Extent of the Climate Blame Frame. *MC J.*, *23*(4). https://doi.org/10.5204/mcj.1666

Mohammad, S. M., & Turney, P. D. (2013). Crowdsourcing a word-emotion association lexicon. *Comput. Intell.*, *29*(3), 436–465.

NSW Bushfire Inquiry. (2020, July). *Final Report of the NSW Bushfire Inquiry* (tech. rep.). NSW Government.

Ogunbode, C. A., Demski, C., Capstick, S. B., & Sposato, R. G. (2019). Attribution matters: Revisiting the link between extreme weather experience and climate change mitigation responses. *Global Environmental Change*, *54*, 31–39.

Ogunbode, C. A., Doran, R., & Böhm, G. (2020). Individual and local flooding experiences are differentially associated with subjective attribution and climate change concern. *Climatic Change*, *162*, 2243–2255.

Osberghaus, D., & Demski, C. (2019). The causal effect of flood experience on climate engagement: Evidence from search requests for green electricity. *Climatic Change*, *156*(1-2), 191–207.

Price, J. C., Walker, I. A., & Boschetti, F. (2014). Measuring cultural values and beliefs about environment to identify their role in climate change responses. *Journal of Environmental Psychology*, *37*, 8–20. https://doi.org/10.1016/j.jenvp.2013.10.001

R Core Team. (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Vienna, Austria. https://www.R-project.org/

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-Item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*(1), 203–212. https://doi.org/10.1016/j.jrp.2006.02.001

Rauchfleisch, A., Siegen, D., & Vogler, D. (2023). How covid-19 displaced climate change: Mediated climate change activism and issue attention in the swiss media and online sphere. *Environmental Communication*, *17*(3), 313–321.

Readfearn, G. (2019). Factcheck: Is there really a green conspiracy to stop bushfire hazard reduction? *The Guardian*.

Readfearn, G. (2020, January). *Explainer: What are the underlying causes of australia's shocking bushfire season?* https://www.theguardian.com/environment/2020/jan/13/explainer-what-are-the-underlying-causes-of-australias-shocking-bushfire-season

Reser, J. P., & Bradley, G. L. (2020). The nature, significance, and influence of perceived personal experience of climate change. *Wiley Interdisciplinary Reviews: Climate Change*, *11*(5), e668.

Reser, J. P., Bradley, G. L., & Ellul, M. C. (2014). Encountering climate change:'seeing'is more than 'believing'. *Wiley Interdisciplinary Reviews: Climate Change*, *5*(4), 521–537.

Ross, D., & Reid, I. (2020, January). *Bushfires: Firebugs fuelling crisis as national arson toll hits 183*. %3Chttps://www.theaustralian.com.au/nation/bushfires-firebugsfuelling-%20crisis-asarson-arresttollhits183/newsstory/%2052536dc9ca9bb87b7c76d36ed1acf53f%3E.

Rural Fire Service. (2020). Gospers Mountain fire is now contained.

Sambrook, K., Konstantinidis, E., Russell, S., & Okan, Y. (2021). The role of personal experience and prior beliefs in shaping climate change perceptions: A narrative review. *Frontiers in psychology*, *12*, 669911.

Shao, W., & Hao, F. (2020). Approval of political leaders can slant evaluation of political issues: Evidence from public concern for climate change in the usa. *Climatic Change*, *158*(2), 201–212.

Shine, J. (2020, January). *Statement regarding australian bushfires.* https://www.science.org.au/news-and-events/news-and-media-releases/statement-regarding-australian-bushfires

Sisco, M. R., Bosetti, V., & Weber, E. U. (2017). When do extreme weather events generate attention to climate change? *Climatic change*, *143*, 227–241.

Sisco, M. R. (2021). The effects of weather experiences on climate change attitudes and behaviors. *Current Opinion in Environmental Sustainability*, *52*, 111–117.

Smirnov, O., & Hsieh, P.-H. (2022). Covid-19, climate change, and the finite pool of worry in 2019 to 2021 twitter discussions. *Proceedings of the National Academy of Sciences*, *119*(43), e2210988119.

Smith, N., & Leiserowitz, A. (2014). The role of emotion in global warming policy support and opposition. *Risk Analysis*, *34*(5), 937–948. https://doi.org/10.1111/risa.12140

Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. F. (2011). Perceptions of climate change and willingness to save energy related to flood experience. *Nature climate change*, *1*(1), 46–49.

Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis: An International Journal*, *32*(6), 957–972.

Stephenson, W. (1986). Protoconcursus: The concourse theory of communication. *Operant Subjectivity*, *9*(2), 37–58.

Stoddart, M. C., Ramos, H., Foster, K., & Ylä-Anttila, T. (2023). Competing crises? media coverage and framing of climate change during the covid-19 pandemic. *Environmental Communication*, *17*(3), 276–292.

Taylor, A., de Bruin, W. B., & Dessai, S. (2014). Climate change beliefs and perceptions of weather-related changes in the united kingdom. *Risk Analysis*, *34*(11), 1995–2004.

The Royal Commission into National Natural Disaster Arrangements. (2020). *Royal Commission into National Natural Disaster Arrangements Report* (tech. rep.). Commonwealth of Australia.

Tsai, M.-H., & Li, N. P. (2023). Trait self-control, emotions, and openness to alternative viewpoints. *Current Research in Behavioral Sciences*, *5*, 100131.

van Valkengoed, A. M., Steg, L., & Perlaviciute, G. (2023). The psychological distance of climate change is overestimated. *One Earth*, *6*(4), 362–391.

van der Linden, S. (2014). On the relationship between personal experience, affect and risk perception: The case of climate change. *European journal of social psychology*, *44*(5), 430–440.

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

van der Linden, S., Maibach, E., & Leiserowitz, A. (2015). Improving public engagement with climate change: Five "best practice" insights from psychological science. *Perspectives on Psychological Science*, *10*(6), 758–763.

van Oldenborgh, G. J., Krikken, F., Lewis, S., Leach, N. J., Lehner, F., Saunders, K. R., van Weele, M., Haustein, K., Li, S., Wallom, D., Sparrow, S., Arrighi, J., Singh, R. K., van Aalst, M. K., Philip, S. Y., Vautard, R., & Otto, F. E. L. (2021). Attribution of the Australian bushfire risk to anthropogenic climate change. *Natural Hazards and Earth System Sciences*, *21*(3), 941–960. https://doi.org/10.5194/nhess-21-941-2021

Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with s* (Fourth) [ISBN 0-387-95457-0]. Springer. https://www.stats.ox.ac.uk/pub/MASS4/

Wang, S., Hurlstone, M. J., Leviston, Z., Walker, I., & Lawrence, C. (2019). Climate change from a distance: An analysis of construal level and psychological distance from climate change. *Frontiers in psychology*, *10*, 230.

Wang, S., Hurlstone, M. J., Leviston, Z., Walker, I., & Lawrence, C. (2021). Construal-level theory and psychological distancing: Implications for grand environmental challenges. *One Earth*, *4*(4), 482–486.

Wang, S., Leviston, Z., Hurlstone, M., Lawrence, C., & Walker, I. (2018). Emotions predict policy support: Why it matters how people feel about climate change. *Global Environmental Change*, *50*, 25–40.

Weber, D., Falzon, L., Mitchell, L., & Nasim, M. (2022). Promoting and countering misinformation during australia's 2019–2020 bushfires: A case study of polarisation. *Social Network Analysis and Mining*, *12*(1), 64.

Weber, D., Nasim, M., Falzon, L., & Mitchell, L. (2020). #ArsonEmergency and Australia's "Black Summer": Polarisation and Misinformation on Social Media. In M. van Duijn, M. Preuss, V. Spaiser, F. Takes, & S. Verberne (Eds.), *Disinformation Open Online Media* (pp. 159–173). Springer International Publishing. https://doi.org/10.1007/978-3-030-61841-4_11

Weber, E. U. (2006). Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic change*, *77*(1-2), 103–120.

Weber, E. U. (2010). What shapes perceptions of climate change? *Wiley Interdisciplinary Reviews: Climate Change*, *1*(3), 332–342.

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

Wong-Parodi, G., & Rubin, N. B. (2022). Exploring how climate change subjective attribution, personal experience with extremes, concern, and subjective knowledge relate to pro-environmental attitudes and behavioral intentions in the united states. *Journal of Environmental Psychology*, *79*, 101728.

World Weather Attribution Consortium. (2020, January). *Attribution of the australian bushfire risk to anthropogenic climate change*. https://www.worldweatherattribution.org/bushfires-in-australia-2019-2020/

Xia, Z., Ye, J., Zhou, Y., Howe, P. D., Xu, M., Tan, X., Tian, X., & Zhang, C. (2022). A meta-analysis of the relationship between climate change experience and climate change perception. *Environmental Research Communications*, *4*(10), 105005.

Zanocco, C., Boudet, H., Nilson, R., & Flora, J. (2019). Personal harm and support for climate change mitigation policies: Evidence from 10 us communities impacted by extreme weather. *Global Environmental Change*, *59*, 101984.

Zanocco, C., Boudet, H., Nilson, R., Satein, H., Whitley, H., & Flora, J. (2018). Place, proximity, and perceived harm: Extreme weather events and views about climate change. *Climatic Change*, *149*, 349–365.

Table 1

Summary of auxiliary psychological measures.

Psychological characteristic	Items	Cronbach's α	Range	Example item	Reference
Climate change cognition and affect					
Knowledge Volume	1	-	1 to 4	How much do you feel you know about climate change?	Malka et al. (2009)
Perceptions of Carbon Emission Causes	7	0.92	1 to 7	Please indicate to what extent each of the following is a cause of climate change, to the best of your knowledge: people driving their cars	Andreotta et al. (2022)
Perceptions of Environmental Harm Causes	4	0.87	1 to 7	Please indicate to what extent each of the following is a cause of climate change, to the best of your knowledge: air pollution from toxic chemicals	Andreotta et al. (2022)
Perceptions of Natural Causes	2	0.79	1 to 7	Please indicate to what extent each of the following is a cause of climate change, to the best of your knowledge: volcanic eruptions	Andreotta et al. (2022)
Perceived Personal Consequences	3	0.87	1 to 7	Please rate for each of the following how likely it is as a consequence of climate change by the year 2050: food shortages where you live	Bostrom et al. (2012)
Perceived Societal Consequences	8	0.96	1 to 7	Please rate for each of the following how likely it is as a consequence of climate change by the year 2050: food shortages in many parts of the world	Bostrom et al. (2012)
Perceived Human Contribution	1	-	1 to 7	How likely do you think it is that human actions have changed global climate?	Bostrom et al. (2012)
Perceived Effectiveness of Carbon Policies	3	0.75	1 to 7	Please rate for each step what effect you think it would have on climate change: requiring cars and trucks to have higher fuel efficiency (1 = Reduce or Stop Climate Change, 4 = Neither Reduce nor Increase, 7 = Increase Climate Change)	Bostrom et al. (2012)

(continued)

Psychological characteristic	Items	Cronbach's α	Range	Example item	Reference
Perceived Effectiveness of Engineering Policies	3	0.42	1 to 7	Please rate for each step what effect you think it would have on climate change: putting more dust in the atmosphere (1 = Reduce or Stop Climate Change, 4 = Neither Reduce nor Increase, 7 = Increase Climate Change)	Bostrom et al. (2012)
Perceived Effectiveness of Green Policies	5	0.91	1 to 7	Please rate for each step what effect you think it would have on climate change: planting trees (1 = Reduce or Stop Climate Change, 4 = Neither Reduce nor Increase, 7 = Increase Climate Change)	Bostrom et al. (2012)
Epistemic Scepticism	8	0.91	1 to 5	Climate change is just a natural fluctuation in Earth's temperatures	Capstick and Pidgeon (2014)
Response Scepticism	7	0.89	1 to 5	There is no point in me doing anything about climate change because no-one else is	Capstick and Pidgeon (2014)
Worry about Climate Change	1	-	1 to 4	How strongly do you feel worry when you think about the issue of climate change?	Smith and Leiserowitz (2014)
Cognitive style					
Orientation to Future Goals	4	0.72	1 to 5	I consider how things might be in the future	Enzler (2015)
Orientation to Immediate Goals	5	0.86	1 to 5	I mainly act to satisfy my immediate concerns, figuring the future will take care of itself	Enzler (2015)
Conspiracist Ideation	6	0.90	1 to 5	The Apollo moon landings never happened and were staged in a Hollywood film studio	Lewandowsky et al. (2013)
Need for Cognition	6	0.79	1 to 5	I would prefer complex to simple problems	Lins de Holanda Coelho et al. (2018)
Ideology, worldviews, and values					
Environment-as-Ductile Worldview	6	0.81	1 to 5	If the balance of the natural environment is upset the whole system will collapse	Price et al. (2014)
Environment-as-Elastic Worldview	6	0.85	1 to 5	The natural environment is capable of recovering from any damage humans may cause	Price et al. (2014)

(continued)

Psychological characteristic	Items	Cronbach's α	Range	Example item	Reference
Political Ideology	1	-	1 to 7	Please indicate the extent to which you identify yourself as politically left-wing or right-wing (1 = Very Left-Wing, 7 = Very Right-Wing)	-
System Justification	8	0.85	1 to 9	Everyone has a fair shot at wealth and happiness	Kay and Jost (2003)
Conservation Values	10	0.32	-2.94 to 5.54	Please, rate the importance of the following values as a life-guiding principle for you: CONFORMITY (obedience, honouring parents and elders, self-discipline, politeness)	Lindeman and Verkasalo (2005)
Self-Transcendence Values	10	0.55	-4.84 to 2.52	Please, rate the importance of the following values as a life-guiding principle for you: BENEVOLENCE (helpfulness, honesty, forgiveness, loyalty, responsibility)	Lindeman and Verkasalo (2005)
Personality					
Agreeableness	2	0.27	1 to 5	I see myself as someone who is generally trusting	Rammstedt and John (2007)
Conscientiousness	2	0.53	1 to 5	I see myself as someone who does a thorough job	Rammstedt and John (2007)
Extraversion	2	0.53	1 to 5	I see myself as someone who is outgoing, sociable	Rammstedt and John (2007)
Neuroticism	2	0.62	1 to 5	I see myself as someone who gets nervous easily	Rammstedt and John (2007)
Openness	2	0.14	1 to 5	I see myself as someone who has an active imagination	Rammstedt and John (2007)

Note:
Conservation and Self-Transcendence Value scores were a weighted average of ten items (rated along a nine-point scale). Table reproduced with updated Cronbach's α from Andreotta et al. (2022), under the Creative Commons license (CC BY 4.0).

Table 2

Effect of psychological characteristics on segment membership, as estimated by a multinomial logistic ridge regression for Studies 1 and 3.

	Acceptors		Fencesitters		Sceptics	
Predictors	Study 1	Study 3	Study 1	Study 3	Study 1	Study 3
Intercept						
	+1.64^	**+1.66^**	**+0.56^**	**+1.03^**	**-2.20^**	**-2.69^**
	[1.64, 2.18]	**[1.44, 2.09]**	**[0.44, 0.99]**	**[0.71, 1.32]**	**[-3.06, -2.19]**	**[-3.22, -2.36]**
Climate change cognition and affect						
Epistemic Scepticism	**-0.33^**	**-0.46^**	+0.11	+0.13	**+0.23^**	**+0.33^**
	[-0.59, -0.26]	**[-0.72, -0.25]**	[-0.05, 0.30]	[-0.08, 0.39]	**[0.16, 0.43]**	**[0.19, 0.46]**
Worry about Climate Change	**+0.31^**	+0.13	-0.06	+0.10	**-0.25^**	**-0.23^**
	[0.23, 0.60]	[-0.09, 0.38]	[-0.25, 0.11]	[-0.12, 0.36]	**[-0.50, -0.19]**	**[-0.44, -0.07]**
Response Scepticism	**-0.29^**	**-0.55^**	+0.08	**+0.34^**	**+0.21^**	**+0.21^**
	[-0.55, -0.19]	**[-0.75, -0.37]**	[-0.09, 0.28]	**[0.14, 0.56]**	**[0.15, 0.40]**	**[0.09, 0.35]**
Perceived Human Contribution	**+0.20^**	**+0.27^**	+0.12	-0.06	**-0.32^**	**-0.22^**
	[0.08, 0.41]	**[0.12, 0.51]**	[-0.02, 0.35]	[-0.29, 0.16]	**[-0.59, -0.23]**	**[-0.42, -0.07]**
Perceived Societal Consequences	**+0.19^**	+0.11	-0.09	+0.06	-0.10	**-0.16^**
	[0.06, 0.39]	[-0.08, 0.38]	[-0.30, 0.05]	[-0.21, 0.25]	[-0.23, 0.04]	**[-0.33, -0.02]**
Perceptions of Environmental Harm Causes	+0.08	+0.04	+0.08	+0.19	**-0.16^**	**-0.22^**
	[-0.09, 0.26]	[-0.18, 0.24]	[-0.08, 0.28]	[0.00, 0.43]	**[-0.32, -0.05]**	**[-0.37, -0.10]**
Knowledge Volume	-0.10	-0.05	-0.06	-0.01	**+0.15^**	+0.06
	[-0.34, 0.01]	[-0.25, 0.13]	[-0.24, 0.10]	[-0.22, 0.19]	**[0.04, 0.43]**	[-0.11, 0.26]
Perceptions of Carbon Emission Causes	**+0.15^**	+0.15	+0.04	**+0.29^**	**-0.19^**	**-0.44^**
	[0.00, 0.35]	[-0.02, 0.32]	[-0.11, 0.23]	**[0.09, 0.49]**	**[-0.36, -0.11]**	**[-0.59, -0.29]**
Perceived Effectiveness of Engineering Policies	**-0.13^**	+0.09	**+0.14^**	-0.10	-0.01	+0.01
	[-0.36, -0.01]	[-0.11, 0.31]	**[0.01, 0.36]**	[-0.31, 0.11]	[-0.14, 0.15]	[-0.15, 0.16]
Perceived Personal Consequences	+0.12	+0.12	-0.02	-0.09	-0.10	-0.03
	[-0.03, 0.30]	[-0.09, 0.36]	[-0.19, 0.14]	[-0.31, 0.15]	[-0.23, 0.02]	[-0.21, 0.11]
Perceived Effectiveness of Carbon Policies	+0.11	-0.13	-0.03	+0.17	-0.08	-0.03
	[-0.03, 0.35]	[-0.34, 0.09]	[-0.23, 0.15]	[-0.07, 0.36]	[-0.27, 0.02]	[-0.16, 0.13]
Perceived Effectiveness of Green Policies	+0.10	-0.04	-0.04	+0.10	-0.06	-0.06
	[-0.02, 0.30]	[-0.24, 0.17]	[-0.20, 0.14]	[-0.12, 0.31]	[-0.27, 0.05]	[-0.20, 0.08]
Perceptions of Natural Causes	-0.08	-0.15	+0.05	+0.10	+0.02	+0.05
	[-0.26, 0.08]	[-0.40, 0.05]	[-0.10, 0.24]	[-0.12, 0.36]	[-0.15, 0.20]	[-0.16, 0.25]
Cognitive style						
Orientation to Future Goals	+0.05	+0.21	+0.06	+0.10	-0.11	**-0.31^**
	[-0.11, 0.25]	[0.00, 0.38]	[-0.10, 0.26]	[-0.09, 0.30]	[-0.33, 0.04]	**[-0.47, -0.11]**
Conspiracist Ideation	**-0.15^**	**-0.49^**	**+0.15^**	**+0.33^**	+0.00	+0.16
	[-0.36, -0.02]	**[-0.70, -0.32]**	**[0.02, 0.36]**	**[0.15, 0.55]**	[-0.18, 0.17]	[-0.02, 0.34]
Need for Cognition	-0.12	-0.07	+0.01	-0.02	+0.10	+0.09
	[-0.32, 0.01]	[-0.25, 0.15]	[-0.15, 0.18]	[-0.23, 0.19]	[-0.03, 0.31]	[-0.12, 0.27]
Orientation to Immediate Goals	+0.02	-0.16	0.00	+0.15	-0.02	+0.02
	[-0.12, 0.25]	[-0.42, 0.00]	[-0.20, 0.17]	[-0.04, 0.41]	[-0.21, 0.10]	[-0.18, 0.21]

(continued)

	Acceptors		Fencesitters		Sceptics	
Predictors	Study 1	Study 3	Study 1	Study 3	Study 1	Study 3
Ideology, worldviews, and values						
Environment-as-Ductile Worldview	+0.18 [-0.01, 0.44]	**+0.40^ [0.23, 0.62]**	-0.11 [-0.36, 0.05]	**-0.21^ [-0.43, -0.01]**	-0.07 [-0.21, 0.10]	**-0.19^ [-0.36, -0.04]**
Conservation Values	-0.11 [-0.32, 0.02]	**-0.26^ [-0.46, -0.06]**	+0.01 [-0.17, 0.18]	-0.02 [-0.22, 0.22]	+0.11 [-0.05, 0.32]	**+0.27^ [0.06, 0.45]**
Environment-as-Elastic Worldview	**-0.20^ [-0.43, -0.05]**	**-0.37^ [-0.58, -0.20]**	+0.05 [-0.15, 0.23]	+0.07 [-0.12, 0.33]	**+0.15^ [0.03, 0.38]**	**+0.30^ [0.12, 0.46]**
System Justification	+0.04 [-0.12, 0.25]	**+0.20^ [0.04, 0.39]**	+0.06 [-0.12, 0.23]	**-0.23^ [-0.44, -0.04]**	-0.09 [-0.30, 0.07]	+0.03 [-0.16, 0.22]
Self-Transcendence Values	+0.04 [-0.10, 0.21]	+0.17 [-0.04, 0.36]	-0.10 [-0.28, 0.05]	+0.02 [-0.20, 0.21]	+0.06 [-0.12, 0.24]	**-0.19^ [-0.33, 0.00]**
Political Ideology	**-0.18^ [-0.41, -0.04]**	-0.10 [-0.35, 0.12]	+0.03 [-0.17, 0.19]	-0.16 [-0.38, 0.06]	**+0.16^ [0.02, 0.40]**	**+0.26^ [0.09, 0.47]**
Personality						
Extraversion	-0.01 [-0.15, 0.14]	+0.03 [-0.21, 0.22]	+0.03 [-0.11, 0.19]	**+0.23^ [0.04, 0.45]**	-0.02 [-0.18, 0.11]	**-0.26^ [-0.43, -0.07]**
Conscientiousness	+0.03 [-0.09, 0.20]	-0.14 [-0.33, 0.01]	-0.06 [-0.21, 0.09]	**+0.19^ [0.01, 0.39]**	+0.03 [-0.15, 0.16]	-0.05 [-0.19, 0.11]
Neuroticism	+0.11 [-0.01, 0.30]	+0.03 [-0.15, 0.22]	-0.02 [-0.17, 0.14]	-0.08 [-0.30, 0.10]	-0.09 [-0.29, 0.01]	+0.05 [-0.09, 0.23]
Agreeableness	+0.04 [-0.11, 0.20]	+0.01 [-0.18, 0.24]	+0.02 [-0.13, 0.17]	-0.03 [-0.27, 0.16]	-0.06 [-0.21, 0.10]	+0.03 [-0.18, 0.23]
Openness	0.00 [-0.16, 0.14]	+0.01 [-0.18, 0.23]	-0.07 [-0.24, 0.06]	0.00 [-0.22, 0.19]	+0.07 [-0.05, 0.25]	-0.01 [-0.22, 0.17]

Note:
Square brackets indicate 95% confidence intervals, estimated using bootstrapping with 10,000 samples. Coefficients with confidence intervals that do not include zero are marked with a caret (^) and are bolded.

Table 3

Sample characteristics and materials for each of the three studies.

	Study		
Characteristics	1	2	3
Time	Before peak bushfire severity	After peak bushfire severity	After peak bushfire severity
Data collection dates			
Start	24-Sep-2019	25-Feb-2020	13-Mar-2020
End	09-Nov-2019	02-Mar-2020	26-Mar-2020
Sample characteristics			
n	435	413	213
Mean age in years (*SD*)	46.71 (17.77)	46.82 (18.04)	47.13 (17.29)
Number of women in sample (%)	219 (50.34%)	198 (47.94%)	103 (48.36%)
Materials			
Q-sort task	✓	✓	✓
Auxiliary psychological scales	✓	✗	✓
Fire Perception Scale	✗	✗	✓
Change in policy items	✗	✗	✓

Table 4

Difference in means of climate change cognition and affect characteristics between Study 1 and Study 3.

	$M_{Study\ 3} - M_{Study\ 1}$				
Psychological characteristics	Estimate	95% *CI*	*t*	*p*	$p_{adjusted}$
Perceptions of Natural Causes	0.39	[0.13, 0.65]	2.95	.003	.04*
Response Scepticism	0.19	[0.03, 0.35]	2.29	.022	.27
Perceived Effectiveness of Green Policies	-0.20	[-0.45, 0.05]	-1.60	.110	1.00
Worry about Climate Change	-0.11	[-0.28, 0.05]	-1.35	.178	1.00
Perceptions of Carbon Emission Causes	-0.15	[-0.38, 0.08]	-1.29	.197	1.00
Perceived Human Contribution	-0.18	[-0.46, 0.11]	-1.22	.222	1.00
Epistemic Scepticism	0.09	[-0.08, 0.25]	1.04	.300	1.00
Knowledge Volume	0.06	[-0.06, 0.19]	0.99	.325	1.00
Perceived Personal Consequences	0.12	[-0.12, 0.36]	0.97	.331	1.00
Perceptions of Environmental Harm Causes	-0.10	[-0.35, 0.16]	-0.75	.457	1.00
Perceived Effectiveness of Engineering Policies	-0.04	[-0.22, 0.14]	-0.43	.670	1.00
Perceived Effectiveness of Carbon Policies	-0.04	[-0.25, 0.18]	-0.33	.742	1.00
Perceived Societal Consequences	-0.01	[-0.25, 0.22]	-0.11	.914	1.00

Note:

*$p_{adjusted} < .05$;

p values were adjusted using the Holm (1979) method.

Table 5

Items of the Fire Perception Scale, their loadings onto each factor, their mean score, and their standard deviation.

Item	Factors			Descriptives	
	Climate Processes	Fire Realities	Arson Causes	*M*	*SD*
1. Climate change made the 2019-20 Australian bushfires more severe	**0.78**	0.34	-0.22	3.62	1.40
2. Climate change made the 2019-20 Australian bushfires less likely to occur	0.27	**-0.70**	**0.42**	2.19	1.27
3. The 2019-20 Australian bushfires have accelerated climate change	**0.84**	0.05	-0.14	3.16	1.30
4. The 2019-20 Australian bushfires are severe	0.17	**0.86**	0.23	4.50	0.79
5. If the government increased taxes on all fossil fuels (e.g., gasoline, oil, coal, kerosene), Australia would be less likely to experience extreme bushfires	**0.84**	-0.19	0.13	2.55	1.32
6. If we changed our lifestyles to reduce our consumption, Australia would be less likely to experience bushfires	**0.86**	-0.06	0.08	3.05	1.39
7. Over one hundred arsonists have contributed to the 2019-20 Australian bushfires	-0.10	0.04	**0.94**	3.47	1.20

Note:

Bolded loadings are greater than .40 in magnitude.

Figure 1

Schematic of the Q-sort task. Participants read through a stack of statements (A) by dragging the top-most statement into the grey box that best corresponded to their point of view (B). As the majority of statements had to be placed around the midpoint, participants could only highlight a few statements that strongly reflect their point of view. Participants could rearrange statements at any time during the task. To facilitate this process, participants could temporarily place statements in the yellow holding area (C). Figure reproduced without changes from Andreotta et al. (2022), under the Creative Commons license (CC BY 4.0).

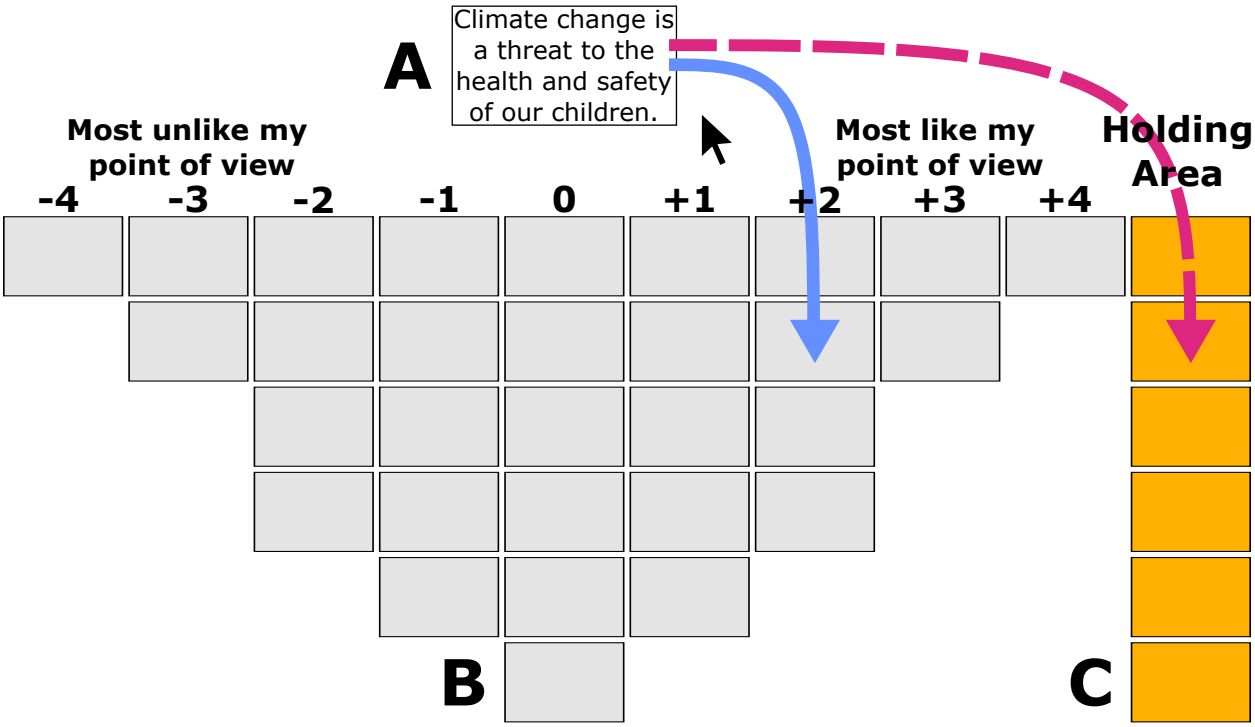

Figure 2

The segment membership of each study, as a proportion (percentage) of the sample. Error bars indicate one standard error of the proportion.

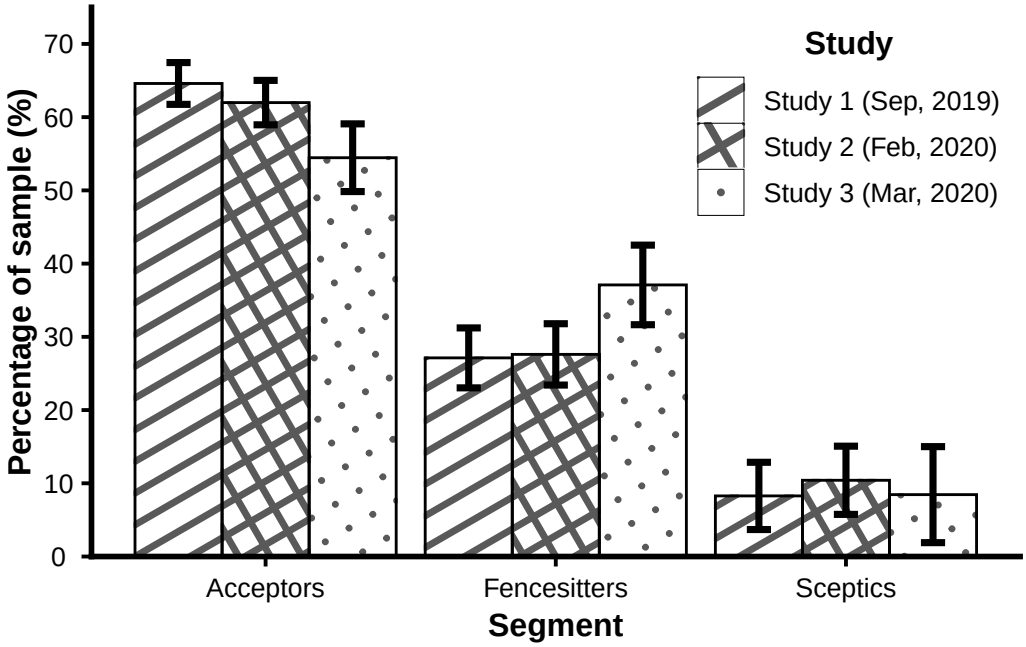

Figure 3

Mean Fire Perception subscale scores as a function of segment. Error bars indicate one standard error above and below the mean.

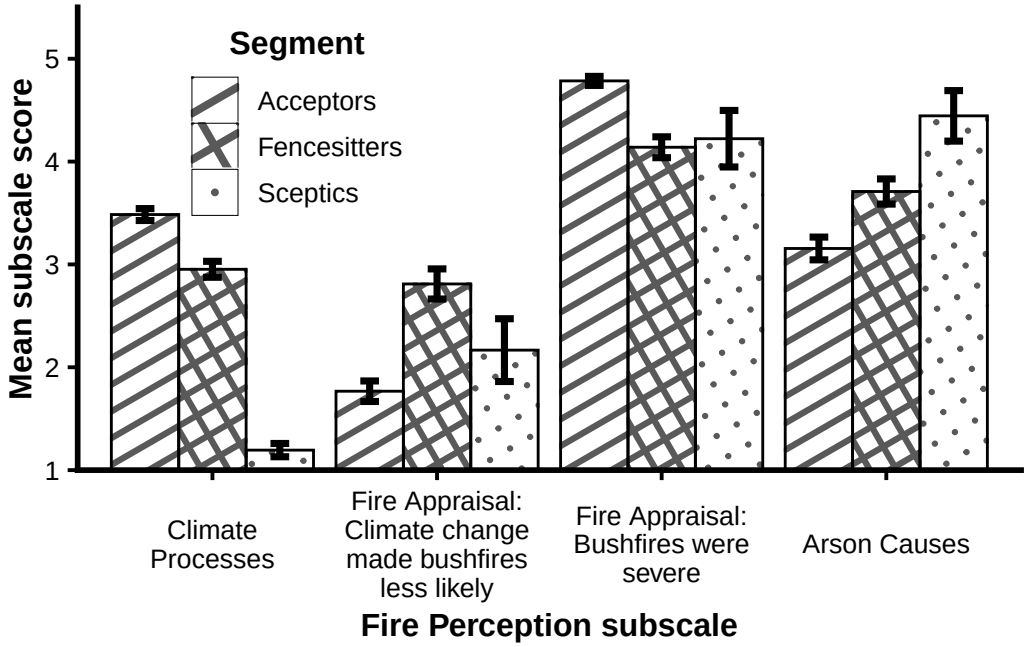

Figure 4

Policy direction preferences as a proportion (percentage) of each segment. Error bars indicate one standard error of the proportion.