

1 **Do weather-related extreme events influence climate-related opinions? The**  
2 **case of the 2019–2020 Australian Black Summer bushfires**

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20           **Data accessibility.** Data and relevant code for this research work are stored in  
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**Abstract**

37

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

55

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

58 **Do weather-related extreme events influence climate-related opinions? The**  
59 **case of the 2019–2020 Australian Black Summer bushfires**

60 In October 2019, lightning ignited the largest fire in Australia’s recent history [1].  
61 The ‘megafire’, so-called for its intensity, size, and difficulty to control, endured for fifteen  
62 weeks, burning 512,000 hectares of land, including the Blue Mountains World Heritage  
63 Area [1]. Accompanying the megafire were bushfires in all Australian states and territories  
64 throughout the unprecedented 2019-2020 bushfire season [2], which became known as the  
65 Black Summer. Together, these fires directly killed at least 33 people, burnt over 24 million  
66 hectares, destroyed over 3,000 homes, killed or displaced nearly three billion animals, and  
67 affected nearly 80% of Australians either directly or indirectly [3, 4]. On a local scale, the  
68 fires trapped thousands of Australians without essential goods and services [3]. On a  
69 national and international scale, the fires transformed the usually festive season into one of  
70 grief and vigilance [5].

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

79 **Effects of weather-related extreme events on climate-related opinions**

80 As climate change increases the frequency and severity of many weather-related  
81 extreme events (hereafter, ‘extreme events’)[6], such as heatwaves, floods, and bushfires,  
82 there are several theoretical reasons for expecting that people’s personal experience of these  
83 events might influence their climate-related opinions. First, an often-cited barrier to  
84 climate change concern and action is psychological distance [7–10]. It is frequently assumed

85 that many people are unconcerned about climate change because they are uncertain about  
86 whether it is happening (hypothetical distance) and think that, if it is happening, it will  
87 affect other people (social distance), in other places (spatial distance), in the distant future  
88 (temporal distance) [for critiques of this idea, see 11–13]. Thus, experience of extreme  
89 events should reduce the psychological distance to climate change, increasing concern  
90 about the issue and willingness to act. Second, although belief in anthropogenic climate  
91 change is generally high among the public, there are indications that the issue is not as  
92 salient as other problems [14]. Experience of extreme events may trigger community  
93 discussions that place the issue “top-of-mind” in the public’s consciousness [15, 16], making  
94 the problem more salient and increasing support for relevant policies [17]. Third,  
95 experience of extreme events makes the abstract risks of climate change concrete and may  
96 provoke negative affective responses that could increase people’s willingness to mitigate the  
97 problem [18–20]. Indeed, it is well-established that the experience of negative affect  
98 associated with climate change is a key predictor of climate risk perceptions and policy  
99 support [21–23]. We refer to these three mechanisms by which experience of extreme events  
100 might influence climate-related opinions as the psychological distance, issue salience, and  
101 affect activation accounts, respectively [24].

102 Over the past decade or so, a burgeoning literature has sought to establish whether  
103 personal experience of extreme events influences climate-related opinions [for reviews, see  
104 24–29]. In this literature, personal experience has been operationalised in different ways.  
105 Studies examining subjective experience typically ask participants to self-report whether  
106 they have personally experienced an extreme event. By contrast, studies examining  
107 objective experience use externally measured extreme events in participants’ place of  
108 residence (e.g., country, region, or postcode) as a proxy for personal experience. The  
109 results of this literature have been somewhat mixed. On the one hand, and consistent with  
110 the precedents just reviewed, several studies have shown that self-reported or objectively  
111 recorded personal experience of extreme events, including drought [30], flooding [16,

112 31–34], heatwaves [35], storms [18, 36], and, notably, forest fires [37, 38], increases belief in  
113 and concern about climate change. For example, Spence et al. [33] found that UK  
114 households who reported experiencing flooding were more concerned about climate change,  
115 perceived it as less uncertain, and felt more confident that their actions would make a  
116 difference, compared to households that did not experience flooding. On the other hand,  
117 other studies have failed to document an association between climate-related opinion  
118 measures and personal experience of climate extremes [39, 40], drought [41], flooding [42,  
119 43], storms [44], and multiple disasters including a bushfire, cyclone, and drought [45]. A  
120 recent meta-analysis using data from 302 studies found that personal experience of extreme  
121 events only has a weak positive association with climate change awareness, with effect sizes  
122 varying considerably across different types of extreme events [46].

123         There are a few known moderators of the effect of personal experience of extreme  
124 events on climate-related opinions [see e.g., 24, 29] that are especially relevant to the  
125 current work. First, personal experience of an extreme event may only influence  
126 climate-related opinions when individuals causally attribute that event to climate change  
127 [47]. Empirical support for this proposition has been provided in numerous studies [31,  
128 48–50]. For example, Ogunbode et al. [49] found that personal experience of flooding only  
129 predicted climate risk perceptions for individuals who attributed the flooding to climate  
130 change.

131         Second, the effect of personal experience of extreme events on climate-related  
132 opinions depends on people’s pre-existing climate change beliefs, a pattern consistent with  
133 motivated reasoning—the tendency for individuals to interpret information in ways that  
134 protect or reinforce their prior beliefs [51, 52]. Experience of extreme events tends to  
135 increase climate risk perceptions primarily among people who already accept climate  
136 change, whereas those who are more sceptical show little or no change [37]. A  
137 complementary line of research uses political ideology as a proxy for these pre-existing  
138 climate change beliefs, based on the well-established association between liberalism and

139 acceptance of climate science and conservatism and climate scepticism [53]. This work  
140 shows that liberals are more likely than conservatives to perceive or interpret extreme  
141 events in ways consistent with climate change [38, 44]. Other work demonstrates that  
142 whether people attribute extreme events to climate change is itself shaped by their prior  
143 beliefs and political ideology [31, 49].

144 Third, media attention to an extreme event may also be necessary for it to shape  
145 climate-related opinions. Extreme events can serve as “focusing events” [54, 55]—sudden,  
146 uncommon, and attention-grabbing occurrences that attract increased media coverage  
147 [56–58] and create opportunities to highlight the links between such events and ongoing  
148 climate change. Media attention to climate change has been shown to influence climate  
149 attitudes [59] and increase public conversations about the issue [60]. However, the effect of  
150 media attention may depend on its frequency and prominence, whether the event is  
151 causally attributed to climate change, and on the presence of competing narratives or  
152 misinformation that undermine the connection between climate change and the extreme  
153 event.

#### 154 **Divergent mass media and social media bushfire narratives**

155 Because media coverage can shape causal attributions and amplify motivated  
156 reasoning, understanding how the bushfires were portrayed in the media is necessary for  
157 interpreting how Australians made sense of the Black Summer. Mocatta and Hawley [61]  
158 charted the content and evolution of media coverage of the Black Summer, which focused  
159 predominantly on the causes of the fires and what or who was to blame. Much mass media  
160 coverage initially discussed the bushfires within the broader context of climate change—a  
161 connection that had already been discussed in the lead-up to the fire season—and  
162 presented apocalyptic images and descriptions of the devastation caused. As the fires  
163 intensified, however, mass-media reporting of their causes increasingly diverged along  
164 ideological lines. Public broadcasters and liberal media outlets framed the bushfires in  
165 relation to climate change, whereas conservative media outlets sought to downplay the

166 severity of the fires and cast doubt on the link between bushfires and climate change. A  
167 key argumentation strategy in the conservative media at this time was the claim that the  
168 fires were “nothing new” and in keeping with historic bushfires in terms of their severity  
169 [62]. Additionally, some conservative media argued that the Black Summer was worsened  
170 by “Greens policies” that prevented firefighters from reducing fuel loads [63], despite the  
171 Greens’ platform’s overt support for hazard reduction [64].

172         Coinciding with the emergence of these narratives in the conservative mass media,  
173 misinformation began to emerge on the social media platform formally known as Twitter  
174 (now X) in Australia and internationally. Under the hashtag #ArsonEmergency, false  
175 claims began to circulate that the bushfires were caused by arson, that preventative  
176 backburning efforts had been reduced due to green activism, that Australia commonly  
177 experienced such bushfires, and that climate change is unrelated to bushfires [65, 66].  
178 Social media researchers agree that the activities were likely a deliberate disinformation  
179 campaign [65, 67].

180         Online misinformation spread under the #ArsonEmergency hashtag, notably the  
181 claim that arsonists were a major cause of the fires, subsequently influenced conservative  
182 mass-media reporting of the bushfires. A prominent example was an article published in  
183 The Australian under the title “Bushfires: firebugs fuelling crisis as national arson toll hits  
184 183” claiming that “more than 180 alleged arson cases have been recorded since the start of  
185 the bushfire season” [68]. The article played a prominent role in fuelling online climate  
186 change denial narratives and was shared by prominent conservatives, such as Donald  
187 Trump Jr., to his audience of four million followers on Twitter, thus propelling the  
188 misinformation to a much larger online audience. The arson claims were grossly  
189 exaggerated [69], calculated based on a range of fire-related offences other than arson, and  
190 relied on annual figures rather than the Black Summer bushfire season [70].

191         In summary, media coverage of the Black Summer bushfires focused predominantly  
192 on the causes of the fires and was characterised by a power struggle between two competing

193 narratives. One narrative emphasised a relationship between climate change and bushfires,  
194 supported by assessments from scientists and statements from major Australian scientific  
195 organisations highlighting the unprecedented nature of the fires and their consistency with  
196 a broader pattern of escalating fire risk under climate change [2, 71–76]. The other  
197 narrative, fuelled by misinformation, cast doubt on the relationship between climate  
198 change and bushfires and promoted alternative explanations for the Black Summer fires,  
199 notably exaggerated claims about arson. This polarised and divisive mass media and social  
200 media landscape could have persuaded those undecided about climate change to become  
201 more accepting or sceptical about the issue. Thus, whether the Black Summer bushfires  
202 and accompanying media narratives altered the climate-related opinions of those undecided  
203 about climate change is an open empirical question.

#### 204 **Current research**

205 In the following, we report the results of three audience segmentation studies of  
206 Australian climate-related opinions. The studies were undertaken to identify distinct  
207 sub-groups of the Australian population that hold different views about climate change.  
208 All three studies employed the Q methodology [77, 78], in which participants completed a  
209 Q-sort task by rank-ordering a series of opinion statements about climate change, derived  
210 from a large-scale analysis of Australian Twitter climate commentary [79, 80], according to  
211 how similar each was to their point of view. Participants' rank-orderings of the statements  
212 were then subjected to Q-factor analysis to identify distinct audience segments of  
213 climate-related opinions.

214 In Study 1 (September 2019), which took place before the peak of the Black  
215 Summer bushfires, participants completed the Q-sort task along with a battery of measures  
216 of prominent psychological characteristics to help facilitate interpretation of the different  
217 audience segments. We found evidence for a three-segment solution comprising Acceptors,  
218 Fencesitters, and Sceptics, ordered from the highest to the lowest belief in anthropogenic  
219 climate change, trust in climate science, concern about the issue, and motivation to tackle

220 it. Segments also differed in their climate change concern and scepticism, mental models of  
221 climate change, political ideology, and worldviews, as assessed using the auxiliary  
222 psychological characteristic measures.

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

230 These two studies were part of a planned program of research that predated the  
231 bushfires but coincided with their occurrence, affording us a natural experiment, so to  
232 speak, to determine whether the bushfires catalysed a change in Australian climate-related  
233 opinions. The results of these two studies have been reported elsewhere [80], but have not  
234 yet been systematically compared to determine whether the occurrence of the bushfires  
235 influenced Australian climate-related opinions. In the current paper, we undertake this  
236 comparison and report the results of a third study conducted one month after our second  
237 study, near the end of the Black Summer. In Study 3 (March 2020), participants completed  
238 the Q-sort task and the same battery of psychological characteristic measures used in  
239 Study 1. Additionally, participants completed a measure of bushfire perceptions assessing  
240 their endorsement of various media and political claims about the bushfires—for example,  
241 that climate change worsened them, that the fires were severe, and that arsonists  
242 contributed to their occurrence—and a measure of the degree to which the bushfires  
243 warranted a change in Australia’s climate policy.

244 It is important to note that because Studies 1 and 2 were not originally designed to  
245 measure personal experience of the bushfires, we did not collect participants’ residential  
246 locations or self-reported measures of experience of the Black Summer bushfires, and these

247 measures were not included in Study 3. Instead, we consider our participants as members  
248 of a population that was very likely to have been affected, directly or indirectly, by the  
249 fires, given their scale, societal reach, and extensive environmental impacts [4], and treat  
250 this as an objective, population-level proxy for personal experience.

251         Whereas our earlier research focused on identifying the number, nature, and  
252 psychological characteristics of Australia’s climate change audience segments [80], the  
253 present work leverages a longitudinal cross-sectional design to examine whether  
254 climate-related opinions shifted across different stages of the Black Summer bushfires.  
255 Using data from all three studies, we first confirmed that the three-segment solution and  
256 the pattern of psychological characteristic differences between segments reported by  
257 Andreotta et al. [80] generalised to Study 3. Next, we explored whether climate-related  
258 opinions varied in response to the Black Summer bushfires, by testing for between-study  
259 differences in the proportion of participants assigned to each segment (Studies 1, 2, & 3)  
260 and in climate change cognition and affect (Study 1 vs. Study 3). Finally, to better  
261 understand any observed shifts or stability in climate-related opinions, we analysed  
262 segment-specific perceptions and preferred policy responses to the Black Summer bushfires  
263 (Study 3). Of particular interest was the degree to which participants causally attributed  
264 the bushfires to climate change versus alternative explanations based on the erroneous  
265 causal claim that the fires were deliberately ignited by arsonists, and whether these  
266 patterns of causal attribution could be understood in terms of motivated reasoning.

267         From an empirical standpoint, the mixed evidence on how extreme events influence  
268 climate-related opinions makes it difficult to specify directional hypotheses. However, from  
269 a theoretical standpoint, the psychological distance, issue salience, and affect activation  
270 accounts introduced at the outset predict that—to the extent that people interpreted the  
271 bushfires as having been worsened by climate change—experience of the bushfires should  
272 make climate change feel more psychologically proximal, heighten the salience of the issue,  
273 and elicit affective responses (e.g., worry) that increase perceived climate risk. Accordingly,

274 a strong prediction is that the proportion of Fencesitters would decrease and the  
275 proportion of Acceptors would increase across studies. A weaker prediction is that, even if  
276 segment composition remains stable, scores on the continuous measures of climate change  
277 cognition and affect would change in a manner that reflects greater acceptance of, and  
278 concern about, the issue (e.g., increased worry and reduced scepticism).

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

## 288 Method

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

## 294 Participants

295 Table 1 provides an overview of the key characteristics of the study samples and the  
296 materials they completed. Data were collected at three time periods. Study 1 was  
297 conducted in September ( $n = 387$ , 88.97% of Study 1 participants), October ( $n = 42$ ,  
298 9.66% of Study 1 participants), and November ( $n = 6$ , 1.38% of Study 1 participants) of  
299 2019, prior to the peak of the Black Summer bushfires. Study 2 was conducted in February  
300 ( $n = 403$ , 97.58% of Study 2 participants) and March ( $n = 10$ , 2.42% of Study 2

301 participants) of 2020, after the peak of the bushfires. Study 3 was conducted in March  
302 2020 ( $n = 213$ ), approaching the end of the Black Summer bushfires.

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

## 312 **Materials**

### 313 *Q-sort task*

314 To segment participants into climate change audiences, we used the Q-sort task [77,  
315 78]. This task requires a set of opinion statements capturing the breadth of conversational  
316 possibilities around an issue, elicited through a bottom-up process. To create our  
317 statements, we drew upon previous work that used an inductive process to identify the  
318 structure of climate change commentary of Australian tweets [79]. This research revealed  
319 five enduring themes of public discourse on climate change: climate change action, climate  
320 change consequences, climate change conversations, climate change denial, and the  
321 legitimacy of climate science and climate change. For each theme, we selected six tweets  
322 that captured the heterogeneity of the theme [see 80]. The resulting 30 tweets were  
323 transcribed as statements that could be understood without the social context of the  
324 original tweet. Where possible, language, sentiment, and tone were preserved. Statements  
325 included: "It is important to vote for leaders who will combat climate change" (climate  
326 change action), "Climate change is a threat to the health and safety of our children"  
327 (climate change consequences), "It is shameful that climate change, the greatest problem of

328 our time, is barely discussed in the media” (climate change conversations), “Climate  
329 change sceptics ignore basic climate science facts” (climate change denial), and “Scientists  
330 should stop falsely claiming that climate change is a settled science” (legitimacy of climate  
331 science and climate change).

332 The Q-sort task was divided into three parts. In part 1, to encourage reflection,  
333 participants began by reading each statement and determining if it was: (1) like their point  
334 of view; (2) unlike their point of view; or (3) neutral or unsure. In part 2, participants  
335 ranked each statement according to how closely it matched their point of view, assigning a  
336 rank from -4 (most unlike their point of view) to +4 (most like their point of view). The  
337 distribution of possible ranks was forced and non-uniform, such that participants had to  
338 consider the few statements to place at the extremes (Figure 1). This encourages  
339 participants to carefully reflect on their views while completing the task [77, 78]. Finally, in  
340 part 3, participants were asked to justify their placement of statements assigned extreme  
341 ranks.

### 342 *Auxiliary psychological scales*

343 A battery of 28 auxiliary psychological characteristic measures was assembled (Table  
344 2). Among these, the most relevant to the current research were state-based psychological  
345 scales of climate change cognition and affect. Specifically, we measured general belief in  
346 anthropogenic climate change, with scales concerning epistemic scepticism (doubt about  
347 anthropogenic climate change), response scepticism (doubt about the effectiveness of  
348 climate change mitigation), perceived human contribution (belief that humans have altered  
349 the global climate), knowledge volume (self-perceived confidence in climate change  
350 knowledge), and worry about climate change. Additionally, we included higher-resolution  
351 inventories to quantify participants’ mental models of specific climate change causes,  
352 climate change consequences, and the effectiveness of climate change mitigation policies.

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

355 worldviews, and values; and personality.

### 356 *Fire Perception Scale*

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

### 371 *Policy direction preferences*

372 To measure participants’ views on the policy consequences of the Black Summer  
373 bushfires, they responded to two items. First, participants were asked: “Do the 2019-20  
374 Australian bushfires justify a change in Australia’s climate change policy?”. Participants  
375 could respond with one of four options: (1) “Yes, the Australian government should be  
376 taking further action to mitigate climate change”; (2) “No, the Australian government  
377 should not modify the current climate change policy”; (3) “Yes, the Australian government  
378 should be taking less action to mitigate climate change”; and (4) “Yes, the Australian  
379 government should be taking no action at all to mitigate climate change”. Next,  
380 participants were asked to justify their response (“Why?”) through writing an open-ended  
381 response.

## 382 Procedure

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

## 393 Sample size justification

394 Sample sizes and the statistical power of our analyses were determined by practical  
395 constraints [81]. Studies 1 ( $n = 435$ ) and 2 ( $n = 413$ ) were undertaken prior to the current  
396 research, with their sample sizes being chosen based on their original objectives [80]. Study  
397 3 ( $n = 213$ ) was made possible by remaining grant funds from the earlier studies. Although  
398 smaller than the first two studies, this sample represented the maximum feasible sample  
399 size given the available budget and the need for rapid data collection following the  
400 bushfires. To determine the power of tests to detect study differences in climate change  
401 audience segments, cognition, and affect, we conducted a sensitivity power analysis with  
402 the G\*Power program [82, 83]. We found our analyses had sufficient power ( $\geq .80$ ) to  
403 detect the expected small effects of study differences in audience segment membership (for  
404 effect sizes of Cohen's  $\omega \geq 0.106$  for a likelihood-ratio  $\chi^2$  test) and climate change cognition  
405 and affect measures (for effect sizes of Cohen's  $d \geq 0.235$  for  $t$  tests of mean differences).

## 406 Results

407 The results are structured into four sections. First, we assess whether the  
408 three-segment solution and the pattern of psychological characteristic differences between

409 segments documented in our original analysis of Studies 1 and 2 [80] generalise to Study 3.  
410 Second, we examine whether the proportion of participants in each segment (Studies 1, 2,  
411 & 3) and their responses on the climate change cognition and affect measures (Studies 1 &  
412 3) changed over time. Third, we investigate segment differences in bushfire perceptions  
413 (Study 3), and fourth, we analyse segment differences in policy preferences (Study 3). All  
414 analyses were completed with the *R* programming language [84].

### 415 **Replication of the three-segment solution**

416 As per our previous research, we used the Q methodology to identify distinct views  
417 on climate change [77]. The Q methodology transposes traditional dimension reduction  
418 techniques to reduce the dimensions of *people* rather than *items*. For each study, we used  
419 principal components analysis with varimax rotation to group individuals with similar  
420 Q-sort ranks. We extracted a single factor, as the second component accounted for only a  
421 minor amount of variance in each study. The extracted factor represented a dimension of  
422 anthropogenic climate change acceptance. Based on factor loadings, we divided individuals  
423 into one of three segments: (1) *Acceptors* ( $n = 653, 61.55\%$ ), whose positive factor loading  
424 was statistically significant from zero ( $p < .05$ ); (2) *Sceptics* ( $n = 97, 9.14\%$ ), whose  
425 negative factor loading was statistically significant from zero ( $p < .05$ ); and (3) *Fencesitters*  
426 ( $n = 311, 29.31\%$ ), whose factor loading was not statistically significant from zero ( $p \geq .05$ ).

427 Although the number of segments was consistent across studies, the nature of the  
428 segments may vary. To explore this possibility, we constructed an average Q sort for  
429 Acceptors and Sceptics in each study [77]. The ranks assigned to each statement were  
430 averaged (weighted by participants' factor loading). These averages were then ranked to  
431 align with the Q-sort structure, generating a set of values known as factor scores. For  
432 example, the statement with the lowest average corresponded to a factor score of -4 and  
433 the statement with the highest average corresponded to a factor score of +4 (see  
434 Supplementary Results for all factor scores). We did not build a representative Q sort for  
435 Fencesitters as the sorting behaviour of this segment is more heterogenous than the other

436 two segments (otherwise Fencesitters would have emerged as a separate factor). In all three  
437 studies, the greatest factor score for Acceptors corresponded to the statement “It is  
438 important to vote for leaders who will combat climate change”, whereas the greatest factor  
439 score for Sceptics corresponded to the statement “Scientists should stop falsely claiming  
440 that climate change is a settled science.”

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

448 We also explored whether segments were distinguished by a consistent pattern of  
449 psychological characteristics by replicating the regression analysis of Andreotta et al. [80].  
450 This analysis was complicated by multicollinearity, which can lead to unstable coefficient  
451 estimates in traditional regression approaches. Instead, we sought to produce stable  
452 estimates with a ridge regression model. A ridge regression reduces the variance of  
453 estimates caused by multicollinearity by shrinking the coefficients towards zero [a  
454 bias-variance tradeoff; 85]. With the *glmnet* package [86], we fitted a multinomial logistic  
455 ridge regression model to predict segment membership as a function of psychological  
456 characteristics for Study 1 and Study 3. The degree of shrinkage, controlled by a  
457 hyperparameter  $\lambda$ , was chosen by a cross-validation process ( $k$ -fold) that minimised  
458 multinomial deviance. Prior to analysis, we converted responses to  $z$  scores for each  
459 predictor in each study. Confidence intervals were estimated by repeating the modelling  
460 procedure via bootstrapping with 10,000 samples [sampled with replacement; 87].

461 The ridge regression model demonstrated good fit for both Study 1 (83.22%  
462 accuracy, accounting for 49.07% of null deviance) and Study 3 (88.26% accuracy,

463 accounting for 66.39% of null deviance). As seen in Table 3, the models' coefficients were  
464 generally consistent (same sign) across studies, indicating a robust association between  
465 psychological characteristics and segment membership. Regarding climate change cognition  
466 and affect, Acceptors and Sceptics were distinguished by opposing patterns of climate  
467 change scepticism and belief in anthropogenic climate change. In contrast, the Fencesitters  
468 of Study 3 were characterised by response scepticism and perceptions that carbon-emitting  
469 activities cause climate change. Turning to cognitive styles, conspiracist ideation was  
470 positively associated with Fencesitter membership, and negatively associated with Acceptor  
471 membership (both studies), whereas Sceptics were characterised by a reduced orientation  
472 towards future consequences (Study 3). Generally, Acceptors and Sceptics were  
473 distinguished by opposing patterns of ideologies, worldviews, and values. Lastly,  
474 personality tended not to be a robust predictor of segment membership, although evidence  
475 from Study 3 indicated that Fencesitters were characterised by greater extraversion and  
476 conscientiousness, whereas Sceptics were characterised by greater introversion.

#### 477 **Change in climate change segment membership, cognition, and affect**

478 To explore whether climate change views changed during the Black Summer  
479 bushfires, we investigated the relative proportions of segments across studies (Figure 2).  
480 Numerically, the proportion of Acceptors fell across time (from 64.60% of the Study 1  
481 sample to 54.46% of the Study 3 sample), whereas the proportion of Fencesitters increased  
482 across time (from 27.13% of the Study 1 sample to 37.09% of the Study 3 sample). In  
483 comparison, the proportion of Sceptics was relatively stable across studies (from 8.28% of  
484 the Study 1 sample to 8.45% of the Study 3 sample). To investigate whether the relative  
485 proportion of segments differed across studies, we created a multinomial logistic regression  
486 model to predict segment membership as a function of study (coefficients reported in  
487 Supplementary Results), using the *multinom* function from the *nnet* package [88]. A  
488 likelihood-ratio test did not indicate a statistically reliable improvement in model fit when  
489 study was included as a predictor, compared to a model with only an intercept term ( $\chi^2$

490 (4) = 8.85,  $p = .065$ , Cohen's  $\omega = 0.09$ ). Although the effect approached significance,  
491 segment membership did not reliably differ across study samples.

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

### 502 **Bushfire perceptions**

503 To explore perceptions of the Black Summer bushfires, we performed a principal  
504 components analysis with varimax rotation on the Fire Perception Scale (Table 5). We  
505 extracted three factors, as these accounted for the majority of scale variance (78.31%; see  
506 Supplementary Results for scree plot). The first factor, labelled *Climate Processes*, was  
507 characterised by four items (items 1, 3, 5, 6) that linked climate change to the bushfires  
508 and accounted for 41.22% of scale variance. The second factor, labelled *Fire Appraisal*, was  
509 characterised by two items (items 2 and 4), with the two most extreme (maximum and  
510 minimum) mean item scores and accounted for 19.97% of scale variance. The third factor,  
511 labelled *Arson Causes*, was characterised by a single item (item 7) stating that the Black  
512 Summer was caused by hundreds of arsonists and accounted for 17.12% of scale variance.  
513 We created subscales corresponding to each factor by averaging item scores. Items that  
514 negatively loaded onto factors were reverse-coded. The multi-item factors of Climate  
515 Processes and Fire Appraisal had an internal consistency of Cronbach's  $\alpha = .86$  (four  
516 items; mean inter-item  $r = .60$ ) and Cronbach's  $\alpha = .42$  (inter-item  $r = .29$ ), respectively.

517 Given the low internal consistency of Fire Appraisal, we analysed its two component items  
518 separately. For brevity, we refer to these items using abbreviated labels—“Climate change  
519 made bushfires less likely” (item 2) and “Bushfires were severe” (item 4)—in the following  
520 analysis.

521 To test segment differences in bushfire perceptions, we fitted linear regression  
522 models predicting Climate Processes, the two Fire Appraisal items, and Arson Causes from  
523 segment membership (coefficients reported in Supplementary Results). All models  
524 accounted for a significant amount of bushfire perception variance compared to  
525 intercept-only models, indicating that segment membership was a significant predictor of  
526 Climate Processes ( $F(2, 210) = 47.44, p < .001, R^2 = 0.31, R^2_{adjusted} = 0.30$ ), the two Fire  
527 Appraisal items (“Climate change made bushfires less likely”:  $F(2, 210) = 18.30, p < .001,$   
528  $R^2 = 0.15, R^2_{adjusted} = 0.14$ ; “Bushfires were severe”:  $F(2, 210) = 19.71, p < .001, R^2 =$   
529  $0.16, R^2_{adjusted} = 0.15$ ), and Arson Causes ( $F(2, 210) = 12.69, p < .001, R^2 = 0.11, R^2_{adjusted}$   
530  $= 0.10$ ).

531 To quantify specific segment differences, we conducted pairwise comparisons of  
532 marginal means using the *marginaleffects* package [90], with a Holm (1979)  $p$  value  
533 adjustment for multiple comparisons. As seen in Figure 3, Acceptors reported higher  
534 endorsement of Climate Processes than Fencesitters (difference = 0.53,  $SE = 0.14$ , 95% CI  
535 = [0.26, 0.80],  $z = 3.87, p < .001, p_{adjusted} < .001$ ), who in turn endorsed Climate Processes  
536 more than Sceptics (difference = 1.76,  $SE = 0.25$ , 95% CI = [1.28, 2.24],  $z = 7.14, p <$   
537  $.001, p_{adjusted} < .001$ ). For the first Fire Appraisal item (“Climate change made bushfires  
538 less likely”), Fencesitters showed higher endorsement than both Acceptors (difference =  
539 1.04,  $SE = 0.17$ , 95% CI = [0.70, 1.38],  $z = 6.05, p < .001, p_{adjusted} < .001$ ) and Sceptics  
540 (difference = 0.64,  $SE = 0.31$ , 95% CI = [0.04, 1.25],  $z = 2.08, p = .037, p_{adjusted} = .074$ ).  
541 Acceptors and Sceptics did not significantly differ (difference = -0.40,  $SE = 0.30$ , 95% CI  
542 = [-0.99, 0.19],  $z = -1.33, p = .182, p_{adjusted} = .182$ ). For the second Fire Appraisal item  
543 (“Bushfires were severe”), Acceptors reported greater endorsement than both Fencesitters

544 (difference = 0.65,  $SE = 0.11$ , 95% CI = [0.44, 0.85],  $z = 6.05$ ,  $p < .001$ ,  $p_{adjusted} < .001$ )  
545 and Sceptics (difference = 0.56,  $SE = 0.19$ , 95% CI = [0.20, 0.93],  $z = 3.04$ ,  $p = .002$ ,  
546  $p_{adjusted} = .005$ ), whereas Fencesitters and Sceptics did not significantly differ (difference =  
547  $-0.08$ ,  $SE = 0.19$ , 95% CI = [-0.46, 0.29],  $z = -0.43$ ,  $p = .664$ ,  $p_{adjusted} = .664$ ). Finally, for  
548 Arson Causes, the pattern of Climate Processes endorsement was reversed. Specifically,  
549 Sceptics showed higher endorsement than Fencesitters (difference = 0.74,  $SE = 0.30$ , 95%  
550 CI = [0.15, 1.32],  $z = 2.47$ ,  $p = .014$ ,  $p_{adjusted} = .014$ ), who in turn showed higher  
551 endorsement than Acceptors (difference = 0.55,  $SE = 0.17$ , 95% CI = [0.23, 0.88],  $z =$   
552  $3.32$ ,  $p < .001$ ,  $p_{adjusted} = .002$ ).

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

564 In contrast, endorsement of the climate change causal claim showed the opposite  
565 pattern. A majority of Acceptors ( $n = 101$ ; 87.07%) agreed that climate change worsened  
566 the severity of the bushfires, whereas agreement was much lower among Fencesitters  
567 (41.77%) and entirely absent among Sceptics. Overall, endorsement of the mass-arson  
568 causal claim was negatively associated with endorsement of the climate change causal claim  
569 ( $r = -.21$ , 95% CI = [-.33, -.08],  $p = .002$ ), consistent with the notion that belief in  
570 misinformation displaced acceptance of scientifically grounded explanations.

571 To test a motivated-reasoning account of perceptions of the bushfires, we examined  
572 the association between political liberalism-conservatism (as indexed by the single-item  
573 measure of political ideology)—a proxy for pre-existing climate change beliefs—and  
574 endorsement of the climate change and mass-arson causal claims. Political liberalism was  
575 associated with stronger endorsement of the climate change causal claim ( $r = -.34$ , 95% CI  
576 =  $[-0.45, -0.21]$ ,  $p < .001$ ), whereas political conservatism was associated with stronger  
577 endorsement of the mass-arson causal claim ( $r = .27$ , 95% CI =  $[0.15, 0.41]$ ,  $p < .001$ ).  
578 However, both correlations were relatively weak, indicating that the perception that  
579 climate change exacerbated the fires was not tied solely to pre-existing political beliefs, and  
580 that the mass-arson causal claim meshed with a broad range of participants—including  
581 some who accept anthropogenic climate change—providing only limited support for a  
582 motivated-reasoning explanation (see Supplementary Results for correlations between the  
583 other auxiliary psychological characteristic measures and the Fire Perception Scale causal  
584 items).

### 585 **Policy direction preferences**

586 Policy direction preferences in response to the Black Summer differed among  
587 participants. Most participants desired more governmental climate change mitigation  
588 policies ( $n = 145$ , 68.08%), or no change to existing policies ( $n = 54$ , 25.35%). Only a  
589 small minority desired less or no governmental climate change mitigation policies ( $n = 14$ ,  
590 6.57%). However, policy direction preferences differed markedly across segments. The  
591 majority of Acceptors and Fencesitters preferred more mitigation policies, whereas most  
592 Sceptics preferred no change (Figure 4).

593 To test whether these segment differences were statistically reliable, we estimated a  
594 binomial logistic regression model predicting the odds of preferring more mitigation policies  
595 as a function of segment membership (see Supplementary Results for full model outcomes).  
596 Sceptics were excluded from the analysis because none expressed this preference. A  
597 likelihood-ratio test indicated that segment membership significantly predicted policy

598 direction preferences ( $\chi^2(1) = 35.45, p < .001$ , Cohen's  $\omega = 0.43$ ). Acceptors  
599 demonstrated a markedly greater preference for more mitigation policies than Fencesitters,  
600 with 89.66% ( $n = 104$ ) endorsing this option compared with 51.90% of Fencesitters ( $n =$   
601 41), corresponding to an odds ratio of 8.03 (95% CI = [3.92, 17.49],  $p < .001$ ).

602 We explored participants' text-based justifications for their policy direction  
603 preferences using an emotion analysis. Emotional associations for each word were detected  
604 using the NRC Word-Emotion Association Lexicon [91], a crowdsourced lexicon in which  
605 words are manually annotated for their association with eight emotions: anger, fear,  
606 anticipation, trust, surprise, sadness, joy, and disgust. For each response, we coded the  
607 presence of each emotion dichotomously (present/not present) if the response contained at  
608 least one word associated with that emotion.

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

614 To test whether emotional content varied across segments, we estimated a binomial  
615 logistic regression model for each emotion with segment membership as the predictor (see  
616 Supplementary Results for full model outcomes). We found no statistically significant  
617 differences between segments for most emotions, except for fear. Acceptors were more  
618 likely than Fencesitters to use at least one fear-related word, with 40.52% ( $n = 47$ ) doing so  
619 compared with 17.72% of Fencesitters ( $n = 14$ ), corresponding to an odds ratio of 3.16  
620 (95% CI = [1.59, 6.28],  $p = .001$ ). Sceptics fell between these two segments, with 33.33% ( $n$   
621 = 6) using at least one fear-related word, and did not reliably differ from either Acceptors  
622 or Fencesitters.

## Discussion

623

624 In this paper, we reported three audience segmentation studies of Australian  
625 climate-related opinions employing the Q methodology that were conducted at different  
626 stages of the Australian Black Summer bushfires. Study 1 was conducted before the peak  
627 of the bushfires (September 2019), whereas Studies 2 and 3 took place after the peak  
628 (February and March 2020, respectively). This afforded us a natural experiment to  
629 determine whether the occurrence of the bushfires triggered a change in Australian  
630 climate-related opinions. All studies required participants to complete a Q-sort task  
631 ranking opinion statements about climate change by degree of endorsement. Studies 1 and  
632 3 additionally incorporated auxiliary measures of prominent psychological characteristics,  
633 including measures of climate change cognition and affect. Study 3 also incorporated  
634 measures of bushfire perceptions and support for climate policy. We examined whether the  
635 three-segment solution and pattern of psychological characteristic differences between  
636 segments reported previously [80] replicated across studies, whether the proportion of  
637 participants in each segment and their climate change cognition and affect differed before  
638 versus after the peak of the Black Summer bushfires, and how segments differed in their  
639 bushfire perceptions and policy preferences.

### Summary of key findings

641 Across all three studies, we find consistent support for a three-segment solution of  
642 Australian climate-related opinions. The three segments are the Acceptors, Fencesitters,  
643 and Sceptics—ordered from the highest to the lowest belief in anthropogenic climate  
644 change, trust in climate science, concern about the issue, and motivation to tackle it. The  
645 segments are remarkably robust, with near-perfect correlations between the archetypal  
646 sorting styles of Acceptors of all studies and Sceptics of all studies. This is impressive given  
647 that the archetypal sorting styles depend on the correlations between the rank orderings of  
648 30 statements, which have several thousand unique permutations. It appears that the  
649 Black Summer bushfires did not change the definitional point of view of an Acceptor,

650 Fencesitter, or Sceptic.

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

665 We found little evidence to suggest that the Black Summer bushfires prompted a  
666 shift in climate-related opinions toward greater acceptance and concern. Instead, across the  
667 three studies, the proportion of Acceptors decreased slightly and the proportion of  
668 Fencesitters increased, while Sceptics remained stable. Although the changes in segment  
669 membership over time did not reach conventional levels of statistical significance, the effect  
670 was only marginally non-significant and may reflect the smaller sample size in Study 3  
671 compared to Studies 1 and 2.

672 The auxiliary measures of psychological characteristics incorporated in Studies 1  
673 and 3 included several measures of climate change knowledge (viz., knowledge volume,  
674 mental models of climate change, epistemic and response scepticism) and affect (viz., worry  
675 about climate change), affording us an additional set of indicators to determine if the  
676 bushfires provoked a change in beliefs about, and emotional responses towards, climate

677 change. However, consistent with the results derived from the Q-sort task, we generally  
678 found no statistically reliable change in responses on these measures between Studies 1 and  
679 3. The only exception was a small increase in Australians' perceptions of natural cycles  
680 (e.g., volcanic eruptions, solar fluctuations) as a cause of climate change. Again, this  
681 evidence contradicts the claim that the Black Summer bushfires elicited greater acceptance  
682 and concern about anthropogenic climate change. It is unclear why the Black Summer  
683 bushfires might have strengthened belief in the role of natural cycles in climate change.  
684 One possibility is that participants interpreted the bushfires and associated weather  
685 extremes as part of broader natural climatic fluctuations, leading to greater endorsement of  
686 natural cycles as a cause of climate change.

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

691 Perceptions of the bushfires in Study 3 varied across segments. Acceptors were most  
692 likely to endorse the view that climate change worsened the fires, followed by Fencesitters,  
693 with Sceptics showing the lowest endorsement. The reverse pattern was observed for the  
694 misinformation-based arson explanation. Sceptics most strongly endorsed the mass-arson  
695 claim, Fencesitters showed moderate endorsement, and even a large minority of Acceptors  
696 endorsed it. Endorsement of the mass-arson explanation was negatively correlated with  
697 endorsement of the climate change explanation. All segments agreed with the claim that  
698 the bushfires were severe, with Acceptors showing the strongest endorsement. However,  
699 Fencesitters were uniquely likely to endorse the claim that climate change made the  
700 bushfires less likely—more so than both Acceptors and Sceptics.

701 Finally, support for climate policy in Study 3 also varied by segments. Acceptors  
702 almost universally agreed that the bushfires warranted more action by Australia to address  
703 climate change, whereas Fencesitters were roughly evenly split between favouring more

704 action and no change in action. Sceptics mostly favoured no change in action by Australia  
705 to address climate change. Fear was routinely used by all segments, but in particular,  
706 Acceptors, to justify their policy position.

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

708 Our results add to the mixed findings on the relationship between climate-related  
709 opinions and personal experience of extreme events [25, 26, 46]. At the outset, we identified  
710 three moderators of the effect of extreme event experience on climate-related  
711 opinions—event attribution, motivated reasoning, and media attention [24]. Taken  
712 together, these moderators may offer a coherent explanation of why the Black Summer  
713 bushfires did not lead to greater acceptance and concern about climate change.

714 The first and most important moderator is event attribution. Previous work shows  
715 that experience of an extreme event influences climate-related opinions only among  
716 individuals who attribute the event to climate change [31, 48–50]. In Study 3, this key  
717 precondition was not met for the vast majority of participants—and critically, it was not  
718 achieved for Fencesitters, the segment most theoretically open to changing their opinions in  
719 response to the bushfires. Most Fencesitters and all Sceptics rejected the notion that  
720 climate change contributed to the fires and instead attributed the bushfires primarily to  
721 arson. Although Acceptors were more likely to endorse a climate change explanation, even  
722 within this segment, a sizeable minority also attributed the fires to arson. Thus, because  
723 most participants—including the Fencesitters most amenable to opinion change—did not  
724 interpret the fires as climate-related, the chief mechanism that links extreme event  
725 experience to increased climate change concern was not engaged.

726 The second moderator, motivated reasoning, partially helps to explain why these  
727 attribution patterns emerged. Consistent with previous research [31, 49], political ideology  
728 influenced causal attributions—liberals were more likely to attribute the fires to climate  
729 change, whereas conservatives were more likely to endorse the arson explanation. However,  
730 motivated reasoning alone cannot fully account for the findings, as belief in the arson

731 narrative was evident across all three segments—including among some  
732 Acceptors—suggesting that wider informational influences were at play.

733         The third moderator that captures these wider informational influences is media  
734 attention. Extreme events can serve as “focusing events” [54, 55], increasing public and  
735 media attention and generating opportunities to highlight the links between such events  
736 and climate change [56–58]. Although the Black Summer bushfires received substantial  
737 coverage, the media environment was highly contested. After an initial period emphasising  
738 the role of climate change, the narrative quickly became politicised [61]. Liberal media  
739 outlets continued to stress the role of climate change in worsening the fires, whereas  
740 conservative outlets were dismissive of this connection. During the peak of the bushfires,  
741 misinformation—particularly exaggerated claims about widespread arson—proliferated  
742 across social media and conservative media outlets. Such misinformation is notoriously  
743 difficult to correct [92, 93], and it is possible that despite officials’ efforts to dismiss the  
744 arson claims [94, 95], these narratives had already taken hold by the time Studies 2 and 3  
745 were conducted. The widespread acceptance of the mass-arson explanation among  
746 Fencesitters and Sceptics, in particular, is consistent with this interpretation. It may also  
747 help explain why the proportion of Acceptors decreased while the proportion of  
748 Fencesitters increased over time. Misinformation exposure may have rendered some  
749 Acceptors more sceptical of the scientific consensus on climate change.

750         However, misinformation is not the only media-related explanation. A content  
751 analysis of Australian news coverage by Burgess et al. [96] found that although 49% of  
752 articles mentioned climate change, only 29% discussed climate change in depth and with  
753 accuracy, and just 16% directly linked climate change to the bushfires. Similar patterns  
754 were observed in a study by Ettinger et al. [97] examining how Australian climate action  
755 non-governmental organisations (NGOs) framed the relationship between climate change  
756 and the Black Summer bushfires on the social media platform Twitter (now X). Although  
757 59% of bushfire-related tweets mentioned climate change, only 16% included scientific

758 explanations describing how climate change influences bushfire frequency and severity,  
759 whereas 42% merely mentioned climate change without explaining its relationship to  
760 bushfires. These findings raise the possibility that many members of the public were not  
761 exposed to sufficiently clear explanations of how climate change influences bushfire risk and  
762 severity, potentially limiting public understanding of the relationship between climate  
763 change and bushfires.

764 Finally, another possible explanation concerns the timing of the later studies.  
765 Studies 2 and 3 were undertaken after the World Health Organisation (WHO) declared the  
766 COVID-19 outbreak a Public Health Emergency of International Concern in January 2020,  
767 and Study 3 coincided with the WHO characterising the outbreak as a pandemic in March  
768 2020. The abrupt nature of the pandemic meant that it quickly became the centre of global  
769 media and public attention, diverting the spotlight away from the bushfires and climate  
770 change [98–102]. Accordingly, the absence of a shift towards greater climate change concern  
771 may reflect a redirection of attention and worry towards the rapidly escalating global  
772 health crisis.

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

### 778 **Implications for theoretical accounts of the effects of extreme event experience**

779 At first blush, the results appear at variance with the psychological distance, issue  
780 salience, and affect activation accounts introduced at the outset. According to these  
781 accounts, experience of the bushfires should have made climate change feel more  
782 psychologically proximal, heightened the salience of the issue, and elicited affective  
783 responses that increased perceived climate risk. Consequently, we would expect to observe  
784 an increase in the proportion of Acceptors and a decrease in the proportion of Fencesitters

785 over time, and/or shifts on the continuous climate change cognition and affect measures  
786 towards greater acceptance and concern about the issue. Yet, contrary to these predictions,  
787 we found a slight decrease in Acceptors and a corresponding increase in Fencesitters, and  
788 no reliable changes on the continuous cognition and affect measures.

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

799         Beyond these psychological accounts, the findings have implications for the  
800 focusing-events framework [54, 55]. Extreme events can serve as focusing events that  
801 increase public attention to an issue and create opportunities for attitude change. However,  
802 the Black Summer bushfires did not appear to have this effect. Media narratives  
803 surrounding the fires quickly became contested and politicised, with climate change  
804 interpretations competing against misinformation-based arson narratives, while the  
805 emerging COVID-19 crisis eventually hijacked the spotlight of public and media attention.  
806 This suggests that focusing events are vulnerable to politicisation, alternative causal  
807 narratives, and competing, attention-grabbing events. Such conditions may prevent the  
808 expected increase in climate change concern or even produce shifts toward greater  
809 scepticism if misinformation about the event dominates media and public discourse.

## 810 **Implications for climate change communication**

811 Our results suggest that communicating the connections of climate change to  
812 specific extreme events is important given the evidence that event attribution is a key  
813 moderator of the effect of extreme event experience on climate-related opinions. However,  
814 when an extreme event is unfolding, scientists face the difficult challenge of balancing clear  
815 attribution statements with avoiding oversimplified explanations of the complex and  
816 uncertain factors underlying an extreme event. For some extreme events, strong attribution  
817 statements are possible but the relationship between climate change and bushfires is  
818 notoriously complex [75]. For this reason, scientific organisations during the Black Summer  
819 avoided attributing the fires to climate change and instead focused on communicating that  
820 climate change was increasing the frequency, duration, and intensity of fires more broadly  
821 [71–73, 76]. Nevertheless, advances in the emerging field of extreme event attribution have  
822 increasingly enabled scientists to assess the role of climate change in specific extreme  
823 events. Extreme event attribution studies attempt to rapidly determine whether climate  
824 change influenced the frequency, likelihood, and/or severity of individual extreme events  
825 [103]. The results of such studies are typically only available after an extreme event has  
826 ended. Remarkably, however, the findings of the first extreme event attribution study of  
827 the Black Summer bushfires, showing that climate change had increased the risk of extreme  
828 fire weather conditions like those that occurred during the Black Summer by at least 30%,  
829 were published on 10 January 2020, during the peak of the fires, on the World Weather  
830 Attribution [104] (and later as a peer-reviewed study [105]). However, in the social media  
831 analysis of climate action NGOs undertaken by Ettinger et al. [97], only 7 of the 102  
832 climate action groups examined shared the study, doing so in just 15 tweets overall.  
833 Accordingly, to the extent that these findings are indicative of broader communication  
834 patterns, they raise the possibility that climate-communication stakeholders may have had  
835 greater scope to draw upon the results of this study to illustrate the link between climate  
836 change and the fires. At the same time, we acknowledge that climate-communication

837 stakeholders may have been appropriately cautious to attach too much weight to the  
838 results of a single, as yet non-peer-reviewed, study.

839         Beyond communicating that climate change is increasing the frequency and severity  
840 of many extreme events such as bushfires, climate-change communicators may also need to  
841 explain more clearly the mechanisms by which climate change contributes to these events.  
842 Indeed, such mechanistic explanations may help to stave off misconceptions fuelled by  
843 misinformation. For instance, if individuals understand that climate change does not ignite  
844 fires but rather creates the unusually hot and dry conditions that enable them to begin,  
845 burn intensely, and spread widely, they may be less likely to be swayed by false claims of  
846 fires being caused by arson. That is, they will recognise that even if individual fires were  
847 ignited deliberately or accidentally, this does not preclude climate change from  
848 contributing to the environmental conditions that allowed the fires to become unusually  
849 severe. Some scientific organisations and climate action groups did provide such  
850 mechanistic explanations during the Black Summer bushfires [71–73, 106, 107]. However,  
851 the content analyses of mass media and social media coverage of the Black Summer by  
852 Burgess et al. [96] and Ettinger et al. [97], respectively, show that these explanatory links  
853 were often missing in broader media and social-media communications, suggesting that  
854 more could have been done to communicate the mechanisms by which climate change  
855 affects bushfire frequency and severity.

856         When misinformation about the causes of an extreme event circulates in mass and  
857 social media, timely correction may be crucial to prevent it from taking root. During the  
858 Black Summer bushfires, state fire services, the police, and journalists all played roles in  
859 countering misinformation about the fires. However, not all corrections are equally effective  
860 in debunking misinformation. Cognitive psychologists have identified numerous best  
861 practices for debunking misinformation [92, 93], and these strategies have been distilled into  
862 an accessible handbook for non-experts [108]. A core principle is that effective corrections  
863 should not simply retract a false claim but provide a plausible alternative explanation for

864 the cause of an event [92]. For instance, when countering the claim that “the bushfires were  
865 caused by arsonists,” a correction that offers an alternative causal account (e.g., “the  
866 bushfires were ignited by lightning”) is more effective than one that merely states that the  
867 claim is false (e.g., “there is no evidence of arson”). Climate-communication stakeholders  
868 should incorporate these best-practice insights into their messaging to increase the  
869 effectiveness of their debunking efforts. Even members of the public can help limit the  
870 spread of misinformation. For example, in their analysis of the #ArsonEmergency tweets  
871 on Twitter, Weber and colleagues [65, 66] identified two different communities, one involved  
872 in the propagation of the false claims and another that sought to debunk those claims.

873 Finally, our results have implications for engaging with the three audience segments.  
874 Acceptors and Sceptics may be relatively low priorities for public engagement campaigns,  
875 albeit for different reasons. Acceptors already strongly believe in anthropogenic climate  
876 change, are highly trusting of climate science, and are strongly supportive of climate  
877 action. Accordingly, additional messaging is unlikely to appreciably shift their views.  
878 Sceptics, by contrast, have firmly entrenched beliefs. Their conservative political ideology  
879 and environment-as-elastic worldviews render them motivated to discount climate science,  
880 meaning they are highly resistant to belief revision in the face of climate science  
881 information [80]. Combined with the fact that they are few in number, these characteristics  
882 suggest there may be little merit in trying to shift the opinions of this segment [although  
883 see 80, for a more nuanced account]. By comparison, Fencesitters represent a more  
884 promising group for public engagement. They are more neutral in terms of political  
885 ideology and environmental worldviews, meaning they are not politically motivated to  
886 oppose climate science, in contrast to Sceptics. Indeed, Fencesitters update their beliefs in  
887 response to climate science information almost as much as Acceptors do [80]. They are a  
888 relatively large segment with more intermediate climate-related opinions, meaning that  
889 with the right messaging strategy, they could perhaps be transformed into Acceptors.

890 Accordingly, we suggest that public engagement campaigns should target the

891 Fencesitters. Unfortunately, we know little about the characteristics of this segment. This  
892 is, in part, because, given the inherent variability of individuals within this segment, we  
893 cannot construct an archetypal Q sort of their statement rankings. However, what we do  
894 know is that, compared to the Acceptors and Sceptics, they are more likely to endorse  
895 conspiracy theories<sup>1</sup>. This curious result, first documented in our original report of Studies  
896 1 and 2 [80], was replicated in Study 3, suggesting it is a robust feature of this segment.  
897 Given that much climate misinformation is grounded in conspiracy theories [111, 112], our  
898 key piece of advice for climate-communication stakeholders is that debunking efforts should  
899 pay particular attention to exposing how climate misinformants employ conspiracy theories  
900 and related deception techniques to mislead the public. Such refutation techniques may be  
901 necessary to prevent climate misinformation from transforming Fencesitters into Sceptics.

## 902 **Potential limitations**

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

910         Second, although around 80% of the Australian population was affected either  
911 directly or indirectly by the fires [4], we did not ask participants about the nature of their  
912 experiences. The distinction between direct and indirect experience is important because  
913 studies have shown that direct experience of an extreme event is more predictive of

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<sup>1</sup> 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 [109]. 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 [110].

914 climate-related opinions than indirect experience [31, 113]. Accordingly, changes in  
915 climate-related opinions are more likely to be observed among individuals who had severe  
916 direct negative experiences of the fires, such as those who suffered property damage.  
917 However, we note that even if we had measured the nature of our participants' experiences,  
918 individuals who had a severe personal experience of the fires are likely under-represented in  
919 Studies 2 and 3, as the disaster's impact would have precluded them from responding to  
920 our web-panel surveys [26].

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

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

## 935 **Conclusions**

936 Previous research examining the association between personal experience of extreme  
937 events and climate-related opinions has produced contradictory findings. It is therefore  
938 perhaps unsurprising that we found no evidence that the Black Summer bushfires  
939 prompted a shift towards greater acceptance of, and concern about, anthropogenic climate  
940 change. A key determinant of whether experience of an extreme event influences

941 climate-related opinions is whether individuals attribute the event to climate change.  
942 Accordingly, the relatively low rate at which Fencesitters attributed the bushfires to  
943 climate change is the most credible explanation for the absence of a positive shift in  
944 climate-related opinions. This lack of attribution may reflect the divergent mass-media and  
945 social-media narratives surrounding the bushfires. In particular, misinformation dismissing  
946 the connection between climate change and the bushfires may have “crowded out”  
947 messages linking bushfires to climate change. That such misinformation influenced  
948 perceptions is evidenced by the sizeable minority of Acceptors who did not reject the arson  
949 claim, and by the majority of Fencesitters and Sceptics who endorsed it. Although climate  
950 change was frequently mentioned in both mass-media and social-media discussions of the  
951 bushfires, clear explanations of how climate change affects bushfire frequency and severity  
952 were less common—another possible reason why many Fencesitters did not attribute the  
953 bushfires to climate change. Motivated reasoning also played a role, but its influence  
954 appeared limited. While politically conservative participants were more likely to endorse  
955 the arson explanation, belief in the mass-arson narrative was found across all three  
956 segments, indicating that misinformation narratives exerted widespread influence. The  
957 implications of these observations are twofold. First, when an extreme event such as a  
958 bushfire occurs, climate-communication stakeholders may need to explain clearly how  
959 climate change is worsening such events by making them more likely and/or more intense.  
960 Second, where misinformation about the cause of an extreme event circulates, proactive  
961 efforts must be undertaken to debunk the misleading claims. This requires that  
962 climate-communication stakeholders are aware of best practices for refuting misinformation  
963 so that their interventions can achieve maximal impact.

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**Table 1***Sample characteristics and materials for each of the three studies.*

Characteristics	Study		
	1	2	3
<b>Time</b>	Before peak bushfire severity	After peak bushfire severity	After peak bushfire severity
<b>Data collection dates</b>			
Start	24-Sep-2019	25-Feb-2020	13-Mar-2020
End	09-Nov-2019	02-Mar-2020	26-Mar-2020
<b>Sample characteristics</b>			
<i>n</i>	435	413	213
Mean age in years ( <i>SD</i> )	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%)
<b>Materials</b>			
Q-sort task	✓	✓	✓
Auxiliary psychological scales	✓	✗	✓
Fire Perception Scale	✗	✗	✓
Change in policy items	✗	✗	✓

**Table 2**  
*Summary of auxiliary psychological measures.*

Psychological characteristic	Items	Cronbach's $\alpha$	Range	Example item	Reference
<b>Climate change cognition and affect</b>					
Knowledge Volume	1	-	1 to 4	How much do you feel you know about climate change?	Malka, Krosnick, and Langer [114]
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. [80]
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. [80]
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. [80]
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. [115]
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. [115]
Perceived Human Contribution	1	-	1 to 7	How likely do you think it is that human actions have changed global climate?	Bostrom et al. [115]
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. [115]
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. [115]

*(continued)*

Psychological characteristic	Items	Cronbach's $\alpha$	Range	Example item	Reference
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. [115]
Epistemic Scepticism	8	0.91	1 to 5	Climate change is just a natural fluctuation in Earth's temperatures	Capstick and Pidgeon [116]
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 [116]
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 [117]
<b>Cognitive style</b>					
Orientation to Future Goals	4	0.72	1 to 5	I consider how things might be in the future	Enzler [118]
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 [118]
Conspiracist Ideation	6	0.90	1 to 5	The Apollo moon landings never happened and were staged in a Hollywood film studio	Lewandowsky, Oberauer, and Gignac [109]
Need for Cognition	6	0.79	1 to 5	I would prefer complex to simple problems	Lins de Holanda Coelho, Hanel, and Wolf [119]
<b>Ideology, worldviews, and values</b>					
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, Walker, and Boschetti [120]
Environment-as-Elastic Worldview	6	0.85	1 to 5	The natural environment is capable of recovering from any damage humans may cause	Price, Walker, and Boschetti [120]
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 [121]
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 [122]

*(continued)*

Psychological characteristic	Items	Cronbach's $\alpha$	Range	Example item	Reference
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 [122]
<b>Personality</b>					
Agreeableness	2	0.27	1 to 5	I see myself as someone who is generally trusting	Rammstedt and John [123]
Conscientiousness	2	0.53	1 to 5	I see myself as someone who does a thorough job	Rammstedt and John [123]
Extraversion	2	0.53	1 to 5	I see myself as someone who is outgoing, sociable	Rammstedt and John [123]
Neuroticism	2	0.62	1 to 5	I see myself as someone who gets nervous easily	Rammstedt and John [123]
Openness	2	0.14	1 to 5	I see myself as someone who has an active imagination	Rammstedt and John [123]

*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  $\alpha$  from Andreotta et al. [80], under the Creative Commons license (CC BY 4.0).

**Table 3**

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

Predictors	Acceptors		Fencesitters		Sceptics	
	Study 1	Study 3	Study 1	Study 3	Study 1	Study 3
<b>Intercept</b>	<b>+1.64<sup>^</sup></b> [1.64, 2.18]	<b>+1.66<sup>^</sup></b> [1.44, 2.09]	<b>+0.56<sup>^</sup></b> [0.44, 0.99]	<b>+1.03<sup>^</sup></b> [0.71, 1.32]	<b>-2.20<sup>^</sup></b> [-3.06, -2.19]	<b>-2.69<sup>^</sup></b> [-3.22, -2.36]
<b>Climate change cognition and affect</b>						
Epistemic Scepticism	<b>-0.33<sup>^</sup></b> [-0.59, -0.26] <b>+0.31<sup>^</sup></b>	<b>-0.46<sup>^</sup></b> [-0.72, -0.25] <b>+0.13</b>	+0.11 [-0.05, 0.30] -0.06	+0.13 [-0.08, 0.39] <b>+0.10</b>	<b>+0.23<sup>^</sup></b> [0.16, 0.43] <b>-0.25<sup>^</sup></b>	<b>+0.33<sup>^</sup></b> [0.19, 0.46] <b>-0.23<sup>^</sup></b>
Worry about Climate Change	[0.23, 0.60] <b>-0.29<sup>^</sup></b>	[-0.09, 0.38] <b>-0.55<sup>^</sup></b>	[-0.25, 0.11] <b>+0.08</b>	[-0.12, 0.36] <b>+0.34<sup>^</sup></b>	<b>[-0.50, -0.19]</b> <b>+0.21<sup>^</sup></b>	<b>[-0.44, -0.07]</b> <b>+0.21<sup>^</sup></b>
Response Scepticism	<b>[-0.55, -0.19]</b> <b>+0.20<sup>^</sup></b>	<b>[-0.75, -0.37]</b> <b>+0.27<sup>^</sup></b>	[-0.09, 0.28] <b>+0.12</b>	[0.14, 0.56] -0.06	[0.15, 0.40] <b>-0.32<sup>^</sup></b>	[0.09, 0.35] <b>-0.22<sup>^</sup></b>
Perceived Human Contribution	[0.08, 0.41] <b>+0.19<sup>^</sup></b>	[0.12, 0.51] <b>+0.11</b>	[-0.02, 0.35] -0.09	[-0.29, 0.16] <b>+0.06</b>	<b>[-0.59, -0.23]</b> -0.10	<b>[-0.42, -0.07]</b> <b>-0.16<sup>^</sup></b>
Perceived Societal Consequences	[0.06, 0.39] <b>+0.08</b>	[-0.08, 0.38] <b>+0.04</b>	[-0.30, 0.05] <b>+0.08</b>	[-0.21, 0.25] <b>+0.19</b>	[-0.23, 0.04] <b>-0.16<sup>^</sup></b>	<b>[-0.33, -0.02]</b> <b>-0.22<sup>^</sup></b>
Perceptions of Environmental Harm Causes	[-0.09, 0.26] -0.10	[-0.18, 0.24] -0.05	[-0.08, 0.28] -0.06	[0.00, 0.43] -0.01	<b>[-0.32, -0.05]</b> <b>+0.15<sup>^</sup></b>	<b>[-0.37, -0.10]</b> <b>+0.06</b>
Knowledge Volume	[-0.34, 0.01] <b>+0.15<sup>^</sup></b>	[-0.25, 0.13] <b>+0.15</b>	[-0.24, 0.10] <b>+0.04</b>	[-0.22, 0.19] <b>+0.29<sup>^</sup></b>	[0.04, 0.43] <b>-0.19<sup>^</sup></b>	[-0.11, 0.26] <b>-0.44<sup>^</sup></b>
Perceptions of Carbon Emission Causes	[0.00, 0.35] <b>-0.13<sup>^</sup></b>	[-0.02, 0.32] <b>+0.09</b>	[-0.11, 0.23] <b>+0.14<sup>^</sup></b>	[0.09, 0.49] -0.10	<b>[-0.36, -0.11]</b> -0.01	<b>[-0.59, -0.29]</b> <b>+0.01</b>
Perceived Effectiveness of Engineering Policies	<b>[-0.36, -0.01]</b>	[-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 [-0.03, 0.30] <b>+0.11</b>	+0.12 [-0.09, 0.36] <b>-0.13</b>	-0.02 [-0.19, 0.14] <b>-0.03</b>	-0.09 [-0.31, 0.15] <b>+0.17</b>	-0.10 [-0.23, 0.02] <b>-0.08</b>	-0.03 [-0.21, 0.11] <b>-0.03</b>
Perceived Effectiveness of Carbon Policies	[-0.03, 0.35] <b>+0.10</b>	[-0.34, 0.09] <b>-0.04</b>	[-0.23, 0.15] <b>-0.04</b>	[-0.07, 0.36] <b>+0.10</b>	[-0.27, 0.02] <b>-0.06</b>	[-0.16, 0.13] <b>-0.06</b>
Perceived Effectiveness of Green Policies	[-0.02, 0.30] -0.08	[-0.24, 0.17] -0.15	[-0.20, 0.14] <b>+0.05</b>	[-0.12, 0.31] <b>+0.10</b>	[-0.27, 0.05] <b>+0.02</b>	[-0.20, 0.08] <b>+0.05</b>
Perceptions of Natural Causes	[-0.26, 0.08]	[-0.40, 0.05]	[-0.10, 0.24]	[-0.12, 0.36]	[-0.15, 0.20]	[-0.16, 0.25]
<b>Cognitive style</b>						
Orientation to Future Goals	+0.05 [-0.11, 0.25]	+0.21 [0.00, 0.38]	+0.06 [-0.10, 0.26]	+0.10 [-0.09, 0.30]	-0.11 [-0.33, 0.04]	<b>-0.31<sup>^</sup></b> [-0.47, -0.11] <b>+0.16</b>
Conspiracist Ideation	<b>-0.15<sup>^</sup></b> <b>[-0.36, -0.02]</b>	<b>-0.49<sup>^</sup></b> <b>[-0.70, -0.32]</b>	<b>+0.15<sup>^</sup></b> [0.02, 0.36] <b>+0.01</b>	<b>+0.33<sup>^</sup></b> [0.15, 0.55] <b>-0.02</b>	+0.00 [-0.18, 0.17] <b>+0.10</b>	+0.16 [-0.02, 0.34] <b>+0.09</b>
Need for Cognition	[-0.32, 0.01] <b>+0.02</b>	[-0.25, 0.15] <b>-0.16</b>	[-0.15, 0.18] <b>0.00</b>	[-0.23, 0.19] <b>+0.15</b>	[-0.03, 0.31] <b>-0.02</b>	[-0.12, 0.27] <b>+0.02</b>
Orientation to Immediate Goals	[-0.12, 0.25]	[-0.42, 0.00]	[-0.20, 0.17]	[-0.04, 0.41]	[-0.21, 0.10]	[-0.18, 0.21]
<b>Ideology, worldviews, and values</b>						
Environment-as-Ductile Worldview	+0.18 [-0.01, 0.44]	<b>+0.40<sup>^</sup></b> [0.23, 0.62]	-0.11 [-0.36, 0.05]	<b>-0.21<sup>^</sup></b> [-0.43, -0.01]	-0.07 [-0.21, 0.10]	<b>-0.19<sup>^</sup></b> [-0.36, -0.04]

*(continued)*

Predictors	Acceptors		Fencesitters		Sceptics	
	Study 1	Study 3	Study 1	Study 3	Study 1	Study 3
Conservation Values	-0.11 [-0.32, 0.02]	<b>-0.26<sup>^</sup></b> [-0.46, -0.06]	+0.01 [-0.17, 0.18]	-0.02 [-0.22, 0.22]	+0.11 [-0.05, 0.32]	<b>+0.27<sup>^</sup></b> [0.06, 0.45]
Environment-as-Elastic Worldview	<b>-0.20<sup>^</sup></b> [-0.43, -0.05]	<b>-0.37<sup>^</sup></b> [-0.58, -0.20]	+0.05 [-0.15, 0.23]	+0.07 [-0.12, 0.33]	<b>+0.15<sup>^</sup></b> [0.03, 0.38]	<b>+0.30<sup>^</sup></b> [0.12, 0.46]
System Justification	+0.04 [-0.12, 0.25]	<b>+0.20<sup>^</sup></b> [0.04, 0.39]	+0.06 [-0.12, 0.23]	<b>-0.23<sup>^</sup></b> [-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]	<b>-0.19<sup>^</sup></b> [-0.33, 0.00]
Political Ideology	<b>-0.18<sup>^</sup></b> [-0.41, -0.04]	-0.10 [-0.35, 0.12]	+0.03 [-0.17, 0.19]	-0.16 [-0.38, 0.06]	<b>+0.16<sup>^</sup></b> [0.02, 0.40]	<b>+0.26<sup>^</sup></b> [0.09, 0.47]
<b>Personality</b>						
Extraversion	-0.01 [-0.15, 0.14]	+0.03 [-0.21, 0.22]	+0.03 [-0.11, 0.19]	<b>+0.23<sup>^</sup></b> [0.04, 0.45]	-0.02 [-0.18, 0.11]	<b>-0.26<sup>^</sup></b> [-0.43, -0.07]
Conscientiousness	+0.03 [-0.09, 0.20]	-0.14 [-0.33, 0.01]	-0.06 [-0.21, 0.09]	<b>+0.19<sup>^</sup></b> [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 4**

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

Psychological characteristics	$M_{Study\ 3} - M_{Study\ 1}$		<i>t</i>	<i>p</i>	<i>p</i> <sub>adjusted</sub>
	Estimate	95% <i>CI</i>			
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*<sub>adjusted</sub> < .05;

*p* values were adjusted using the Holm [89] method.

**Table 5**

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

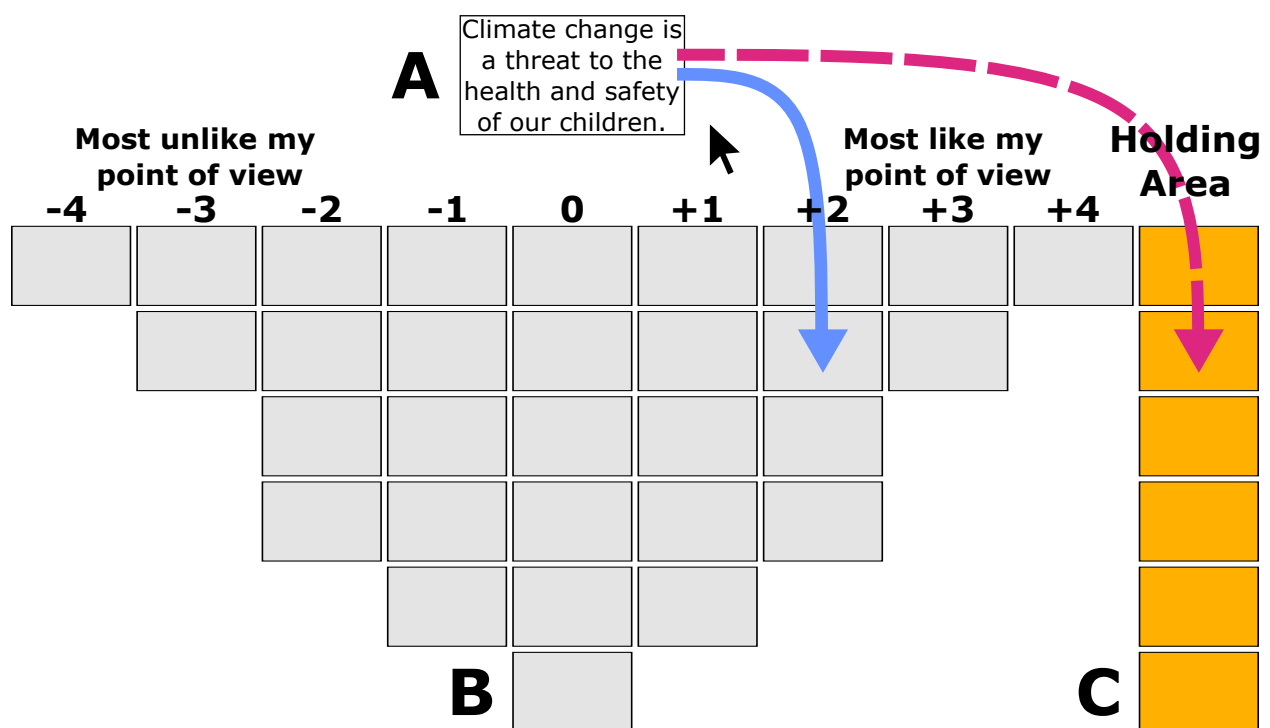
Item	Factors			Descriptives	
	Climate Processes	Fire Appraisal	Arson Causes	<i>M</i>	<i>SD</i>
1. Climate change made the 2019-20 Australian bushfires more severe	<b>0.78</b>	0.34	-0.22	3.62	1.40
2. Climate change made the 2019-20 Australian bushfires less likely to occur	0.27	<b>-0.70</b>	<b>0.42</b>	2.19	1.27
3. The 2019-20 Australian bushfires have accelerated climate change	<b>0.84</b>	0.05	-0.14	3.16	1.30
4. The 2019-20 Australian bushfires are severe	0.17	<b>0.86</b>	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	<b>0.84</b>	-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	<b>0.86</b>	-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	<b>0.94</b>	3.47	1.20

*Note:*

Bolded loadings are greater than .40 in magnitude.

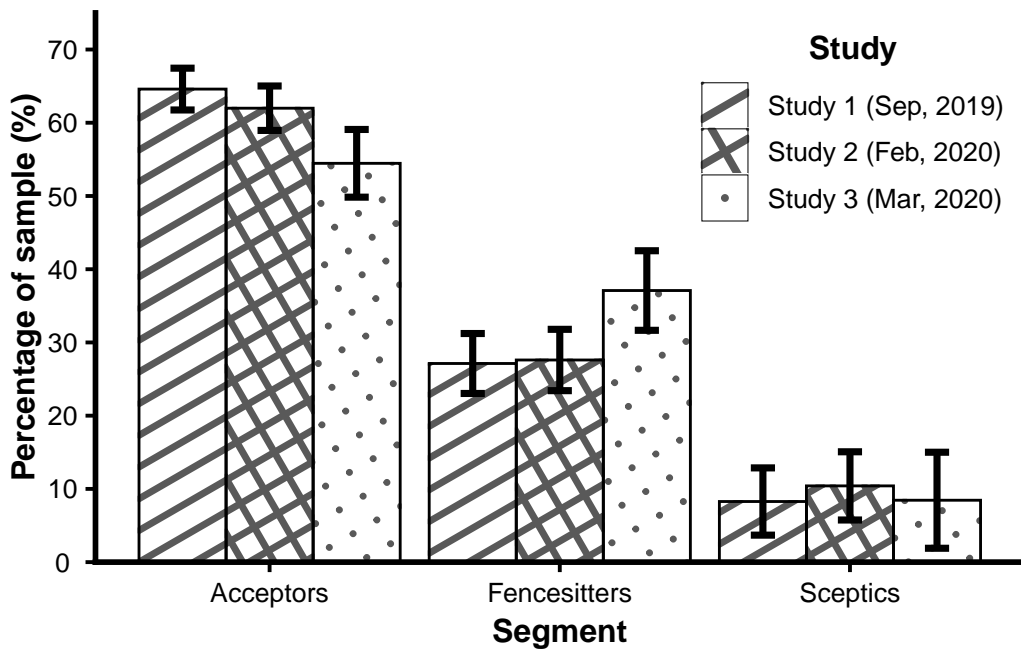
**Figure 1**

*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. [80], under the Creative Commons license (CC BY 4.0).*

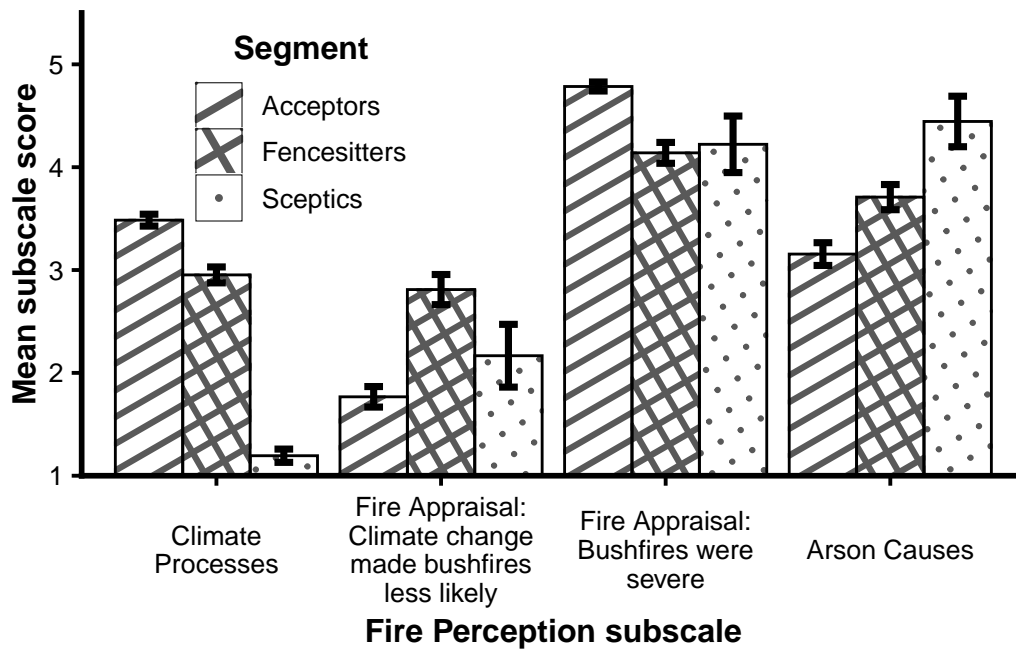


**Figure 2**

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



**Figure 3**  
*Mean Fire Perception subscale scores as a function of segment. Error bars represent one standard error of the mean.*



**Figure 4**  
*Policy direction preferences as a proportion (percentage) of each segment. Error bars represent one standard error of the proportion.*

