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Knowing what you feel matters: Emotion differentiation impacts climate-related attitudes, beliefs, and behaviors

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ABSTRACT

The topic of climate change and humans' role in causing or addressing it often elicits a negative emotional response. Considerable literature supports associations between both general distress and specific negative emotions with climate-relevant outcomes. However, little is known about how individuals' tendency to differentiate specific climate change negative emotions from one another versus experience non-specific, broad negative distress may influence such associations. The current investigation examines Climate Change Distress (CCD) to assess whether specific climate change emotions of anger, anxiety, and sadness, can be distinguished from an overarching emotional distress construct in their associations with climate-relevant outcomes. We include data from the original open-source CCD investigation (N_{Total} = 868). When negative emotions are sufficiently differentiated, they hold distinct influences on climate change experiences, engagement, and pro-environmental attitudes and behavior. Overarching emotional distress displayed the largest associations with responses to climate change (|β|s = .19-.62, *ps* < .001). However, decomposing distress into specific negative emotions independently accounts for smaller, yet significant, variance in key climate outcomes (|β|s = .15-.39, *ps* < .001). Additionally, higher climate change emotion differentiation of these specific emotions is associated with higher pro-environmental attitudes and actual behavior (|β|s = .10-.26, *ps* < .029). Greater climate anger that is more differentiated is associated with greater pro-environmental behavior (β = .13, *p* = .038). In contrast, greater anxiety accompanied by lower emotion differentiation was associated with greater pro-environmental behavior (β = −.18, *p* = .037). Sadness differentiation was not independently associated with included measures (|β|s<.11, *ps*>.164). Results suggest that climate change distress alone is not sufficient to understand individuals' climate-focused attitudes and behaviors. Specific emotions associated with climate change, as well as the clarity with which individuals identify them, play a role, sometimes prompting opposing behaviors that align with those emotions' motivational underpinnings. This knowledge can potentially be leveraged to appeal to those who may be differentially emotionally affected by climate change as both an acute and chronic threat.

1. Introduction

Climate change is a pressing global challenge, with profound consequences not only for the environment (Intergovernmental Panel on Climate Change [IPCC], 2007, 2021) but also for individuals' physical and psychological well-being (Clayton, 2020; Kerr et al., 2022; Palinkas & Wong, 2020). As planetary costs are reflected in rising temperatures, extreme weather events, and ecological disruptions, the psychological fallout in part manifests in the form of climate change distress. Although progress has been made in measuring overall climate distress (e.g., Hepp et al., 2023; Latkin et al., 2022; Reser et al., 2012, pp. 1–304; Searle & Gow, 2010), there remains a need to simultaneously evaluate the specific emotions that comprise climate distress and their independent relationships with environmentalism. A parallel body of emotion literature suggests that discrete emotions within negative affect are differentially associated with climate change attitudes and behavior (e.g., Pihkala, 2022; Van der Linden, 2015).

The consequences of the climate crisis may evoke a mix of complex responses, which can include anxiety, fear, sadness, grief, guilt, anger, and other negative emotions (Clayton & Karazsia, 2020; Hepp et al.,

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2023; Hogg et al., 2021; Jarrett et al., 2024; Pihkala, 2020; Stanley et al., 2021; Stevenson & Peterson, 2015; Stewart, 2021), together comprising distress. Extant work in this area is additionally inclusive of other important components to climate crisis responses (e.g. cognitive and functional impairment), which speaks to the breadth of psychological impact of climate change (e.g., Clayton & Karazsia, 2020; Hogg et al., 2021). Although the complexity of such responses naturally contains multiple psychological components, the range of co-occurring negative emotions is particularly notable.

The co-occurrence of related yet distinct emotions in response to climate change has necessitated a measure of overarching distress, as well as a measure of its separate, emotional components. Recent work on the measurement of climate responses presents a parsimonious model of climate distress (Hepp et al., 2023) that specifically includes affective components and conceptualizes cognitive and functional processes as related but distinct. However, relevant literature has also expounded on how each type of negative emotion, when examined separately, holds different downstream outcomes, such as their relative propensity to motivate action (Stanley et al., 2021). The simultaneous phenomenological overlap in emotions and their distinct downstream implications suggest that a deeper understanding of meta-processes in emotion may be crucial.

Emotion differentiation, or the ability for individuals to differentiate between specific emotions (Barrett et al., 2001), may help clarify psychological and behavioral consequences of climate change distress. Research suggests that evaluating climate responses in tandem and accounting for the degree to which individuals distinguish, or differentiate, between emotions is key to reconciling generalized climate distress and determining the downstream consequences of specific emotions (e.g., Contreras et al., 2024). Emotion differentiation may offer a lens in understanding a more nuanced model of emotional responses to climate change.

1.1. Climate change distress

There is increasing cross-disciplinary interest in understanding the distress caused by climate change. Albrecht and colleagues (2007) introduced the term "solastalgia" to describe chronic distress resulting from environmental degradation due to climate change. Under the concept, Albrecht (2011) further identified related psychological impacts, including psychoterratic states such as eco-anxiety, eco-paralysis, and eco-nostalgia. Qualitative research highlights that those living in climate-impacted areas are likely to report emotional experiences of frustration, powerlessness, hopelessness, and overwhelm (Albrecht et al., 2007; Kurth & Pihkala, 2022; Moser, 2013; Ágoston, Csaba, et al., 2022). Yet, it remains unclear whether these complex and fused emotional constructs represent separate, discrete emotions, or a general negative response to climate change.

There are multiple approaches to understanding broad affective processes that can inform the conceptualization and measurement of climate change-related responses. General feelings can be studied as a singular affective component, focusing on characteristics that transcend specific emotions and their content. Seminal work has suggested that affect can be summarized through dimensions of arousal (intensity/degree) and valence (positive/negative; Russell, 1979). In this framework, individuals can feel, for example, very bad (i.e., high arousal, negative valence) or a little good (i.e., low arousal, positive valence), and particular combinations of arousal and valence motivate approach or avoidance behavior.

Alternatively, specific emotions have objects tied to them (Russell, 2003; Schwarz & Clore, 2007), which provide individuals with stored cognitive schemas through which certain coping strategies are learned to be more/less probabilistically successful (Lazarus, 1982, 1991). Although specific emotions that are more approach-oriented (e.g., anger, excitement) might be expected to typically be higher arousal than specific emotions that are more avoidance-oriented (e.g., fear, sadness), all emotions can vary in arousal levels within themselves (Gable & Harmon-Jones, 2010). Thus, anger might range in arousal from irritability to aggression, while sadness might range in arousal from moping to wailing. Classically, climate change is an "object", or source, from which specific emotions and differing motivational drives originate. Motivational drives are mentally represented as attitudes, which the overall emotion literature suggests should be congruent with simultaneous emotions (e.g., attitudes encompassing the belief that a loss, injustice, barrier, or threat is occurring should be associated with distress; Harmon-Jones et al., 2011). General and specific conceptualizations of emotion were integrated when Russell and colleagues (Russell, 2003; Russell & Barrett, 1999) developed a hierarchal taxonomy that encompassed both general (e.g., distress) and specific (e.g., angry) affective responses within an arousal/valence circumplex that operates at different time scales. In the case of climate change, its complexity underscores both common and distinct sources of negativity—from general uncertainty of the future or the devastation of environmental and human loss to specific inequities in the ecological and political fallout of climate inaction. Given that these climate change experiences are harmful, they should be expected to evoke a sense of distress that is adaptive insofar as it motivates addressing the distressing experiences (Carver & Scheier, 1990). It also follows to map these disparate sources of negativity arising from climate change onto different emotional reactions, though all would seemingly contribute to distress. Thus, both a general sense of negativity and specific, discrete emotions tied to different individual sources underneath the climate change umbrella are likely to operate simultaneously.

1.2. The case for discrete climate emotions

Although generalized models for emotion may be useful in providing a simplified account of how emotional reactions drive outcomes, extensive evidence suggests that discrete emotions also drive different psychological and behavioral responses. In the context of climate change, considering discrete emotions offers clear benefits, as some emotions may be more useful/detrimental in evoking environmental action than others. When negative emotions are examined in isolation within respective contexts—anxiety at what is to come, sadness at what has been lost, and anger at what is not yet done—they provide fruitful insight on their unique roles in shaping climate change response. Substantial recent work points to the simultaneous operation of multiple affective dimensions related to climate change, encompassing various emotional experiences (Marczak et al., 2023; Ágoston, Csaba, et al., 2022). We focus on those captured by the CCD-DIS (Hepp et al., 2023).

1.2.1. Climate anxiety

Anxiety is a predominant emotional response associated with climate change. Although we focus in this investigation on affective components of climate anxiety, prior research has often operationalized climate anxiety as a combination of affective, cognitive, and functional components (Clayton & Karazsia, 2020), thereby overlapping considerably with related constructs such as eco-anxiety and climate change worry. Findings from these literatures may nevertheless inform the scientific understanding of the anticipated impacts of climate anxiety. Climate anxiety may potentiate environmental action, but with psychological consequences. Prior research suggests that climate anxiety is positively associated with pro-environmental attitudes and behavior across diverse samples, including adolescents (Becht et al., 2024), Australian adults (Hogg et al., 2024) and samples from Global South (Heeren et al., 2022). Relatedly, climate change worry has been found to be an action-oriented emotional construct, distinct from non-affective variables like perceived risks of climate change (Van der Linden, 2017). Experiencing climate change worry is linked to a sense of personal responsibility towards climate change, support for climate mitigation policies, and information seeking behaviors (Bouman et al., 2020; Hmielowski et al., 2019). However, evidence also suggests that climate anxiety is associated with

poorer mental health (Hogg et al., 2024; Ogunbode et al., 2021), suggesting that the motivational benefits of climate anxiety for environmental attitudes may sometimes come at the cost of adverse mental health consequences.

1.2.2. Climate sadness

Negative ecological harms include human and non-human lives and communities. Although separable constructs, the experience of climate-related sadness may overlap considerably with a sense of ecological grief due to irreparable loss. Eco-grief and eco-anxiety are related (Ágoston, Csaba, et al., 2022; Ágoston, Urbán, et al., 2022), suggesting shared affective origins, but with varied downstream consequences. Eco-grief, often triggered by current or anticipated ecological losses (Proudley, 2013), may significantly shape responses to climate change (Cunsolo & Ellis, 2018). Unlike eco-anxiety, such responses may not potentiate action. Grief and sadness in response to a loss of one's home can give rise to withdrawal feelings of hopelessness and despair (Ellis & Albrecht, 2017). Such responses can result in disengagement and reduced motivation, presenting obstacles for to climate change action (Hmielowski et al., 2019).

1.2.3. Climate anger

Compared to both anxiety and sadness, anger is perhaps most associated with approach-oriented, and often higher arousal behaviors that promote collective action and activism (Carver & Harmon-Jones, 2009; Stanley et al., 2021; Van Zomeren, Spears, Fischer, & Leach, 2004). Salient subtypes of anger related to collective action include group-based anger, especially relevant in the context of racial inequity and intergroup conflict (e.g., Van Zomeren et al., 2004), and moral anger, which is evoked by social evaluations of individual duty (Panno et al., 2021; e.g., Reese & Jacob, 2015). Both forms of anger are relevant to environmentalism, especially considering disproportionate effects of climate change on marginalized communities (Hickman et al., 2021). However, while anger can be productive, it can similarly harm well-being if not well-regulated (Diong & Bishop, 1999; Diong et al., 2005; Yamaguchi et al., 2017).

Research on anger and other discrete emotions, along with the varied profiles of each emotions' impact on well-being and climate change engagement, presents a compelling case for disentangling general distress into its disparate parts.

1.3. Emotion differentiation

Individuals can and do feel "bad," often "extremely" so, about climate change and its impacts, but why they feel so may be a key factor when considering seminal work in emotion theory. Valence (positive versus negative) and arousal (low versus high) are foundational to most theories of emotion (Russell, 2003), because they provide the where (i.e., direction). Contextual responses to valenced stimuli specify the what (i.e., target; Barrett et al., 2007; Izard, 2007; Rottenberg & Gross, 2003). Meanwhile, stored schemas provide a probabilistic landscape of the how (i.e., strategy; Ortony et al., 1988; Schwarz & Clore, 1983, 2003, 2007). This sequence of cognitive processes provides a (non-exclusive) foundation for emotion differentiation (Kashdan et al., 2015), which is independent from separate emotion levels and has unique correlations with behavioral outcomes.

Emotion differentiation refers to the tendency, conscious or unconscious, to distinguish primary, secondary, simultaneous, and otherwise discrete emotional experiences as actually separate and independently informative (Lane & Trull, 2022). It was originally theorized as an individual tendency (Barrett et al., 2001) that could be contextually influenced (Kashdan & Farmer, 2014), with later work illustrating its moment-to-moment variability and independent predictive power (Erbas et al., 2022; Lane & Trull, 2022; Tomko et al., 2015). Broadly, low trait-level emotion differentiation is linked with emotion dysregulation (Barrett et al., 2001). Studies have indicated that undifferentiated negative affect can have significant within-person effects in terms of increased momentary impulsivity (Racine et al., 2024; Tomko et al., 2015) and dysregulated behaviors associated with specific emotions (anger: Maloney et al., 2024; Pond Jr et al., 2012; anxiety: Kashdan & Farmer, 2014; guilt: Bicaker et al., 2022; sadness: Demiralp et al., 2012); impaired coping: Kalokerinos et al., 2019).

Taken together, literature suggests that the ability to differentiate specific emotions plays a role in how individuals experience, interpret, and respond to emotionally charged situations. Given that climate change evokes a wide range of negative emotions, it may be useful to examine: (1) whether discrete emotional experiences related to climate change influence climate-related perceptions and actions above and beyond general distress; and, (2) how psychological outcomes are influenced by the ability to distinguish between specific emotions. While climate change is perceived as a harmful event that elicits general distress, specific emotional responses may vary depending on how individuals interpret the issue. Differing appraisals can evoke distinct emotions, which may lead to different outcomes. Individuals who can differentiate between discrete negative emotions may be more likely to engage in directed climate action.

1.4. Current research

The existing literature is replete with general and specific climate change negative emotion investigations. We leverage open-source data from one such investigation to pursue questions that are inherent to existing empirical work but have not yet been pursued: whether specific climate emotions (i.e., anxiety, sadness, anger) are associated with outcomes independently from general distress, and whether emotion differentiation alters these associations. We examine outcomes such as climate action that have been examined in the climate distress literature but not while considering global distress, discrete emotions, and emotion differentiation simultaneously. In addition, we examine constructs theoretically related to climate emotion that to our knowledge have not yet been empirically linked to it (i.e., climate experiences and attitudes). The original conceptualization of the distress component in the recent CC-DIS was to disambiguate generalized versus specific negative emotionality in response to climate change (Hepp et al., 2023; see Supplemental Materials[2]). This was informed by multiple areas of social and clinical psychology regarding: a) the regulating utility of differentiating the sources and types of experienced emotions (Barrett et al., 2001; Schwarz & Clore, 1983); b) the lack of measures capturing the full spectrum of negative emotional responses to climate change (e.g., Clayton & Karazsia, 2020); and c) the absence of tests as to whether specific climate change emotions are distinct from a generalized climate distress construct (e.g., Clayton & Karazsia, 2020). Theory and empirical evidence outside of the climate change context indicates that specific emotions are differentially motivating as a function of the individual and differentially relevant with respect to the type of emotion-focused coping response (e.g., approach versus avoid; Kashdan et al., 2010, 2014). Recent research also suggests that, although the CCD primarily indexes an overarching distress construct, specific climate emotions are separable from overall distress and account for substantial reliable variance (Lane et al., unpublished manuscript). Thus, undifferentiated emotional responses (e.g., generalized distress) to climate change may impede individuals' climate experiences and engagement.

1.4.1. Hypotheses

Should specific emotions be associated with downstream effects,

[2] Fig. S1 provides four examples of responses to the 15 CCD items and resulting climate change emotion differentiation (CCED) estimates. It illustrates how the same overall CCD score (Panels A and B) or same emotional experience for a specific emotion subscale (Panels C and D) can have very different interpretations when they are differentiated versus not.

relevant outcomes of interest would include experiences of climate change impact, attitudes, and engagement, as well as actual climate change behaviors. We hypothesize that differentiated emotions will be additionally impactful to individuals' behaviors, based on prior work linking specific emotions to action (e.g., Latkin et al., 2022; Lerner & Keltner, 2001; Panno et al., 2021).

In line with previous work, we hypothesize that higher levels of CCD will be associated with greater endorsement of climate change experiences, attitudes, and engagement, independent of differentiation. To the extent that specific emotional responses to climate change are differentiable, they should modify such reactions. Specifically, we hypothesize that climate change emotion differentiation, independent of arousal/degree, will be associated with higher endorsement of climate change experience and pro-environmental behavior. In terms of each differentiated emotion, we hypothesize that anger and anxiety, being approach-oriented emotions, will be associated with higher climate change engagement and pro-environmental behavior. However, we acknowledge that their effects may diverge in direction, depending on the immediacy and ostensible risk of the engagement (Lerner & Keltner, 2001). In contrast, we hypothesize that sadness will be associated with null or otherwise negative independent associations with pro-climate action measures given its underlying withdrawal-orientation.

2. Methods

Data for the current investigation originates from four studies reported by Hepp and colleagues (2023) in the development of the Climate Change Distress and Impairment Scale (CC-DIS). The present focus is on the Climate Change Distress (CCD) items, the unique contribution of the theorized specific emotion subscales, and their independent validity with respect to external climate change measures. Analyses of specific subscales and climate change negative emotion differentiation include self-report measures from Study 3 and behavioral responses from a social dilemma game (Greater Good Game) from Study 4 as these were the only two studies to also collect external validation measures.

2.1. Participants

Individuals included in the current analyses ($N_{Total} = 868$; $N_{Study\ 3} = 374$; $N_{Study\ 4} = 494$) completed the CC-DIS and validity measures as part of larger survey or experimental protocols. Individual study sample sizes, demographics, and inclusion criterion are provided by Hepp and colleagues (2023) on OSF (https://osf.io/eprdw/). Samples were recruited internationally (Study 3: primarily UK [$n = 159$], USA [$n = 128$], Canada [$n = 35$], South Africa [$n = 26$], Other [$n = 26$]; Study 4: Germany) and were restricted to individuals who believed in anthropogenic climate change.

2.2. Procedures

Full details of procedures for each study are provided in the original publication (Hepp et al., 2023), including ethics approval, data collection medium and timeline, and participant remuneration. Relevant to the current investigation, all participants completed the self-report CCD items included in the final scale. In addition, in Study 3, participants completed climate change validity measures after the CCD items but in random order, and in Study 4, participants engaged in the Greater Good Game (GGG; Klein et al., 2017) after providing demographic information and completing the CCD items.

2.3. Measures

2.3.1. Climate change distress

Three types of climate change related negative emotions were assessed with the 15 items constituting the distress component of the CC-DIS (Hepp et al., 2023). These items measured feelings of anger, anxiety, and sadness (5 items each; 1 = strongly disagree, 5 = strongly agree). The same 15 items were assessed in each of the studies reported by Hepp and colleagues (2023). Importantly, as supported by recent psychometric work (Lane et al., unpublished manuscript) estimating bifactor models of overall distress and specific emotion subscales displayed superior fit compared to a one-dimensional alternative. The reliability of the overall distress scale (ω's = .91-.95) was excellent, and, important to the current work, that of the specific emotion subscales was adequate to excellent (ω's = .69-.91) for both Study 3 and Study 4 (see Supplementary Materials).

2.3.2. Climate change emotion differentiation

Emotion differentiation of climate change related negative emotions was estimated using the variance decomposition intraclass correlation method developed by Lane and Trull (2022). This approach estimates the relative consistency in item ratings within versus across subscales for each individual, such that subscales receiving the same ratings across all items and subscales (e.g., 4's) would represent a complete lack of emotion differentiation, while a single subscale that had equally elevated ratings (e.g., 4's) with the other two subscales having all equally lower ratings (e.g., 1's) would represent complete differentiation. Differentiation estimates can range from 0 (completely undifferentiated) to 1 (completely differentiated). To avoid biasing the undifferentiation index, individuals who reported no emotions whatsoever would have been coded as completely differentiated (c.f., Lane & Trull, 2022), however, all but one participant reported at least some elevation of negative climate-related emotions. Conceptually, emotion differentiation is intended to reflect the degree to which an individual has clarity in their experience across specific emotions independent of intensity.[2] This is reflected in the variability across item ratings. Importantly, in the current data a vast majority of individuals display variability in their ratings ($n = 844$; 97.24%). Of those who did not report variability in their ratings on climate distress ($n = 24$), 19 (2.19%) reported the maximum score of 5 (extremely agree) on all items (all 1's: $n = 1$; all 2's: $n = 0$; all 3's: $n = 2$; all 4's: $n = 2$). For the purposes of the current analyses, all elevated scores with no variability were thus coded as complete undifferentiation (see Supplementary Materials for visualizations of CCED as they relate to individual emotions and overall distress within individuals).

Although the majority of emotion differentiation research has indexed differentiation across multiple time points, the current investigation adopts a cross-sectional estimation procedure used in single time point contexts (e.g., Maloney et al., 2024). Other researchers have also adapted differentiation indices using cross-sectional measures to examine associations with similar outcomes to aggregated momentary indices (e.g., Erbas et al., 2014; Israelashvili et al., 2019; Nook et al., 2018). Findings have been consistent across intensive longitudinal and cross-sectional studies, in part because the differentiation indices typically used in the longitudinal studies are often aggregated to the cross-sectional level for analysis (Barrett et al., 2001; Kalokerinos et al., 2019; Liao et al., 2025), which does not distinguish between person level and momentary effects (e.g., Curran & Bauer, 2011). Additionally, empirical work finds considerable positive associations between momentary and retrospective affect ratings (Neubauer et al., 2020), suggesting at least the partial translatability in this conceptualization across timescales.

2.3.3. Climate change engagement (study 3)

Six subscale items from a measure of climate change engagement (Clayton & Karazsia, 2020) indexed individuals' self-reported behavioral engagement in climate change engagement (e.g., "I recycle", "I turn off lights"; 1 = never, 5 = almost always; $\alpha = .77$, $\omega = .82$).

2.3.4. Climate change experience (study 3)

Three subscale items (Clayton & Karazsia, 2020) indexed individuals' self-reported direct ("I have been directly affected") and

vicarious experience ("I know someone who has been directly affected") of climate change consequences (α = .85, ω = .87).

2.3.5. Environmental attitudes (study 3)

Individuals' attitudes towards humans' impact on nature ("the balance of nature is very delicate and easily upset") and the earth's ecology ("humans are severely abusing the environment") were measured with the Revised New Environmental Paradigm Scale (Dunlap, 2008; Dunlap & Van Liere, 1978; 1 = strongly disagree, 5 = strongly agree; α = .80, ω = .81).

2.3.6. Greater Good Game (GGG; study 4)

The GGG is a social dilemma paradigm in the style of a nested public goods game. In the game, participants were informed that they were part of an anonymous group of three in which each member was given an endowment and could decide how to spend this endowment. Details are provided in Hepp and colleagues (2023). Participants could opt to allocate their endowment according to, a) selfish, b) cooperative, or c) pro-environmental options. Choices were analyzed using a multinomial processing tree (MPT; Batchelder & Riefer, 1999). Individual-level parameters were estimated for the probability of selfish behavior, distinguishing selfish (*s*) from non-selfish choices (1-*s*). Conditional on non-selfish behavior, an additional parameter captured the probability of distinguishing pro-environmental (*e*) from cooperative behavior (1-*e*).

2.4. Data analysis

We conducted a series of hierarchical regressions using Hepp and colleagues' Study 3 and 4 data to ascertain whether specific negative climate change emotions and climate change emotion differentiation (CCED) were associated with external climate change engagement, experiences, attitudes, and behaviors. All variables were standardized within study prior to analysis. Our baseline model (Model 1) included overall climate change distress, CCED, and their interaction. Models 2-4 included specific negative climate change emotion subscales individually, again with CCED and their interactions. Model 5 included all specific climate change negative emotion subscale scores simultaneously, including their interactions with CCED, to examine the unique associations between specific negative emotions and climate change outcomes compared to generalized associations. Moreover, in Model 5, including all three specific emotion subscales served to statistically covary out overall distress and test associations unique to the individual emotions. All analyses and visualizations were conducted using R Statistical Software (v4.3.2; R Core Team, 2021).

3. Results

Descriptive statistics and correlations are provided for all measures of the two studies included in the current analyses in Table 1. Results of the regression analyses are presented in Table 2 (Study 3) and Table 3 (Study 4). As expected, total scores of the CCD were highly correlated with the emotion-specific subscale scores. However, CCED scores were minimally associated with CCD (and its subscale scores) suggesting that: 1) the construct may be different and useful, and 2) the non-overlap between distress and specific emotional reports could be leveraged to account for variability separate from overall distress.

3.1. Self-report study (study 3, Table 2)

3.1.1. Climate change engagement

Overall negative emotion levels, indexed by higher overall CCD, was positively associated with individuals' self-reported proactive climate change engagement (Model 1: β = .51, *SE* = .04, $p < .001$). Entered separately (Models 2-4), anger (β = .45, *SE* = .05, $p < .001$), anxiety (β = .49, *SE* = .05, $p < .001$), and sadness (β = .47, *SE* = .05, $p < .001$) were also all positively associated with engagement. Entered simultaneously (Model 5), anger (β = .15, *SE* = .08, $p = .050$), anxiety (β = .26, *SE* = .08, $p = .003$), and sadness (β = .16, *SE* = .08, $p = .045$) continued to contribute independently to engagement, lending support to the impact of specific discrete emotions. There were no main effects or interactions as a function of CCED.

3.1.2. Climate change experience

Higher CCD was positively associated with individuals' self-reported climate change experience (Model 1: β = .17, *SE* = .05, $p < .001$). Entered separately (Models 2-4), anger (β = .16, *SE* = .05, $p < .001$) and anxiety (β = .20, *SE* = .05, $p < .001$) were positively associated with climate change experiences. The impact of climate change sadness (β = .08, *SE* = .05, $p = .138$) was weaker and failed to reach conventional thresholds for significance. Simultaneously (Model 5), climate change anxiety was associated with a greater degree of reported experiences (β = .32, *SE* = .09, $p < .001$), but climate change sadness was associated with a lesser degree of reported experiences (β = −.26, *SE* = .09, $p = .004$).

There were no main effects for emotion differentiation across models; but significant interaction effects with differentiation emerged

Table 1
Descriptive statistics and bivariate correlations for included Study 3 and 4 measures.

	Measure	*M*	*SD*	*Range*	1.	2.	3.	4.	5.	6.	7.	8.	9.
Study 3													
1.	CCD	3.90	.63	1 – 5	1.00								
2.	CCD Anger	3.81	.70	1 – 5	.88***	1.00							
3.	CCD Anxiety	3.88	.70	1 – 5	.91***	.71***	1.00						
4.	CCD Sadness	4.01	.69	1 – 5	.90***	.69***	.76***	1.00					
5.	CCED	.28	.33	0 – 1	.09†	−.08	.11*	.21***	1.00				
6.	CC Engagement	3.84	.71	1 – 5	.51***	.44***	.49***	.46***	.04	1.00			
7.	CC Experience	2.25	1.10	1 – 5	.17***	.19***	.21***	.07	.00	.21***	1.00		
8.	CC Attitudes	3.62	.54	1 – 5	.62***	.52***	.56***	.59***	.17**	.38***	.00	1.00	
Study 4													
1.	CCD	3.61	.90	1 – 5	1.00								
2.	CCD Anger	3.51	.92	1 – 5	.90***	1.00							
3.	CCD Anxiety	3.53	1.02	1 – 5	.94***	.75***	1.00						
4.	CCD Sadness	3.77	.96	1 – 5	.95***	.77***	.87***	1.00					
5.	CCED	.24	.31	0 – 1	.11*	.04	.07	.21***	1.00				
9.	GGG unCoop/Coop	.23	.28	0 – 1	−.28***	−.25***	−.23***	−.30***	−.01				
10.	GGG ProEnv/Coop	.37	.31	0 – 1	.32***	.27***	.30***	.32***	−.03				−.29***

Notes: CCD = Climate Change Distress; CCED = Climate Change Emotion Differentiation; GGG = Greater Good Game; unCoop = uncooperative behavior, Coop = cooperative behavior; ProEnv = Pro-environmental behavior.
Shaded cells correspond to ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$.

Table 2
Study 3 hierarchical regression mode results for self-report measures.

Parameter	Climate Change Engagement									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*
Intercept	.00	−.09, .09	.00	−.10, .09	.00	−.09, .09	.00	−.10, .09	−.01	−.11, .08
CCD	.51***	.42, .60								
CC Anger			.45***	.36, .55					.15*	.00, .31
CC Anxiety					.49***	.40, .58			.26**	.09, .43
CC Sadness							.47***	.38, .56	.16*	.00, .32
CCED	−.01	−.10, .08	.07	−.02, .17	−.02	−.11, .07	−.07	−.16, .03	−.03	−.12, .07
CCD*CCED	.03	−.06, .11								
CC Anger * CCED			−.04	−.12, .04					−.04	−.18, .10
CC Anxiety * CCED					.01	−.07, .09			.06	−.10, .21
CC Sadness *CCED							.02	−.07, .11	.02	−.13, .17
R^2	26.4%		20.1%		24.2%		21.2%		26.9%	
Parameter	Climate Change Experience									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*
Intercept	−.02	−.12, .08	.01	−.09, .11	−.02	−.12, .08	−.03	−.14, .07	−.02	−.12, .09
CCD	.17***	.07, .27								
CC Anger			.16**	.05, .26					.13	−.05, .30
CC Anxiety					.20***	.10, .30			.32***	.13, .51
CC Sadness							.08	−.03, .18	−.26**	−.44, −.08
CCED	−.03	−.13, .07	.02	−.08, .12	−.04	−.14, .06	−.04	−.15, .06	.01	−.09, .12
CCD*CCED	.19***	.10, .28								
CC Anger * CCED			.15***	.06, .24					.07	−.08, .23
CC Anxiety * CCED					.18***	.09, .27			.04	−.13, .21
CC Sadness *CCED							.16**	.06, .26	.08	−.08, .25
R^2	7.4%		6.4%		8.3%		3.2%		11.2%	
Parameter	Environmental Attitudes									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*
Intercept	.00	−.08, .08	−.01	−.09, .08	.01	−.08, .09	.00	−.09, .09	−.01	−.09, .08
CCD	.61***	.53, .69								
CC Anger			.55***	.46, .64					.18*	.04, .32
CC Anxiety					.56***	.47, .64			.24**	.09, .40
CC Sadness							.58***	.49, .67	.26***	.11, .40
CCED	.11**	.03, .20	.21***	.12, .30	.11**	.03, .20	.04	−.04, .13	.10*	.01, .19
CCD*CCED	−.02	−.09, .05								
CC Anger * CCED			−.07†	−.15, .00					.00	−.13, .13
CC Anxiety * CCED					−.08*	−.16, .00			−.10	−.24, .04
CC Sadness *CCED							.00	−.08, .08	.08	−.05, .22
R^2	39.3%		31.7%		33.2%		34.9%		39.8%	

Notes: CCD = Climate Change Distress; CCED = Climate Change Emotion Differentiation; Ang = Anger; Anx = Anxiety; Sad = Sadness.
Shaded cells correspond to ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$.

for CCD and all of the individual negative emotion models. As CCED increased, the generally positive association between specific negative emotions and climate change experience was increased (CCD: β = .19, *SE* = .05, $p < .001$; Anger: β = .15, *SE* = .04, $p = .001$; Anxiety: β = .18, *SE* = .05, $p < .001$; Sadness: β = .16, *SE* = .05, $p = .002$; Fig. 1). Including all three emotion subscales as simultaneous predictors resulted in no statistically significant independent interaction effects, possibly due to collinearity, small independent effects, and resulting reduced power across the different negative emotion subscales (*r*'s > .60; Lane & Hennes, 2019).

3.1.3. Environmental attitudes

Higher CCD was positively associated with individuals' self-reported pro-environmental attitudes (Model 1: β = .61, *SE* = .04, $p < .001$). Entered separately (Models 2-4), anger (β = .55, *SE* = .04, $p < .001$), anxiety (β = .56, *SE* = .04, $p < .001$), and sadness (β = .58, *SE* = .04, $p <$ .001) were positively associated with climate change attitudes. Entered simultaneously (Model 5), all three emotions retained their independent effects (Anger: β = .18, *SE* = .07, $p = .012$; Anxiety: β = .24, *SE* = .08, $p = .002$; Sadness: β = .26, *SE* = .07, $p < .001$).

Across analyses, there was a significant positive main effect of CCED for overall distress, anger, and anxiety (β's = .11 – .21, *SE*s = .04, *p*'s = .029 – .008) but not sadness (β = .04, *SE* = .04, $p = .319$). The CCED effect remained with all CCD subscales included simultaneously (β = .10, *SE* = .04, $p = .029$). Negative interaction effects emerged for specific anger (marginal; β = −.07, *SE* = .04, $p = .053$) and anxiety (β = −.08, *SE* = .04, $p = .048$) such that the positive association between the level of emotional experience and pro-environmental attitudes was reduced as climate change emotions became more differentiated. When visualized (Fig. 2), this effect was specific to lower levels of emotion, such that individuals who were more differentiated reported more positive climate change attitudes than those who were less differentiated. At high levels of negative emotion, there was no effect of CCED. However, neither interaction effect remained in the combined model.

Table 3
Study 4 hierarchical regression model results for behavioral measures.

Parameter	GGG *s* parameter (selfish vs. unselfish)									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*
Intercept	.00	−.09, .09	.00	−.09, .09	.00	−.09, .08	.00	−.09, .09	.01	−.08, .11
CCD	**−.28*****	−.37, −.19								
CC Anger			**−.25*****	−.34, −.16					−.05	−.22, .12
CC Anxiety					**−.23*****	−.32, −.15			.13	−.07, .33
CC Sadness							**−.31*****	−.40, −.22	**−.39*****	−.60, −.19
CCED	.03	−.06, .11	.00	−.09, .09	.00	−.08, .09	.06	−.03, .15	.08	−.02, .17
CCD*CCED	.01	−.08, .10								
CC Anger * CCED			.04	−.04, .12					−.01	−.14, .12
CC Anxiety * CCED					.05	−.03, .14			.09	−.08, .27
CC Sadness *CCED							−.01	−.11, .08	−.10	−.29, .09
R^2	7.8%		6.3%		5.6%		9.3%		10.1%	
Parameter	GGG *e* parameter (cooperative vs. pro-environmental)									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*	β	95% *CI*
Intercept	.01	−.08, .09	.00	−.08, .09	.01	−.08, .09	.01	−.08, .10	.01	−.08, .10
CCD	**.32*****	.24, .41								
CC Anger			**.28*****	.19, .36					−.09	−.26, .08
CC Anxiety					**.31*****	.22, .39			.17†	−.03, .37
CC Sadness							**.33*****	.25, .42	**.26****	.06, .46
CCED	−.06	−.15, .02	−.04	−.13, .05	−.04	−.13, .05	**−.09***	−.18, .00	−.08†	−.17, .01
CCD*CCED	−.04	−.13, .05								
CC Anger * CCED			−.04	−.12, .04					**.13***	.01, .26
CC Anxiety * CCED					**−.09***	−.18, −.01			**−.18***	−.35, −.01
CC Sadness *CCED							.04	−.13, .05	.01	−.18, .20
R^2	10.9%		7.8%		10.3%		11.2%		12.6%	

Notes: CCD = Climate Change Distress; CCED = Climate Change Emotion Differentiation; GGG = Greater Good Game; Ang = Anger; Anx = Anxiety; Sad = Sadness. Shaded cells correspond to ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$.

3.2. Behavioral GGG study (study 4, Table 3)

3.2.1. Cooperative (versus selfish) behavior (GGG s parameter)

Higher CCD was negatively associated with individuals' selfish compared to cooperative behavior (Model 1: β = −.28, *SE* = .04, $p < .001$). Entered separately (Models 2-4), anger (β = −.25, *SE* = .04, $p < .001$), anxiety (β = −.23, *SE* = .04, $p < .001$), and sadness (β = −.31, *SE* = .04, $p < .001$) were all associated with less selfish and more cooperative choices. Entered simultaneously, only sadness (β = −.39, *SE* = .10, $p < .001$) continued to contribute independently to less GGG selfish behavior, lending support to the specificity of individual emotions with sadness relating to empathy and concern for others (Fultz et al., 1988). There were no main effects or interactions as a function of CCED.

3.2.2. Pro-environmental (versus cooperative) behavior (GGG e parameter)

Higher CCD was positively associated with individuals' pro-environmental behavior (Model 1: β = .32, *SE* = .04, $p < .001$). Entered separately (Models 2-4), anger (β = .28, *SE* = .04, $p < .001$), anxiety (β = .31, *SE* = .04, $p < .001$), and sadness (β = .33, *SE* = .04, $p < .001$) were positively associated with pro-environmental choices compared to just cooperative ones. Entered simultaneously (Model 5), only sadness retained an independent effect (Anger: β = −.09, *SE* = .09, $p = .291$; Anxiety: β = .17, *SE* = .10, $p = .084$; Sadness: β = .26, *SE* = .10, $p = .009$).

Across analyses, there was a significant negative main effect of CCED only for the sadness subscale model (Model 4: β = −.09, *SE* = .04, $p = .039$) that was reduced in the full model (Model 5: β = −.08, *SE* = .05, $p = .076$). There was a single CCED interaction effect with anxiety (β = −.09, *SE* = .04, $p = .029$) in the single measure models (1-4). In the full model (5), the CCED-anxiety interaction remained (β = −.18, *SE* = .09, $p = .037$), and another interaction between CCED and anger reached statistical significance (β = .13, *SE* = .06, $p = .038$). Of note, the two interactions were in opposite directions for the specific climate change emotion subscales (Fig. 3). At high levels of differentiation, indicating that individuals have clarity with respect to their specific emotions, higher levels of emotion experience had little effect on choosing pro-environmental over cooperative behavior. For specific anger responses to climate change, at low levels of differentiation, anger and pro-environmental behavior were negatively associated, with greater pro-environmental behavior observed at lower levels of anger (Fig. 3A). In contrast, at low levels of differentiation, anxiety and pro-environmental behavior were positively associated, with greater pro-environmental behavior observed at higher levels of anxiety (Fig. 3B).

4. Discussion

The present investigation examined whether specific negative emotions have incremental validity in predicting climate change experiences, engagement, attitudes, and behavior above and beyond generalized distress. We also tested whether the effects of generalized or discrete emotions on psychological and behavioral outcomes vary by individuals' ability to differentiate emotions. Although some scholars offer a parsimonious approach to understanding negative emotions elicited by climate change (e.g., Albrecht et al., 2007; Beckord et al., 2025; Hepp et al., 2023; Koder et al., 2023; Searle & Gow, 2010), recent work suggests that modeling multiple specific emotions simultaneously to identify their independent effects might be informative (Contreras et al., 2024), at least to some degree (e.g., Lynam et al., 2006; Miller & Chapman, 2001). Perspectives advocating the usefulness of discrete negative emotions often overlook that the overlap removed through covariation may reflect meaningful individual differences. These differences are theoretically central to core models of emotion differentiation and regulation (Barrett et al., 2001; Kashdan et al., 2015). In the context of climate change, such differentiation may help explain emotional responses that are distinct from generalized distress.

In other words, although the negative emotions captured by the CC-

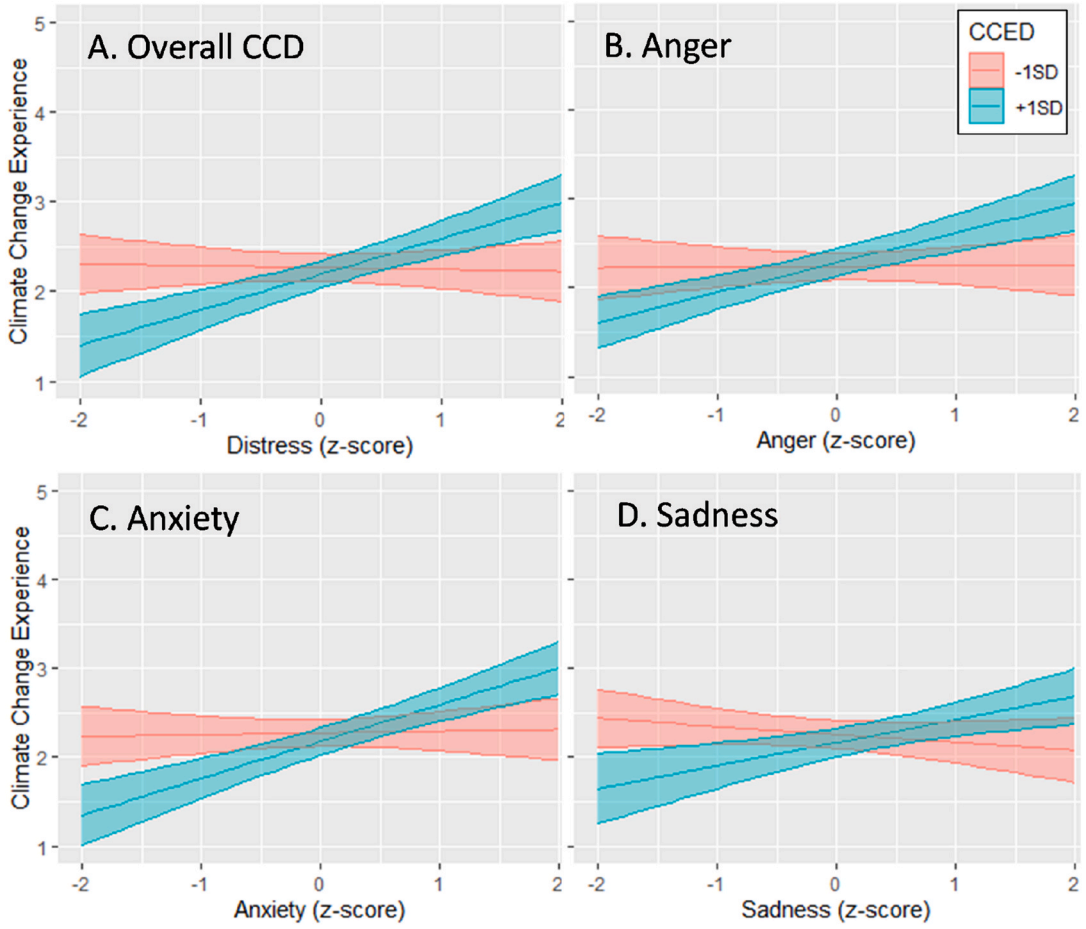

Fig. 1. Predicted endorsement of climate change self-reported experience for general CCD and separate climate change emotions as a function of level of CCD differentiation (Study 3).
Notes. CCD = Climate Change Distress; CCED = Climate Change Emotion Differentiation.

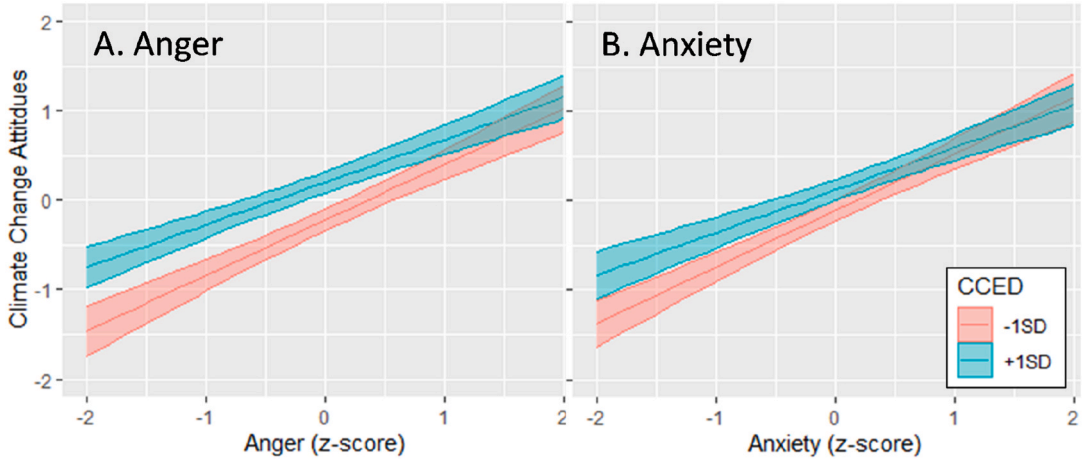

Fig. 2. Predicted endorsement of climate change self-reported environmental attitudes as a function of climate change anger/anxiety and climate change emotion differentiation (Study 3).
Notes. CCD = Climate Change Distress; CCED = Climate Change Emotion Differentiation.

DIS are highly correlated (Table 1), they are also distinguishable and reliably so. Emotion research has long shown that more variance is accounted for at the level of valence and arousal than at the level of categorical, specific emotions (Barrett, 2006). However, specific emotion categories within in the same valence still have utility, as demonstrated, for example, by the literature showing negative outcomes associated with failing to distinguish between them (Smidt & Suvak, 2015).

In this study, although much variance is accounted for at the level of valence (i.e., overall distress), explaining the high intercorrelations between different negative emotions, the specific emotions uniquely predict outcome variables in a manner that is largely consistent with

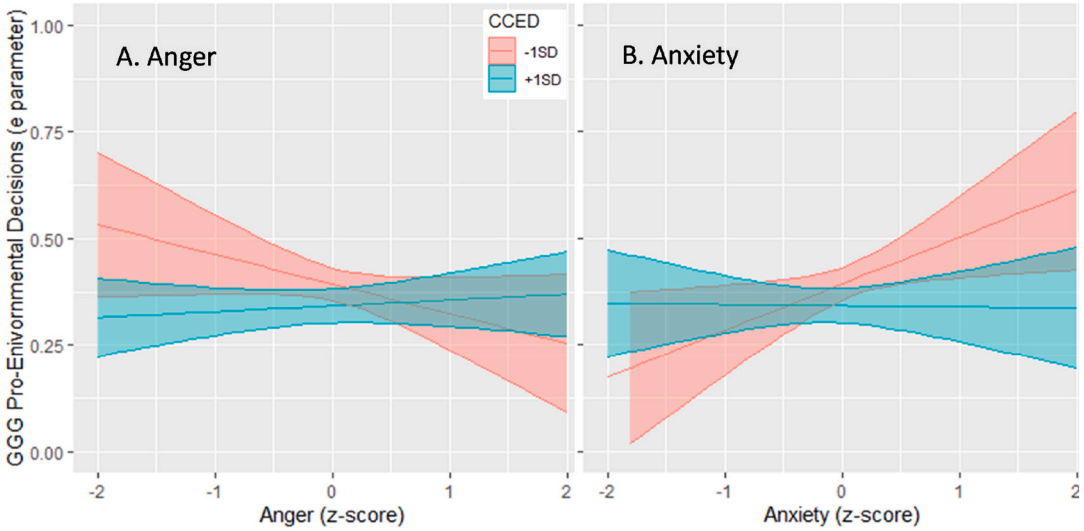

Fig. 3. Study 4 predicted pro-environmental behavior preference (compared to cooperative) as a function of specific climate change emotion intensity and differentiation for anger (A) and anxiety (B) in the Greater Good Game.
Notes. GGG = Greater Good Game; CCED = Climate Change Emotion Differentiation.

current theory once this shared variance is accounted for. This situation is akin to the dark triad literature, in which Machiavellianism, narcissism, and psychopathy are positively correlated, but when their shared variance is accounted for, also predict unique outcomes (Furnham et al., 2013).

Our results indicate that a general distress construct captures a substantial portion of emotional responses to climate change in included measures (R^2 = 8-38%). Specific emotions, though, still play a role, individually (R^2 = 1-3%), and especially as a whole (total R^2 = 12-51%; ΔR^2 = 1-13%; all *ps* < .001). This research goes further than previous work by providing insights into the relationships between specific negative emotional responses to climate change, their associations with climate-related experiences, attitudes, and behavior, and a focal emotion regulatory mechanism that impacts these associations.

The current work supports the importance of examining negative climate-related emotions in the context of one another by demonstrating the moderating effect of differentiation on the relationship between climate change-related emotions and action. The findings largely support our hypotheses, while also revealing nuances in how specific emotions like anger, anxiety, and sadness independently contribute to these outcomes. Consistent with Hepp and colleagues (2023), we found that emotional distress accounted for a majority of variance in climate change experience, attitude, engagement, and behavioral responses. In line with extant work, generalized emotional distress appears to be a powerful motivator for pro-environmental attitudes and action (e.g., Albrecht et al., 2007; Beckord et al., 2025; Hepp et al., 2023; Koder et al., 2023; Searle & Gow, 2010). We then hypothesized that CCED would be independently associated with greater endorsement of climate change engagement and pro-environmental behavior, extending beyond the traditional high-arousal, negative-valence framework.

Differentiated emotional responses significantly informed climate change experiences, attitudes, and behavior. For instance, differentiated emotions of anger and anxiety were positively associated with pro-environmental experiences. Similar patterns were observed for pro-environmental attitudes, with the caveat that being higher on differentiation was associated with greater pro-environmental attitudes, regardless of how angry or anxious an individual felt.

Differential associations between climate change constructs and associated emotions arose when it came to actual behavior. This was expected given the focused, action-oriented nature of anger, and, by contrast, the diffuse and expansive nature of anxiety. Individuals who can clearly differentiate between emotions are more likely to engage in pro-environmental behavior when approach emotions are clear and not conflated with other negative emotions. In contrast, anxiety is a diffuse, non-specific emotion that is inherently driven by broader valence and arousal (Lerner & Keltner, 2001).

Prior research has not explored the association of emotion differentiation with experience or attitudes. Unsurprisingly, differentiation increases concrete evaluations for both on average. However, interactions with anger and anxiety with respect to pro-environmental attitudes revealed that the negative association was specific to lower levels of arousal. These results suggest that feeling a little negative but knowing that one is angry versus stressed may be associated with greater pro-environmental behavior.

Taken all together, the current results demonstrate the impact of differentiation in multiple ways, some with greater applied implications than others. Negative emotions may generally load onto outcomes like experience or attitudes in the same direction but nonetheless may still impact the magnitude of associations, demonstrating a nuanced role in guiding downstream consequences. Most crucially, differential relationships among differentiated emotions occur in behavioral outcomes, which are a central concern in the extant literature (e.g., Hmielowski et al., 2019; Carver & Harmon-Jones, 2009; Stanley et al., 2021; Van Zomeren et al., 2004). Therefore, emotion differentiation may be most relevant in the promotion of climate and collective action, while parsimonious models of distress may be apt when focusing on the experiential or phenomenological aspects of the climate crisis. Still, other factors in addition to emotion differentiation may be at play in determining the emotion to outcome pathway.

Notably, and contrary to our predictions, sadness was positively associated with proactive climate change engagement and choosing pro-environmental over cooperative behavior. According to longstanding emotion theory and research, sadness immediately motivates withdrawal behavior (Oatley & Jenkins, 1992). However, the studies examined here asked participants how they felt without specifying a time range. Thus, the current findings may represent an ambiguous timeline of the emotions experienced, focusing less clearly on the immediate effects of non-pathological sadness. Future work is needed to understand the time range evoked in different measurements, and to discern immediate versus non-immediate effects of relevant emotions in prompting reflection and effective behavior.

4.1. Limitations

The current investigation is limited by a narrow range of emotions, limited measurement precision (including a restricted timescale and construct ambiguity), and a lack of globally representative sample. The present study, by initial psychometric design, omits a broader range of specific negative emotions suggested to influence climate change attitudes. While anxiety, anger, and sadness are commonly examined, prior research has also reported the effects of guilt (Ágoston, Csaba, et al., 2022; Kleres & Wettergren, 2017; Rees, Klug, & Bamberg, 2015) and helplessness or hopelessness (Hmielowski et al., 2019; Salomon et al., 2017). These unexamined emotions may overlap with both generalized distress and the three discrete emotions studied here. Beyond these negative emotions, the current study also did not include the literature documenting the influence of generalized or specific positive emotions on climate change experiences, attitudes, and behavior. Notably, this literature has reported mixed effects of positive emotions such as hope or pride on climate-related outcomes (e.g., Bury et al., 2020; Feldman & Hart, 2018; Wong-Parodi & Feygina, 2021 for beneficial effects; Adams et al., 2020; Hornsey & Fielding, 2016; Van Zomeren et al., 2019 for null or reverse effects; see also Schneider et al., 2021 for a brief review). Considering the role of emotion differentiation among positive emotions may similarly help clarify these seemingly inconsistent findings. Future research could benefit from examining the differentiability of these additional emotions, as well as individual differences in emotion differentiation, to assess their incremental validity in predicting climate attitudes and behavior. In addition, the average CCED in the two samples in this study was .28 and .24 on a 0 (completely undifferentiated) to 1 (completely differentiated) scale, respectively. It is unclear how to directly interpret these differentiation levels or how they compare to means in the global population, and furthermore, how the findings here would generalize to a more globally representative sample.

Along these lines, the cross-sectional nature of the study and the method used to estimate differentiation limit what we can infer about what the measure captures. The CCD items are framed broadly to assess general feelings without a specific timeframe. Climate change distress likely includes both stable and situationally reactive components. The differentiation method was originally developed for intensive measurement designs that capture both momentary changes and stability over time. With a single measurement, we cannot disentangle the two components.

It is also not clear what object (Schwarz & Clore, 2003) each emotional response to the individual climate distress items refers to. For instance, simultaneous emotional responses (e.g., anxiety, anger) may arise from different eliciting objects (e.g., flood, pollution) and may reasonably be considered distinct responses. The current approach treats simultaneous elevation of different emotions, even if they stem from different sources, as indicative of low differentiation. Without additional contextualization, these different situations of experiencing simultaneous emotions are indistinguishable using the ICC approach and require further methodological development. Nevertheless, prior work has shown that cross-sectional indices of differentiation (Erbas et al., 2014) and aggregated momentary indices (Barrett et al., 2001), in which these situations are conflated, predict maladaptive outcomes. While there is need for further refinement, we believe that our predictions using the cross-sectional index of emotion differentiation in this study are still justified. In addition, even if participants are well-differentiated and accurately report experiencing multiple emotions simultaneously, the co-occurrence of these emotions may still create cognitive confusion or competition that makes regulation challenging (Kashdan et al., 2015). Future research should employ longitudinal designs to disentangle within-person and between-person associations and to more robustly capture the temporal dynamics underlying emotional differentiation, its sources, and their influences on climate-related outcomes.

While the present research benefits from demonstrating convergence between emotional predictors of climate engagement across attitudinal and behavioral outcomes, it is nonetheless important to acknowledge that our single behavioral measure, the Greater Good Game, primarily captures a limited set of private-sphere pro-environmental behaviors. For example, it includes individual resource allocation decisions but does not assess public-sphere actions (e.g., political activism). Prior research suggests that private- and public-sphere pro-environmental behaviors may be differentially associated with emotional responses to climate change (e.g., Becht et al., 2024; Prinzing et al., 2024). As a result, the present findings may not generalize to forms of climate action that represent public-sphere behavior. A broader range of behavioral measures would more comprehensively capture how discrete emotions and their differentiability shape climate action.

Lastly, the present study focuses on populations in the global north, who currently experience relatively lower risk of severe climate devastation, while also disproportionately contributing to the climate crisis (e.g., Füssel, 2010). This inequality is an important consideration for the evaluation of climate emotions, as the reasons for, the nature of, and the consistency (including intensity) of such emotions may vary by global context. For instance, emotions associated with loss, such as sadness, are likely evoked by the direct losses of climate change, such as physical destruction of communities and endangering of life. Perhaps consistent with this idea in terms of extant climate change impact, supplementary analyses indicated that Canadian respondents reported both the highest levels of distress and differentiation among the sampled countries while those from Germany scored the lowest on both scales. Certainly, those not in immediate danger can still experience great distress, including in anticipation of the harm to others, presently or in the future, and those in- or out-of their communities (Clayton et al., 2023; Galway & Field, 2023). Still, this difference in the severity of risk (both real and imagined) may play a role in the nature and consistency of emotions experienced, including those related to risk perception, such as anxiety (e.g., Butler & Mathews, 1987; Hogarth et al., 2011).

Similarly, the reasons which underly negatively valanced climate emotions may differ based on country-specific engagement and culture surrounding climate change, such as the politicization of climate change (McCright & Dunlap, 2011), or the degree of collective and institutional commitment to climate initiatives (Galway & Field, 2023). As previously mentioned, guilt is an unexplored emotion in the CCD subscale but should be further probed as a contextualized country-specific factor (Kleres & Wettergren, 2017). Future research should consider what would be an appropriate and constructive regulation of these emotions towards climate action, and the role of such emotions, as bounded by their sociopolitical context or physical environments.

4.2. Implications

The current research corroborates and expands upon the idea that general climate change distress and specific negative climate change emotions are separable and useful constructs. In addition, the current findings support the importance of emotion differentiation in detecting relationships between specific climate change emotions and actions to mitigate climate change. However, the impact of emotion differentiation varies with emotional degree (Barrett et al., 2001), and whether differentiation leads to increased adaptive behavior depends on the specific emotion in question. This study demonstrated that all three of the specific climate-related negative emotions (for this measure) were positively associated with pro-environmental climate attitudes. Future research should attempt to establish the temporal relationship between attitudes, specific emotions, and differentiation and examine whether attitudes mediate the relationships between negative climate emotions and behavioral outcomes.

Hepp and colleagues found that a unidimensional model provided a parsimonious structure for the CC-DIS. However, given theory of emotions, both within the context of climate change and more broadly, researchers are likely to continue forming questions regarding the effects

of specific negative emotions on climate action. Differentiation, in the context of arousal (i.e., degree, intensity), is crucial to interpreting the relationship between specific climate-related emotions and behavioral outcomes and attitudes. This is observed most acutely in the current research such that pro-environmental GGG decisions are most probable when individuals are highly undifferentiated and experiencing, a) low levels of anger (54% vs. 31%), or b) high levels of anxiety (62% vs. 33%). So, there may be a case for 'mixed' emotions being useful in motivating climate action. We recommend that researchers use the CC-DIS to answer questions regarding the impact of specific emotions on climate action and to examine different specific emotions simultaneously to account for the moderating effect of emotion differentiation.

5. Conclusion

In line with recent recommendations in the climate change literature, enriching measurement of specific climate-related emotional responses experienced by individuals, and how they facilitate pro-environmental behaviors, assists in understanding what individuals respond to affectively and how they will act on those responses. To investigate these factors, it is essential to develop measures that reliably distinguish between generalized and specific emotions and assess how individuals' climate-related actions vary depending on the degree to which they feel generalized versus specific affect. Moreover, individuals' ability to differentiate which emotions they are experiencing guides downstream beliefs and actions yet is currently understudied. Such research could inform the development of interventions that evoke or facilitate emotions that motivate necessary pro-environmental actions, increasing the likelihood of maximizing positive impact.

CRediT authorship contribution statement

Taeik Kim: Writing – review & editing, Writing – original draft, Validation, Resources, Investigation. **Mairéad A. Willis:** Writing – review & editing, Writing – original draft, Validation, Investigation, Funding acquisition. **Aijia Gao:** Writing – review & editing, Writing – original draft, Validation, Investigation. **Janel Jett:** Writing – review & editing, Writing – original draft, Validation, Investigation. **Sean P. Lane:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Ethics approval and consent to participate

Included studies' protocols and data are openly available for public use. All were originally reviewed and approved (or waived) by the original authors' (Hepp et al., 2023) host universities' Institutional Review Boards (ID 2021-543). All included participants gave consent to participate.

Availability of data and materials

The data supporting the conclusions of this article are available in the OSF repository: https://osf.io/eprdw/.

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Declarations of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2026.103109.

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