

# Development and validation of a measure of climate change anxiety

Susan Clayton\*, Bryan T. Karazsia

*The College of Wooster, United States*



## ARTICLE INFO

Handling editor: Sander van der Linden

### Keywords:

Climate change  
Climate anxiety  
Psychological adaptation  
Ecoanxiety  
Climate change anxiety

## ABSTRACT

There is increasing attention to the negative emotional responses associated with awareness of climate change. We present three studies developing a scale of climate change anxiety. In Study 1, the scale was developed and validated in an MTurk sample of 197. Exploratory factor analysis of our item pool revealed a four-factor structure, with cognitive-emotional impairment, functional impairment, behavioral engagement, and experience emerging as unique factors. Cognitive-emotional impairment and functional impairment were considered to constitute subscales for climate change anxiety; along with behavioral engagement, they were all related to experience as well as to negative emotions. Neither climate change anxiety nor general depression and anxiety were related to behavioral engagement. Study 2 replicated the factor structure as well as the pattern of correlations in a second MTurk sample of 199. Study 3 examined the relationship between climate change anxiety and adaptation responses in a sample of 217, and tested whether climate change anxiety scores would be affected by the framing of a climate change message. Overall, results suggest that climate change anxiety is not uncommon, especially among younger adults; that worry can be differentiated from a more serious impact on one's life; and that climate change anxiety is correlated with emotional but not behavioral responses to climate change.

## 1. Introduction

Climate change is increasingly acknowledged to present a variety of threats to human health, including mental health (Clayton & Manning, 2018; Clayton, Manning, & Hodge, 2014; Dodgen et al., 2016, pp. 217–246; Doherty & Clayton, 2011; Manning & Clayton, 2018). Some of the potential for negative impacts comes from direct experiences, e.g. of major storms, droughts, or wildfires. A growing number of media reports, however, as well as some scientific papers (e.g., Berry & Peel, 2015; Helm, Pollitt, Barnett, Curran, & Craig, 2018; Reser, Bradley, Glendon, Ellul, & Callaghan, 2012; Searle & Gow, 2010), describe negative emotional consequences associated simply with perceptions of climate change: that is, people's awareness of the problem that is not linked to specific personal experiences. For example, in fall of 2018 an article in the BBC news described the fear associated with climate change among Vietnamese children (Shukman, 2018); this was followed a month later by a piece on climate anxiety in the Portland Press Herald (Pols, 2018); and in December 2018, NBC news published a piece on “the growing emotional toll of climate change” (Scher, 2018). In December of 2019, Grist magazine called climate anxiety the “biggest pop-culture trend” of the year (McGinn, 2019).

A number of national surveys provide evidence of negative emotions associated with climate change. In the *American Psychological*

*Association's*, 2018 “Stress in America” survey, 51% of respondents listed climate change as “a somewhat or significant source of stress” (*American Psychological Association*, 2018; *Bethune*, 2018). A more targeted survey conducted by the Yale Program on Climate Change Communication has documented emotional responses to climate change over the years, with a recent iteration showing that 69% of Americans are at least “somewhat worried” about global warming and 29% saying they were “very worried;” almost half (49%) think they are personally going to be harmed by it (*Leiserowitz et al.*, 2018). Berry and Peel reported that 56% of rural Australians were worried about climate change in 2015. Twenty-four percent of Europeans met a slightly higher threshold of being “very worried” in 2016 (*Steenjtes et al.*, 2017). In a nationally representative 2018 survey (*Minor et al.*, 2019), 38% of Greenlanders reported that they felt fear “moderately” or very strongly; 19% reported moderate or strong sadness, and 18% reported moderate or strong hopelessness. Guilt and anger were also common. (Interestingly, 43% reported moderate or strong hope.) In a review of research on non-economic values that are subject to intangible harm from climate change, *Tschakert, Ellis, Anderson, Kelly, and Obeng* (2019) include mental and emotional wellbeing.

Perhaps the most common way of summarizing the emotional response is to call it climate anxiety, or more specifically, climate change anxiety. Anxiety is a fundamental process that serves adaptive functions

\* Corresponding author. Author can be reached at Department of Psychology, The College of Wooster, 930 College Mall, Wooster, OH, 44691, United States.  
E-mail address: [sclayton@wooster.edu](mailto:sclayton@wooster.edu) (S. Clayton).

in animals, including humans (Barlow, Durand, & Hofmann, 2019). It involves negative emotionality that is characterized by physical symptoms and future-oriented apprehension (Barlow, 2002). As it is future-oriented, it can lead to appropriate, adaptive preparations for forthcoming performances (e.g., Yerkes & Dodson, 1908) or precautions for possible threats (Barlow, 2002). In more extreme forms, however, it can be maladaptive, leading to dysregulation of emotion (Barlow, 2002; Barlow et al., 2019), or maintenance of a chronic state of worry (Borkovec, Alcaine, & Behar, 2004). Thus, anxiety is closely associated with the process of worry, or apprehensive expectation. In clinical presentations such as Generalized Anxiety Disorder, worry is perceived as difficult to control and is associated with various physical symptoms, such as fatigue, restlessness, irritability or sleep disturbance (American Psychiatric Association, 2013). Specific foci of anxiety and trauma-related disorders vary across individuals and clinical presentations (e.g., Barlow, 2014).

Given the projected impacts of climate change on human health and wellbeing, it seems reasonable for it to have negative emotional consequences, such as increasing anxiety. The direct impact on emotions evoked by experiencing events associated with climate change, such as major storms, droughts, or land loss, is well documented (Manning & Clayton, 2018; Obradovich, Migliorini, Paulus, & Rahwan, 2018) and extreme climate events can serve as stimuli for anxiety and trauma (Clayton, Manning, Krygsman, & Speiser, 2017; Fritze, Blashki, Burke, & Wiseman, 2008). Individual responses range from what are considered “common reactions to abnormal events” (Luber et al., 2014) to more chronic conditions, such as post-traumatic stress disorder (Davidson & McFarlane, 2006). As abnormal climate events increase in frequency and are attributed to global climate change (Luber et al., 2014), it is logical that worry about such events – or future-oriented concern about climate change – could impact individuals’ psychological functioning; that even the mental health of individuals not directly affected by weather related events could be impacted by the patterns of climate change (Doherty, 2015; Doherty & Clayton, 2011).

One way in which this could occur is through the processes of worry and anxiety. Worry and grief can accompany a sense that places and things of value are being degraded (Wang, Leviston, Hurlstone, Lawrence, & Walker, 2018). These objects of value can range from one’s home or other important location, to one’s personal identity and sense of self (Ellis & Albrecht, 2017; Norgaard, 2006), to one’s way of life or culture (Adger, Barnett, Brown, Marshall, & O’Brien, 2013; Cunsolo & Ellis, 2018). Indeed, some of the resistance to accepting climate change comes from the motivation to defend the existing structure of social, economic, and political arrangements, which is threatened by climate change (Feygina, Jost, & Goldsmith, 2010).

The threat posed by climate change can be described as even more extensive than simply damage to things people care about. Tschakert, Ellis, and Anderson (2019) describe the perception of loss associated with climate change, pointing out that the “sense of self and security can ... be corroded through fear and anxiety of feeling or being at risk, even if no actual climate-related harm occurs” (p. 59). Stoknes (2015) referred to “the great grief” associated with the sense that nature is changing. Reser and Bradley (2017) discuss the existential threat that climate change poses, characterizing it as representing a different level of magnitude than the focus of typical studies on risk. Using evocative language, Norgaard (2006) described this threat as a potential loss of ontological security: a lack of confidence that the natural world is as it appears to be; a deep and troubling sense that something has gone wrong with the natural world and our relationship to it. Stoknes further characterized it simply as a feeling that one’s knowledge is no longer true. For ease of discussion, we describe it as climate change anxiety, but the range of potential negative emotions is broad.

Although worry about climate change appears to be a fairly common experience, some people are likely to experience more worry than others. For example, younger people seem to feel more anxiety: in the APA survey, millennials expressed greater concern about climate

change than older adults (APA, 2018). Certainly some people are more directly at risk of harm from climate change: some people (including many indigenous people) may be located in geographically vulnerable areas, or be exposed to the impacts of climate change through their occupations. The media also have a role to play in creating climate anxiety; especially when people’s perceptions are not based on their own direct experiences, the narrative constructed by both traditional and social media will affect their interpretations of the threat (cf. Pihkala, 2019; Whitmarsh & Capstick, 2018).

In addition, some people may feel more connected to the natural world for cultural or personal reasons. This connection may make them care more about, or be more attentive to, environmental threats. In a stratified sample of over 1500 Australians (Dean et al., 2018) people who scored higher on a measure assessing personal identification with nature (a subscale of the Nature Relatedness scale) reported more symptoms of stress, as well as higher levels of depression and anxiety, suggesting that a close relationship with nature might make people more vulnerable to climate anxiety. Similarly, Helm et al. (2018) found that biospheric concern was associated with ecological stress, but also with ecological coping.

In the research reported here, the Environmental Identity (EID) scale (Clayton, 2003) will be used to assess individuals’ perception of identification with nature. Environmental Identity refers to a self-concept that reflects a feeling of emotional as well as cognitive connection to nature. Research has shown that people high in EID demonstrate greater environmental concern as well as more pro-environmental behavior. High levels of EID should promote greater attention to environmental threats as well as higher value for the wellbeing of nature.

Some level of concern about climate change is appropriate, reflecting a realistic threat perception. Bearing in mind the possibility for anxiety to be functional in preparing people to deal with the effects, is there an important difference between being worried and very worried about climate change – a threshold at which the worry begins to affect people’s lives? Certainly, anecdotal reports refer to people being “paralyzed” by their emotions about climate change. One indication that climate change worry may have a significant impact was found in a 2018 survey for the New York Times. In a nationally representative sample of about 1800 adults, about 25% of Americans said they expected to have fewer children than they considered ideal; of these, 33% cited worry about climate change. Business Insider reported results of a 2019 poll that found almost 30% of Americans at least somewhat agreed that couples should consider the impacts of climate change when deciding whether or not to have children (Relman & Hickey, 2019). (See also a group organized around this issue at <http://conceivablefuture.org/>) Wolfe and Tubi (2019) suggest that the fear, or even terror, associated with climate change may induce inaction as a defensive response; in some cases, what looks like apathy is really paralysis.

Higginbotham, Connor, and Baker (2014; see also Homburg & Stolberg, 2006) considered the role of stress as a determinant of pro-environmental behavior in the context of climate change. In their model, responses to climate change begin with experiences, which can be both direct and indirect; these experiences lead to threat and coping appraisals as well as an emotional response, which in turn can lead to problem-solving, self-protection, and emotional expression, finally resulting (or not) in climate action. This is consistent also with van der Linden’s (2014) model, which suggested that cognitive and affective responses to climate change can occur simultaneously, reciprocally affecting each other. There has been a great deal of research on cognitive appraisals of climate change. Our focus here is to describe part of the emotional response and examine its relationship to experience (as a precursor) and to behavioral engagement (as a consequence).

Although awareness of climate anxiety or of some form of negative emotional response to climate change seems to be increasing, there is little conceptual clarity regarding this construct. Many terms have emerged, including solastalgia (Albrecht, 2005), environmental distress

(Higginbotham, Connor, Albrecht, Freeman, & Agho, 2006), ecological grief (Cunsolo & Ellis, 2018), ecological stress (Helm et al., 2018), eco-anxiety (Cordial, Riding-Malon, & Lips, 2012), pre-traumatic stress disorder (Van Susteren, 2017), and climate change distress (Reser, Bradley, & Ellul, 2012). These terms have slightly different implications: some are specifically associated with climate change, while others indicate reactions to more general environmental degradation, and they describe slightly different patterns of emotional response. They also rely on different levels of supporting evidence; some simply describe impressions, for examples among clinicians, while others have been assessed empirically. Cunsolo and Ellis (2018) argue that ecological grief should be taken into account by policymakers who are trying to assess the impacts of climate change. In order to do so, it is important to have an operational definition. The goal of the present research was to develop a measure of climate change anxiety that would allow for consistency in measurement and understandings.

### 1.1. Measuring the psychological impact of climate change

There have been previous attempts to measure negative emotions associated with climate change. Searle and Gow (2010) measured climate change distress with 12 items focused on emotions: "Thinking about climate change now makes me feel – concerned, tense, worried, anxious, depressed, hopeless, powerless, sad, helpless, stressed, angry, scared". Their principal components analysis produced a two factor structure which accounted for 64 percent of the total item variance. Factor one was named climate change anxiety (Thinking about climate change now makes me feel – tense, anxious, worried, angry, concerned, stressed, sad, scared, depressed) and factor two was labelled climate change hopelessness (thinking about climate change now makes me feel – powerless, helpless, hopeless). Cronbach's alpha was 0.92 for the overall climate change distress scale, and 0.92 and 0.82 for the climate change anxiety and climate change hopelessness subscales, respectively.

Other researchers have focused on a more general measure of solastalgia, defined as negative emotions associated with change to a valued place. Eisenman et al. (2015, in EcoHealth) measured psychological distress and solastalgia with 6 items. Solastalgia was correlated with distress, though it's important to note that the items assessing solastalgia included measures of negative emotion:

- Seeing [the place that is negatively affected] has been stressful.
- I feel like I have been grieving for the loss of [the place that was negatively affected].
- I feel sad when I look at the landscapes damaged by [the event].

Probably the most extensive effort to measure the emotional response to climate change is found in work by Reser and colleagues (Reser, Bradley, & Ellul, 2012). In work for the Australian National Climate Change Adaptation Research Facility and with the Understanding Risk Research Centre at Cardiff University, they surveyed national samples of Australians in 2010 (N = 3096) and 2011 (N = 4347) about their perceptions, understandings, and responses to climate change. Referring to "a dramatic dearth of evidence-based findings" on the topic (p. 139), the researchers defined climate change distress as experienced apprehension, anxiety, sorrow, or loss due to the threat and projected consequences of climate change, for oneself, humanity, and/or the natural world. They measured it with 7 items, asking for agreement or disagreement with items such as "I experience distress," "worry about," "feel personal responsibility," "feel a sense of loss," "feel some guilt," about climate change, or "the threat of climate change is affecting my quality of life." Cronbach's alpha for the scale was 0.93.

In addition to the large representative sample size, this research was noteworthy for attempting to link climate change distress to experiences as well as to psychological coping and adaptation responses. Prior

experience of climate change was significantly associated with distress, as were age and gender (younger people and women showed higher levels of distress). Notably, the researchers found that the experience of psychological distress in response to climate change was the strongest predictor of psychological adaptation to climate change, with psychological adaptation mediating the relationship between distress and behavioral engagement.

Measuring the reactions to climate change is important. Only with a valid measure can responses be evaluated in context – differences can be examined across samples and across time. A valid measure also enables more accurate assessment of relationships between climate change distress and other constructs, such as environmental concern and general anxiety. Most fundamentally, a valid measure also allows us to define what it is we are talking about when we talk about climate anxiety, and to evaluate the impact of therapeutic responses for people whose anxiety is extreme.

To measure the psychological response to climate change, there must be a clear conceptualization of the construct. It seems most similar to a measure of stress or anxiety: an affective response to environmental circumstances. There are also ways in which it is similar to depression, but depression is less clearly associated with a specific cause, such as climate change. In a discussion of issues surrounding the measurement of stress, Epel et al. (2018) argue that stress is important because of its link to psychological and physical wellbeing – a link that could also be present for climate change anxiety. They also identify a lack of consistency in stress measurement as well as a lack of precision in defining what stress actually is. Their model of stress includes psychological responses to a stressor such as cognitive appraisals as well as rumination, emotional responses, emotion regulation strategies, and coping efforts. The appraisals are important in defining whether a stressor is actually perceived as such: a stress response is triggered when the stressor is identified as a threat to things that are important, including physical safety or one's sense of self, and possibly beyond the perceiver's ability to cope.

### 1.2. The present research

Previous measures of emotional response to climate change showed internal reliability as well as concurrent validity, but none had the primary focus of the current measure: to look for the relationship between climate anxiety and personal wellbeing. We used several methods to generate items. One was extensive reading – not only in the psychological literature described above, but also a variety of blogs addressing emotional responses to climate change. For example, English professor Kate Shapira started a project on "climate anxiety counseling", with an associated blog (<https://climateanxietycounseling.wordpress.com>) in 2014, to let people "share their anxieties about the changing world." We also examined posts on several other sites, including <http://eco-anxiety.blogspot.com/>. Many posts reported sadness and grief, as well as fear, guilt, and frustration. People also described physical symptoms: feeling "sick" or physical pain. Some describe uncontrollable crying. Some reported a feeling of paralysis. Blogs clearly do not describe a representative sample and cannot be used to describe a typical response; however, we looked at them in order to see some of the range of responses described by people who describe themselves as emotionally impacted by climate change.

More importantly, we grounded our item selection in existing measures. In particular, we wanted to see whether climate change anxiety could be considered clinically relevant by being associated with impaired functioning. It is worth noting that several studies (Berry & Peel, 2015; Verplanken & Roy, 2013) have found no relationship between climate change worry and mental health in general; Helm et al. (2018), however, found that environmental stress predicted depressive symptoms. Can a difference between healthy and unhealthy worry be identified? The consideration of relevant clinical symptoms led us to adapt items from a rumination measure and a functional impairment

measure. The rumination items, based on the Ruminative Responses Scale (Treyner, Gonzalez, & Nolen-Hoeksema, 2003), were included to assess whether people were thinking about climate change to an unhealthy extent. The functional impairment items, adapted from the Weiss Functional Impairment Rating Scale (Weiss, 2000), were included to assess whether the emotions associated with climate change were interfering with people's ability to function. Finally, we incorporated some behavioral items based on the Drive for Muscularity scale (McCreary & Sasse, 2000) to see whether engaging in pro-environmental behaviors was associated with climate change anxiety.

## 2. Method, study 1 and study 2

### 2.1. Participants

For Study 1, 203 participants who resided in the United States were recruited via Amazon's Mechanical Turk. Sample sizes of about 200 are appropriate for most factor analyses (MacCallum, Widaman, Zhang, & Hong, 1999; Tabachnik & Fidell, 2019). After screening out participants who took less than 90 seconds to respond, 197 participants were retained, of whom 117 identified as male and 80 as female (they were given an "other" option but no one selected it). The sample was 75% Caucasian, with just under 10% African heritage and smaller percentages Asian, Latinx, or other ethnicity. The majority (about 50%) were between 25 and 34, but ranged from the category 18–24 to three people who were 75 or older. The majority had completed a 4-year degree but ranged from one respondent who had not complete high school to 13 who had a graduate or professional degree.

Study 2 was a direct replication of Study 1. One hundred ninety-nine U.S. participants were recruited via Mechanical Turk approximately 3 months after Study 1. Of these, 133 identified as male, 64 as female, and 2 as "other". The sample was a little less diverse: 83% were Caucasian, 6% Asian American, and the other categories were represented by less than 3% of the sample. The age range and education level were almost identical to Study 1: 50% were between 25 and 34, but they ranged from 18 to 75–84; 44% had a 4-year degree, with 44% having less education.

### 2.2. Measures

To assess impaired cognitive-emotional involvement with the topic of climate change, four items assessed impacts on concentration and emotions. An additional four items were adapted from the Ruminative Response scale (Treyner, Gonzalez, & Nolen-Hoeksema, 2003), with the preface: "How often do you engage in the following thought patterns? Please indicate what you generally do, not what you think you should do." Six items were loosely based on a functional impairment scale (Weiss, 2000). We also included three items assessing personal experience of climate change and five items adapted from the Drive for Muscularity Scale to assess sustainable behavior. A single item measured a feeling of efficacy about addressing climate change. These items are shown in Table 1. (Two additional items were deleted based on the results of the factor analyses.)

In order to assess concurrent and discriminant validity, we included three other measures. A general tendency toward anxiety was assessed with a four-item measure of general anxiety and depression (Kroenke, Spitzer, Williams, & Lowe, 2009), which obtained a Cronbach's alpha of .92 (Study 1) and 0.93 (Study 2). To look for connections with personal engagement in environmental issues, an 11-item measure of environmental identity (Clayton, 2003) was also included; Cronbach's alpha was .92 (Study 1) and 0.90 (Study 2).

People were also asked to indicate the extent to which they felt each of eleven negative emotions associated with climate change: sad, scared, alone, angry, pessimistic, guilty, helpless, hopeless, isolated, frustrated, and resigned. These items were based on terms represented in the blogs associated with emotional response to climate change.

**Table 1**  
Questionnaire items.

Please rate how often the following statements are true of you.				
1	2	3	4	5
Never	Rarely	Sometimes	Often	Almost always
1.	Thinking about climate change makes it difficult for me to concentrate.			
2.	Thinking about climate change makes it difficult for me to sleep.			
3.	I have nightmares about climate change			
4.	I find myself crying because of climate change			
5.	I think, "why can't I handle climate change better?"			
6.	I go away by myself and think about why I feel this way about climate change			
7.	I write down my thoughts about climate change and analyze them			
8.	I think, "why do I react to climate change this way?"			
9.	My concerns about climate change make it hard for me to have fun with my family or friends.			
10.	I have problems balancing my concerns about sustainability with the needs of my family.			
11.	My concerns about climate change interfere with my ability to get work or school assignments done.			
12.	My concerns about climate change undermine my ability to work to my potential.			
13.	My friends say I think about climate change too much.			
14.	I have been directly affected by climate change			
15.	I know someone who has been directly affected by climate change			
16.	I have noticed a change in a place that is important to me due to climate change			
17.	I wish I behaved more sustainably			
18.	I recycle			
19.	I turn off lights			
20.	I try to reduce my behaviors that contribute to climate change			
21.	I feel guilty if I waste energy			
22.	I believe I can do something to help address the problem of climate change			

Note: Items 1–13 constitute the climate change anxiety scale. Items 1–8 represent cognitive-emotional impairment; 9–13 measure functional impairment; 14–16 measure experience of climate change; 17–22 measure behavioral engagement.

Internal reliability for the emotions was 0.93 (study 1) and 0.92 (Study 2). All items were measured on a 1–5 scale.

## 3. Results

### 3.1. Study 1

A series of factor analyses were conducted using the principal axis factoring approach with direct oblimin (oblique) rotation. As previous research suggests the popular Kaiser criterion (i.e., eigenvalues greater than 1.0) alone is unreliable (e.g., Velicer & Jackson, 1990), examination of the scree plot was also used to determine the optimal number of factors. As recommended by Costello and Osborne (2005), we conducted analyses in an iterative manner, testing models at and around the 'elbow' in the scree plot, and after deleting items that have either low loadings (< 0.30) or that cross-loaded (> 0.30 on more than 1 factor). Using this approach, a four factor solution emerged as the one with high factor loadings within a scale and minimal cross-loadings. This model accounted for 69.78% of variance among the items. Factor loadings are presented in Table 2. Cronbach's alpha for all scales was > 0.80.

Factor 1 represents cognitive and emotional impairment in response to climate change, reflected in rumination, difficulty sleeping or concentrating, and nightmares or crying. Factor 2 indicates behavioral engagement: not just engaging in sustainable behavior, but endorsing the significance of a behavioral response. The self-efficacy item also loaded on this factor. Factor 3 represents personal experience of climate change. Finally, factor 4 reflects functional impairment: high ratings on this factor indicate that concern about climate change is interfering with a person's ability to work or socialize.



**Table 2**  
Study 1 – Summary of exploratory factor analysis using principal axis factoring (n = 197).

Item	Factor Loadings <sup>a</sup>			
	Factor 1	Factor 2	Factor 3	Factor 4
Thinking about climate change makes it difficult for me to concentrate.	<b>.67</b>	.05	.04	.25
Thinking about climate change makes it difficult for me to sleep.	<b>.77</b>	.03	.05	.17
I have nightmares about climate change.	<b>.82</b>	-.12	-.06	.03
I find myself crying because of climate change	<b>.78</b>	-.10	-.03	.05
I think, “why can't I handle climate change better?”	<b>.76</b>	.08	-.04	.02
I go away by myself and think about why I feel this way about climate change	<b>.86</b>	.05	.02	.06
I write down my thoughts about climate change and analyze them	<b>.85</b>	.02	-.01	.02
I think, “why do I react to climate change this way?”	<b>.84</b>	.01	-.04	.06
(I seek out information about climate change in the media.) <sup>b</sup>	.09	<b>.45</b>	-.23	.01
I wish I behaved more sustainably	.19	<b>.50</b>	.02	-.04
I recycle.	.01	<b>.53</b>	-.01	.02
I turn off lights.	-.26	<b>.58</b>	.08	-.04
I try to reduce my behaviors that contribute to climate change.	-.18	<b>.73</b>	-.13	.14
I feel guilty if I waste energy.	-.01	<b>.81</b>	.04	-.02
I believe I can do something to help address the problem of climate change.	.05	<b>.58</b>	-.18	-.03
I have been directly affected by climate change.	.04	.05	<b>.86</b>	.00
I know someone who has been directly affected by climate change.	.08	.05	<b>.88</b>	.07
I have noticed a change in a place that is important to me due to climate change.	.08	.03	<b>.75</b>	.07
My concerns about climate change make it hard for me to have fun with my family or friends.	-.03	.03	.02	<b>.91</b>
I have problems balancing my concerns about sustainability with the needs of my family.	.01	.08	-.01	<b>.75</b>
My concerns about climate change interfere with my ability to get work or school assignments done.	-.02	-.04	-.02	<b>.90</b>
My concerns about climate change undermine my ability to work to my potential.	.06	-.10	-.02	<b>.82</b>
My friends say I think about climate change too much.	.25	-.03	-.07	<b>.57</b>
(I feel uncomfortable when someone brings up climate change in conversation.) <sup>b</sup>	.24	.03	.06	<b>.60</b>
Cronbach's alpha (among items with loadings > .40)	.96	.81	.88	.93

<sup>a</sup> Factor loadings over .40 appear in bold, unless the item cross-loads. All values rounded to two decimal places.

<sup>b</sup> Item not retained.

**Table 3**  
Means and correlations between the climate response subscales.

Variables	Mean (Study 1)	Standard Deviation (Study 1)	1	2	3	4	5	6	7
1. Cognitive impairment	1.75	.97	–	<b>.78***</b>	<b>.27***</b>	-.01	<b>.22**</b>	<b>.62***</b>	<b>.60***</b>
2. Functional impairment	2.09	1.08	<b>.84***</b>	–	<b>.24**</b>	-.01	.09	<b>.50***</b>	<b>.56***</b>
3. Experience	3.08	1.20	<b>.28***</b>	<b>.25**</b>	–	<b>.39***</b>	<b>.37***</b>	<b>.52***</b>	<b>.25**</b>
4. Behavioral Engagement	3.67	.84	-.01	-.00	<b>.40***</b>	–	<b>.55***</b>	<b>.35***</b>	-.00
5. Environmental Identity	3.11	.97	<b>.22**</b>	<b>.17*</b>	<b>.46***</b>	<b>.53***</b>	–	<b>.42***</b>	.11
6. Negative Emotionality	2.30	.96	<b>.52**</b>	<b>.45***</b>	<b>.37**</b>	<b>.23**</b>	<b>.40***</b>	–	<b>.64***</b>
7. Depression/Anxiety	2.04	1.06	<b>.54***</b>	<b>.47***</b>	<b>.16*</b>	.01	<b>.17*</b>	<b>.70***</b>	–
Mean (Study 2)			1.75	2.01	3.34	3.83	2.62	2.30	2.10
Standard Deviation (Study 2)			1.07	1.16	1.18	.80	.80	.91	1.16

Note. Correlations above the diagonal are from Study 1; correlations below the diagonal are from Study 2. To aid comparability, all variables were coded from 1 to 5.

Each factor was used to construct a subscale. In order to enhance comparability, we computed subscale scores by taking the mean of the items with strong loadings on that factor, so that all scores could range from 1 to 5 regardless of the number of items. Correlations between the subscales, along with means and standard deviations, are shown in Table 3. Notably, all subscales are correlated with experience of climate change, but behavioral engagement is not associated with cognitive or functional impairment, while cognitive and functional impairment are strongly correlated. We consider the cognitive and functional impairment subscales to constitute the true “climate change anxiety” response.

3.1.1. Concurrent and discriminant validity

Table 3 shows correlations between the subscales and environmental identity, emotional response to climate change, and the depression and anxiety measure. Negative emotions correlated with all subscales as well as with depression and anxiety. Depression and anxiety was strongly correlated with both cognitive and (slightly less strongly) functional impairment, but only moderately related to experience and not at all to behavioral engagement. EID was most strongly correlated with behavioral engagement; moderately with experience and with cognitive impairment; but not at all with functional impairment.

3.1.2. Demographic differences

There were gender differences in the behavioral engagement measure: women ( $M = 3.86, SD = 0.66$ ) scored significantly higher than men ( $M = 3.55, SD = 0.92$ ):  $t(195) = 2.57, p = .007$ ; 95% CI for difference [0.08, 0.53]. No other gender differences were significant. There was not a linear relationship with age, but analyses of variance were conducted after eliminating the two oldest age groups due to small N's. Significant differences were found in cognitive impairment,  $F(4, 184) = 7.88, p < .001$  ( $\eta^2 = 0.15$ ) and in functional impairment,  $F(4, 184) = 5.72, p < .001, \eta^2 = 0.11$ ). For both variables, the youngest age groups (18–35) scored higher than the remaining age groups. There were no significant differences associated with education level. Due to the small number of cases in each category, statistical analyses for differences associated with ethnicity were not conducted. However, African heritage respondents ( $N = 19$ ) scored higher than Asian heritage ( $N = 11$ ) or Caucasian ( $N = 147$ ) respondents on each factor. Latino/Latina respondents ( $N = 7$ ) scored the highest means in cognitive impairment, experience, and functional impairment, but lowest in behavioral engagement.

**Table 4**  
– Summary of confirmatory factor analysis, Study 2 ( $n = 199$ ).

Item <sup>b</sup>	Factor Loadings <sup>a</sup>			
	Factor 1	Factor 2	Factor 3	Factor 4
Thinking about climate change makes it difficult for me to concentrate.	.82			
Thinking about climate change makes it difficult for me to sleep.	.90			
I have nightmares about climate change.	.90			
I find myself crying because of climate change.	.91			
I think, “why can't I handle climate change better?”	.84			
I go away by myself and think about why I feel this way about climate change	.91			
I write down my thoughts about climate change and analyze them	.93			
I think, “why do I react to climate change this way?”	.89			
(I seek out information about climate change in the media.) <sup>a</sup>		.53		
I wish I behaved more sustainably		.40		
I recycle.		.60		
I turn off lights.		.40		
I try to reduce my behaviors that contribute to climate change.		.83		
I feel guilty if I waste energy.		.64		
I believe I can do something to help address the problem of climate change.		.78		
I have been directly affected by climate change.			.93	
I have known someone who has been directly affected by climate change.			.88	
I have noticed a change in a place that is important to me due to climate change.			.67	
My concerns about climate change make it hard for me to have fun with my family or friends.				.82
I have problems balancing my concerns about sustainability with the needs of my family.				.83
My concerns about climate change interfere with my ability to get work or school assignments done.				.91
My concerns about climate change undermine my ability to work to my potential.				.90
My friends say I think about climate change too much.				.84
(I feel uncomfortable when someone brings up climate change in conversation) <sup>a</sup>				.83
Cronbach's alpha	.97	.79	.86	.94

<sup>a</sup> Item not retained.

### 3.2. Study 2

MPlus 7.0 (Miller, 2018) was used for all Confirmatory Factor Analysis (CFA) procedures. Following recommendations of Kline (2005), multiple fit indices in addition to the Chi-Square statistic were used to evaluate the model. This approach is recommended because the Chi-Square statistic is influenced by sample size (Hu & Bentler, 1999). Additional fit indices included the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI, also known as the Non-Normed Fit Index). Values greater than 0.90 and 0.95 for the CFI and TLI indicate acceptable and good fit, respectively. Values less than 0.08 for the RMSEA indicate a reasonable fit, with RMSEA values less than 0.05 indicating good fit (Hu & Bentler, 1999). In addition to examining fit indices, standardized factor loadings were also considered.

The model resulting from Study 1 demonstrated good to acceptable or reasonable fit with the observed data:  $\chi^2(246) = 553.03, p < .001$ , CFI = 0.93, TLI = 0.92, RMSEA = 0.07 (CI<sub>90%</sub> = 0.06–0.08). All factor loadings were > 0.40 (see Table 4).

#### 3.2.1. Concurrent and discriminant validity

Table 3 shows the correlations between subscales and the scales for negative emotions, depression and anxiety, and EID. Results were similar to those from Study 1.

#### 3.2.2. Demographic differences

Similar to Study 1, there was a gender difference in behavioral engagement,  $t(195) = 2.17, p = .03$ , 95% CI for difference [0.02, 0.50], with women ( $M = 4.01, SD = 0.73$ ) scoring higher than men ( $M = 3.75, SD = 0.82$ ). There were no gender differences in the other subscales. As in Study 1, there were significant differences associated with age in cognitive impairment,  $F(4,191) = 7.55, p < .001$  ( $\eta^2 = 0.14$ ) and functional impairment,  $F(4,191) = 8.81, p < .001$  ( $\eta^2 = 0.16$ ); once the top two categories (which had few respondents) were eliminated, the lowest two age groups (18–34) had higher scores than the remaining groups. Education was also significantly related to functional impairment,  $F(4, 194) = 2.63, p = .04$  ( $\eta^2 = 0.05$ ), with an

almost-linear increase in score from the least educated ( $M = 1.54, SD = 1.54$ ) to the most educated ( $M = 2.32, SD = 1.29$ ); similar results were found for cognitive impairment,  $F(4, 194) = 5.43, p < .001$ ,  $\eta^2 = 0.10$ , with means ranging from 1.1 ( $SD = 0.23$ ) for the high school graduates to 2.1 ( $SD = 1.3$ ) for those with advanced degrees. (The trends in Study 1 were similar but did not reach statistical significance.) Due to small samples, differences associated with ethnicity were not examined.

#### 3.2.3. Evidence for climate change anxiety

As seen in Table 3, means for the anxiety subscales were fairly low, although experience of climate change was at the midpoint of the scale (“sometimes true of me”) and behavioral engagement approached the “often true of me” level. This is not surprising; we would not expect high levels of climate change anxiety in the general public. However, a substantial proportion of the respondents scored above the midpoint of the scale for cognitive or functional impairment, with 26–27% above the midpoint on functional impairment, and 17–19% over the midpoint on cognitive impairment, in Studies 1 and 2. See the distribution of scores in Fig. 1 and Fig. 2. Although there are no clear cutoff points, we suggest that, if 25% of a sample report that climate change makes it difficult for them to function more often than “sometimes”, this indicates that climate change is beginning to have a significant effect on mental health.

## 4. Study 3

Study 3 was designed to investigate two questions regarding climate change anxiety. First, it examined whether the climate change anxiety subscales might be affected by a framing paragraph that emphasized power or powerlessness in response to climate change. It was unclear how stable response to climate change should be in response to an experimental manipulation of framing. It seemed unlikely that ratings of functional impairment would be affected by such a simple manipulation. Cognitive impairment, however, as a less concrete aspect of climate change anxiety, might be affected by the way in which climate change was described. Direct experience of climate change should be

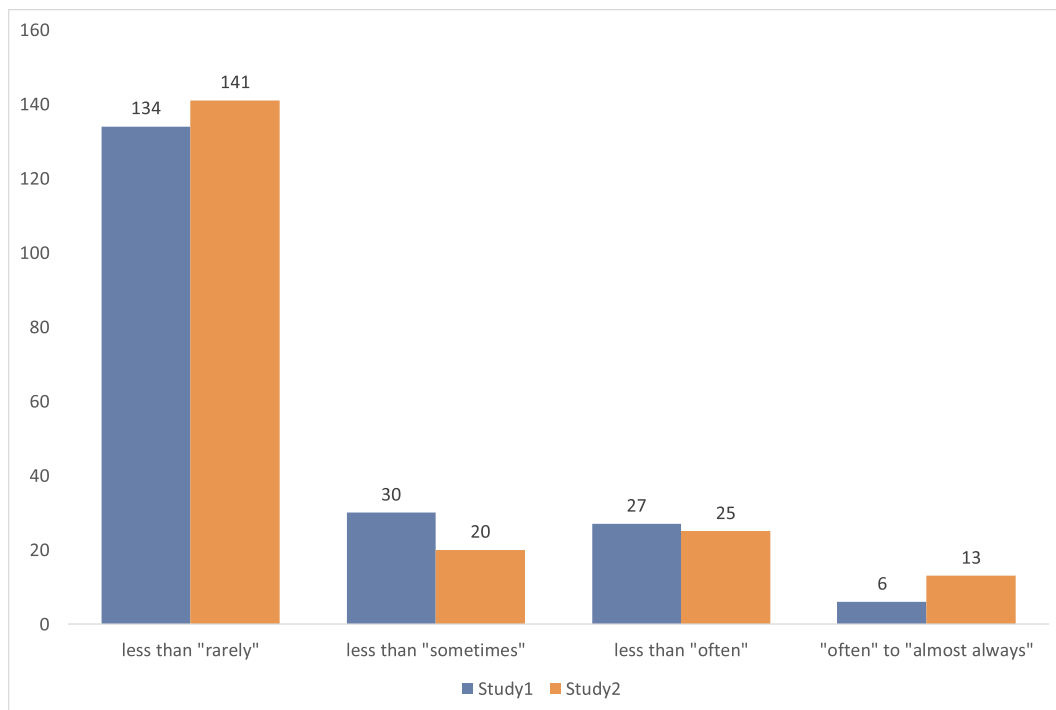


Fig. 1. Distribution of responses for cognitive impairment.

immune to framing, although it was possible that the framing paragraph would prime salient experiences.

A second goal was to explore the relationship between climate change anxiety and the psychological adaptation scale examined by Reser, Bradley, & Ellul, 2012. In order to understand and encourage

adaptation to climate change, it is important to see whether the psychological response is associated with the functional responses included on the adaptation scale, such as looking for “things that I can address and change in my everyday life” and changing “the way I think about and view how we live in and use our natural environment”. Indeed,

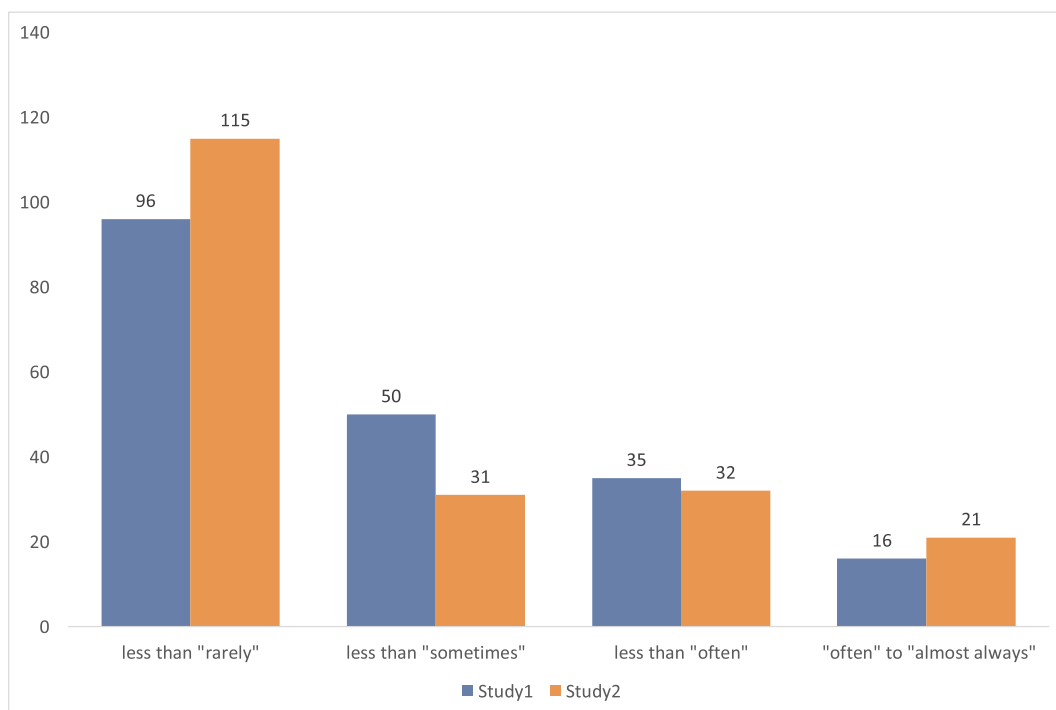


Fig. 2. Distribution of responses for functional impairment.

Reser et al. found that their measure of climate change distress predicted psychological adaptation as assessed by their coping variables.

#### 4.1. Participants

Two hundred and ninety-seven U.S. participants were recruited from Amazon's Mechanical Turk, but missing data left a sample of 217: 142 men, 74 women, and one who did not identify as either. A power analysis suggested that 210 would be an adequate sample size. The majority of participants were between 23 and 35, but ranged from 18 to 22, to between 55 and 64. Of those who identified an ethnicity, 76% were Caucasian. Most had a bachelor's degree, but some had only a high school education and a few had attended graduate or professional school.

#### 4.2. Method

Participants were randomly assigned to one of two framing conditions: an empowering message or a powerless message. This paragraph preceded the survey.

Version A (empowering;  $N = 109$ ): *Climate change has become an increasing topic of discussion in society. With the likely impacts on our environment, solutions are key to find. There are many advances that will help to protect our planet. Greenhouse gases contributing to global warming have long been on the rise but new technologies provide alternative sources of energy. Electric vehicles can address the air pollution problem in the immediate term and reduce the amount of climate change in the long-term. Similar opportunities exist for climate-smart buildings, urban planning and design, green spaces in cities, and urban farming. Wind and solar power are cheaper than ever and responsible for an increasing portion of energy use. Finally, people are also becoming aware of the need to take action, and are mobilizing to create effective change.*

Version B (powerless;  $N = 108$ ): *Climate change has become an increasing topic of discussion in society. With the potential impacts on our environment, solutions are hard to find. Temperatures are rising all over the planet. Greenhouse gases contributing to global warming have long been on the rise and are now accelerating at their fastest pace in seven years. Many species might die out, unable to adapt to the rapid temperature shift. Other species, like disease-carrying mosquitos, may proliferate. There is a higher incidence of drought, major storms, and wildfires. The changing climate may also lead to an impaired ability to grow food, with consequences including the potential for famines, forced migration, economic crises – and war. Finally, people seem to feel powerless, and are unsure how to respond effectively to the situation.*

After the framing paragraph, participants completed the climate change anxiety measure, including cognitive and functional impairment subscales, in addition to their experience of climate change. They also completed a seven-item measure of psychological adaptation, adapted from Reser, Bradley, & Ellul, 2012. Reser et al. report a Cronbach's alpha of .85–.87 for the adaptation scale.

#### 4.3. Results

A principle-axis factor analysis of the adaptation scale indicated a single factor that accounted for 58% of variance; Cronbach's alpha was .87. It was strongly correlated with experience ( $r = 0.54, p < .001$ ), moderately correlated with functional impairment ( $r = 0.24, p < .001$ ), and uncorrelated with cognitive impairment ( $r = 0.05, n.s.$ ). Reser, Bradley, & Ellul, 2012 also reported a correlation of 0.30 between adaptation and experience of climate change, although their measure of experience was different from the present one. Because both adaptation and impairment reflect one's experiences of climate change, we also calculated the correlations between climate change anxiety and adaptation while controlling for experience. The partial correlation

with cognitive impairment remained insignificant ( $r = 0.07$ ), and the partial correlation with functional impairment became nonsignificant ( $r = 0.13, p = .056$ ). Overall, there is no evidence that climate change anxiety was associated with adaptation once experiences of climate change are controlled.

A series of ANOVAs examined the impact of framing condition (Adger et al., 2013) on climate change anxiety, experience of climate change, and psychological adaptation. As expected, there was no significant impact on experience. There was also no impact on psychological adaptation or on functional impairment. However, cognitive impairment scores were significantly higher in the empowering condition ( $M = 1.97, SD = 1.07, 95\% CI [1.76, 2.17]$ ) compared to the powerless condition ( $M = 1.67, SD = 0.91, 95\% CI [1.49, 1.84]$ ;  $F[1, 215] = 4.83, p = .03, \eta^2 = 0.022$ ).

#### 4.4. Discussion

It is notable that experience of climate change was correlated with psychological adaptation. Climate change has the potential to be a chronic stressor, but it is subject to individual interpretation. When experience of climate change was controlled, the correlation between impairment and coping became nonsignificant. We suspect the positive zero-order correlation between functional impairment and adaptation reflects the importance of a willingness to acknowledge the negative impacts of climate change, as reflected by the correlation with experience, and to adapt to these negative experiences, rather than implying that impairment itself is an adaptive reaction.

The impact of the framing paragraph on climate change anxiety was selective, with a positive but not very strong effect on cognitive impairment. It is plausible that an empowering frame can help people to engage with the issue of climate change, while a powerless frame reduces their willingness to think about it; future research should investigate this in greater depth to see if there are practical implications for an empowering message to reduce avoidance and denial. In general, other aspects of climate change response (functional impairment, reported experience, and adaptation) were immune to framing effects.

### 5. General discussion

The results of these studies indicate that climate change anxiety can be identified and reliably measured, and that the psychological response to climate change is complex. In particular, it is possible to distinguish between what could be described as an adaptive response of behavioral engagement, even accompanied by negative emotions, and a response that is more maladaptive in that a person's ability to function is impaired. Whereas the climate change anxiety response – both cognitive and functional impairment – was associated with a general measure of depression and anxiety, behavioral engagement was not associated with either the specific or the general anxiety response. Yet they are all positively correlated with experience of climate change and with negative emotions in response to climate change. In other words, experiencing climate change is associated with more than one type of response.

One reason to care about climate change anxiety is out of concern for individual wellbeing. Another reason has to do with the predictors of effective action. These results suggest that there are ways of engaging with the issue of climate change that allow people to maintain psychological wellbeing while still acknowledging the negative climate circumstances. Indeed, in Study 3, experiences of climate change were positively correlated with a measure of psychological adaptation, defined as positive coping responses such as thinking about ways to reduce one's carbon footprint.

Environmental identity, assessing a predisposition to connect with environmental issues, was strongly associated with behavioral



engagement as well as being significantly correlated with cognitive impairment and reported experience of climate change. Notably, it was uncorrelated or only weakly correlated with functional impairment, and with depression and anxiety, though it did correlate with experiencing negative emotions in response to climate change. As expected, environmental identity may prompt a greater awareness of, and attentiveness to, environmental changes, along with both cognitive and behavioral engagement. The research is consistent in indicating that those who feel more identified with nature will show a stronger response to climate change. Dean et al. (2018), for example, found that identification with nature was associated with higher levels of stress among Australians, similar to the association with negative emotions here. The positive aspects of environmental identity (e.g., Dean et al., 2018) may even protect individuals from a dysfunctional response to climate change, expressed as impairment. Future research should explore this further.

Although not examined here, it is also possible to experience a positive emotional response to climate change. Past studies have found some people reporting hope or empowerment (e.g., Clayton, 2018; Minor et al., 2019), especially associated with collective action (Bamberg, Rees, & Schulte, 2018). Some people may even be pleased at the prospect of warmer temperatures (Pihkala, 2019). It is worth recognizing that emotional responses to climate change occur within a social context that can foster positive or negative emotions, or encourage denial of the phenomenon. Norgaard (2006), for example, describes a socially organized denial in Norway that inhibits at least the public acknowledgement of negative emotions. Gibson et al. (Gibson, Haslam, & Kaplan, 2019) report on the culturally specific ways in which climate-change-related distress is expressed in Tuvalu, an island nation whose culture and livelihoods are profoundly threatened by the changing climate.

With the evidence for climate change becoming stronger, and the human impacts becoming more apparent, questions of how people can be resilient in the face of this stressor become more salient. When responding to a psychological stressor, both approach and avoidance are possible responses. A self-protective response may encourage suppressing or denying negative emotions, as many people have done with regard to climate change, but this fails to address the problem. Acknowledging one's emotional response can be part of adaptation (Reser, Bradley, & Ellul, 2012). Verplanken and Roy (2013) also emphasize the adaptive nature of worrying. However, anxiety that is too strong may be maladaptive and begin to interfere with work or social relations.

Overall, levels of climate change anxiety were fairly low in these samples, while behavioral engagement and experience were fairly high. A significant minority of respondents, however, received a high score on the anxiety subscales. We suggest this signals that clinical psychologists and other therapists should be attentive to the way in which their clients are being affected by climate change, and think about ways to address climate change anxiety among their clients. Some therapists are already doing this, emphasizing approaches such as enhanced self-efficacy, finding sources of meaning, and simply getting outside to reconnect with nature (Andrews, 2017; Castelloe, 2018; Clayton et al., 2017; Doherty, 2015; Pols, 2018). A feeling of collective efficacy can also enhance resilience and motivate engagement with the issue (Bamberg et al., 2018; Homburg & Stolberg, 2006). A 2019 report from Finland (Pihkala, 2019) looking at climate anxiety in depth discussed both its prevalence and effective responses to help people cope, and described evidence that hearing about heat waves or wildfires in media reports can increase levels of stress. Some informal support groups have even been formed to connect people feeling worried about climate change, such as the Good Grief Network ([www.goodgriefnetwork.org](http://www.goodgriefnetwork.org)).

As presented here, climate change anxiety is not a clinical diagnosis,

and this measure is not designed to be a clinical assessment. Rather, we expect it to be most useful in assessing the prevalence of climate-related anxiety in specific populations, as well as changes over time in response to specific events or to changing understandings of climate change.

The next stages of research could examine which groups are more likely to experience climate anxiety: members of indigenous communities, for example, or climate scientists, or those whose communities are most at risk. The present research began to investigate demographic differences, finding some consistent associations: women were more behaviorally engaged, and younger people were more cognitively involved and impaired. But more diverse samples, and nationally representative samples in different parts of the world, would help us to better understand the extent to which climate change anxiety is becoming a significant threat among different cultures, as well as providing further validation of the scale. Children would be a particularly important group to assess; this scale should be comprehensible to children from the age of 12, and there is increasing interest in how children may be affected by anxiety about climate change, in part because today's children have the potential to be important political agents in prompting public actions to address the problem. Other constructs to consider in future studies include examination of various forms of individual differences as potential correlates of climate change anxiety, including personality traits and experiences of significant natural effects of climate change (e.g., major storms, power outages, forced migration), some of which are known to have negative effects on mental health (Davidson & McFarlane, 2006). Future research could also address a broader spectrum of emotional responses to climate change, including the anger and frustration that people report in response to deniers or intransigent politicians as well as possible positive emotions, and the question whether positive and negative emotional responses can be positively correlated.

### 5.1. Limitations

Several limitations of this research need to be acknowledged. Most fundamental is the sample. Although MTurk samples are generally more representative than college student samples, they are not representative of the population at large. Future studies should obtain more national samples, as well as deliberately sampling specific populations of interest such as environmentalists, first responders, or climate change deniers. In addition, we did not randomize the order in which subscales were presented; it is possible that there were some order effects, for example with questions asking people about their experience of climate change prompting a greater degree of associated anxiety.

## 6. Conclusion

These studies measured psychological responses to climate change, finding two subscales that assess cognitive or functional impairment. Although the subscales are highly correlated and can be combined to assign an overall "climate change anxiety" score, they showed some differences in patterns of correlation and future researchers may want to examine them separately. These scales were neither positively nor negatively correlated with behavioral engagement, and also were not significantly correlated with psychological adaptation, once the perceived experience of climate change was controlled. Thus, a negative emotional response, such as feeling sad, scared, angry, etc., can be distinguished from what we have defined here as a more clinically significant "anxious" response. Negative emotions in response to climate change were more common and were associated with behavioral engagement, as well as with a general connection to nature as assessed by environmental identity; whereas climate change anxiety was uncorrelated with behavior and less strongly correlated with EID. Further

research in this area should examine the predictors that lead to a more or less adaptive emotional response among those who are thinking about climate change, as well as to positive behavioral responses.

#### Author notes

All ethical guidelines were followed in conducting this research. The authors declare no competing interests.

#### CRedit authorship contribution statement

**Susan Clayton:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Writing - original draft. **Bryan T. Karazsia:** Formal analysis, Writing - review & editing.

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