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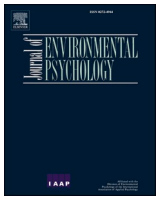

Acting as we feel: Which emotional responses to the climate crisis motivate climate action

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ABSTRACT

The current study assessed emotional responses and emotion regulation strategies to the climate crisis, and their relationship to pro-environmental behaviour cross-sectionally using self-report online surveys. 1307 participants were recruited through convenience sampling from six European countries, alongside a distinct sample of 1040 participants representative of age, sex, and ethnicity in the United States. Our findings replicated the well-known association that stronger negative emotions to the climate crisis are associated with more pro-environmental behaviour. The relationship between climate emotions and pro-environmental behaviour was moderated by resignation in the US sample, by cognitive reappraisal and other-blame in the European sample and mediated by rumination in both samples. Furthermore, latent profiles of emotional responses were identified. In both samples, there was one distinct class demonstrating strong climate emotions, and a group with very low or no climate emotions (alongside with two/three groups with moderate emotional intensity in the European and the US samples, respectively). Findings also revealed that members of the emotional group were more likely to take climate action and tend to engage more in emotion regulation than the unemotional group. Our results highlight the crucial role of emotions and emotion regulation strategies in mitigating the climate crisis by taking pro-environmental action.

1. Introduction

The climate crisis is one of the largest threats ever faced by humanity, with tremendous impact on every region of the world (Bouman et al., 2020; Intergovernmental Panel On Climate Change, 2023). Its detrimental effects have already been witnessed globally, both in the form of direct consequences for the natural world and indirect consequences for human societies (Stern et al., 2021). The latest Intergovernmental Panel on Climate Change report (IPCC, 2023) states with clarity the need for immediate and urgent action both by individuals and across several international entities to address the climate crisis. Mitigation and adaptation to the climate crisis is considered a crucial global priority for sustainable development. A significant element of climate change mitigation lies in individual end-user consumers' choices. This particularly applies to people living in developed countries, where an individual has many options to consume extra goods and services which are not fundamental for well-being, so their individual pro-environmental behavioural choices could easily and directly

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contribute to climate change mitigation. Besides consumers' choices, pro-environmental behaviour comprises activism that aims to increase global awareness and influence political decision-making such as signing related petitions, going to protests, etc. (Rooney-Varga et al., 2018). The complexity of the climate crisis requires an interdisciplinary framework that includes economic, social, and natural sciences to tackle the related issues and address climate risk at the pace needed (IPCC, 2023).

1.1. Climate emotions and their relationship to pro-environmental behaviour

Emotions are important drivers of behaviour, as they guide attention, shape cognitions, and create impulses and motivations to act (Brosch et al., 2013; Feldman & Hart, 2018; Izard, 2009; Lerner et al., 2015). In the same vein, emotions of both positive and negative valence experienced in relation to the climate crisis have repeatedly been demonstrated to be among the most significant determinants of pro-environmental decision-making and behaviours (e.g., Brosch, 2021; Feldman & Hart, 2018; Whitmarsh et al., 2022). When discussing the wide scope of climate or eco-emotions, researchers have highlighted the importance of using the term *emotion* inclusively, in a way that encapsulates several feelings, affects, emotions, moods and mental states (e.g.: feeling significantly anxious, depressed or in shock) related to the climate crisis (Pihkala, 2022a). Although the climate crisis may trigger a wide range of emotions that may become overwhelming and therefore impact one's mental health (Ogunbode et al., 2022), a personal and societal sense of responsibility may motivate an impactful engagement on pro-environmental behaviours (Bouman et al., 2020; Kythreotis et al., 2019). Hence, identifying which emotional responses about the crisis lead to more pro-environmental behaviour is vital for communication policies to mitigate the climate crisis. While beyond the scope of the current paper, it would be crucial to consider situational factors, as the effect of emotions on pro-environmental behaviour will likely vary across different contexts.

The literature about emotions related to pro-environmental behaviour is rich and rapidly growing (González-Hidalgo & Zografos, 2020; Ojala et al., 2021; Salas Reyes et al., 2021). Numerous studies have linked negative emotions such as anxiety, guilt, anger and worry to pro-environmental behaviour, the most widely studied and publicly discussed of which is eco- or climate anxiety (Brosch, 2021; Clayton & Karazsia, 2020; Verplanken & Roy, 2013; Ágoston et al., 2022). However, eco-anxiety has also been linked with a reduced sense of self-efficacy, which is related to less pro-environmental action, a phenomenon that is also referred to as eco-paralysis (Innocenti et al., 2023).

Sadness and grief related to the climate crisis have also been commonly studied and share the common ground of different sensations of loss (Pihkala, 2022b). Neologisms have been coined, like solastalgia to describe the emotional grief that arises when witnessing the devastating repercussions on natural environments (Albrecht et al., 2007). Empirical results suggest that eco-depression is associated with more collective participation in pro-environmental actions (Stanley et al., 2021).

Moreover, guilt seems to be linked to promoting pro-environmental action: according to an empirical study, the likelihood that participants would sign an environmental petition rose when collective guilt for human-caused environmental degradation was included (Rees et al., 2015). In another study, negative feedback about one's carbon footprint triggered feelings of guilt that led to increased pro-environmental behaviour (Adams et al., 2020).

Studies concerning anger found interrelations with feelings of frustration and rage, not only with regards to the causes of the climate crisis, but around judgements of unfairness, lack of ambition in policy and astounding climate denial (Pihkala, 2022a). Recent findings suggest that the intensity of frustration related to the climate crisis motivates individuals to engage in pro-environmental action (Fritsche et al., 2018; Stanley et al., 2021), especially in forms of activism and policy support (Gregersen et al., 2023).

Taken together, empirical results have demonstrated that the above described high-arousal negative climate emotions are robustly associated with pro-environmental behaviour (Brosch, 2021). However, it is important to outline that not all negative emotions relate to more pro-environmental behaviour. For example, boredom was found to be related to less pro-environmental action (Geiger et al., 2021). On the other hand, studies have also found links between positive emotions, such as hope, and pro-environmental behaviour (e.g., Feldman & Hart, 2018; Kleres & Wettergren, 2017; Ojala, 2012). Hope appears to be associated with higher engagement in pro-environmental behaviour when it entails beliefs on climate change mitigation as a result of taking (collective) action (Brosch, 2021; Ojala, 2015). Conversely, optimistic messages about the progression of the climate crisis appear to increase hope, while at the same time, decrease the willingness to act by providing a false sense of security (Hornsey & Fielding, 2016, 2020; Kaida & Kaida, 2016). A recent meta-analysis of 46 studies corroborates these results. Hope is, in general, associated with pro-environmental behaviour ($r = 0.18$), however, this association is contingent on the focus of hope. Feeling hopeful about the results of taking action was associated with higher engagement ($r = 0.40$), while feeling hopeful because of the perception that climate change is not that serious of a problem was associated with less engagement in climate action ($r = -0.40$)(Geiger et al., 2023). Furthermore, hope can be conceptualised both as an emotion and a cognition, however, whether it was measured as a feeling or as a thought did not moderate its association with pro-environmental behaviour (Geiger et al., 2023).

Whether or not individuals feel motivated to take action to mitigate the climate crisis could depend on a wide range of factors. Experiencing negative emotions appear to be a primary source of motivation (Brosch, 2021; Clayton & Karazsia, 2020; Rees et al., 2015; Ágoston et al., 2022), as well as threat appraisal, i.e., whether the impacts of the climate crisis appear to be abstract and distant, or a direct existential threat, the latter of which has been found to motivate pro-environmental action (Stollberg & Jonas, 2021). However, viewing the climate crisis as a significant proximal stressor may also trigger climate change denial or scepticism depending on other contextual factors, such as the lack of collective efficacy beliefs (Morton et al., 2011). Experiencing positive emotions related to the climate, such as hope, however, seems to have a significant but complex relationship to pro-environmental behaviour. While generally linked to higher engagement, the impact tends to vary based on whether hope is measured as a cognitive construct, i.e., beliefs that climate change can be mitigated through action, which is consistently linked with more pro-environmental behaviour, or as an emotion, where results are less consistent (Ojala, 2023). The variability of findings regarding eco-emotions suggests the relevance of contemplating a diverse range of positive and negative emotions when trying to comprehend the psychological responses to climate change, and their potentiality in shaping positive and helpful action (Verplanken et al., 2020), as well as various situational factors that affect their functioning. While the present research focuses on the range of emotions themselves, it is important to underline that emotions will not always function in the same way (Chapman et al., 2017; Davidson & Kecinski, 2022), therefore, although beyond the scope of this paper, situational factors should also be accounted for in future studies.

1.2. Emotion regulation in the context of the climate crisis

Emotion regulation (ER) refers to strategies that change the intensity, duration, and type of an emotional response, and vary in the extent to which they are conscious or unconscious, effortful or effortless, implicit or explicit, automatic or controlled (Gross, 2013). ER might take place at various stages of an emotional experience, from choosing to participate in or avoiding a situation (situation selection), modifying the situation, deciding where to turn one's attention, altering the way one is

thinking about the situation (cognitive change) and response modulation. ER might alter the experience of the emotion, but also change the context that caused the emotion in the first place (Gross, 2015). Although the relationship between emotions and pro-environmental behaviour has been widely studied, the literature on how this association might be affected by different ER strategies is scarce. One study by Panno et al. (2015) found that individuals more prone to using cognitive reappraisal about climate emotions showed higher levels of climate change perception as well as more pro-environmental behaviour. This suggests that ER strategies might influence behavioural responses about the climate crisis, highlighting that ER in response to the climate crisis merits further research attention.

When selecting the ER strategies to measure, we focused on *cognitive* ER strategies based on relevant meta-analyses (Kraiss et al., 2020; Naragon-Gainey et al., 2017; Visted et al., 2018) as well as widely used cognitive ER strategy questionnaires, namely the Cognitive Emotion Regulation Questionnaire (CERQ, Garnefski & Kraaij, 2006) and the Emotion Regulation Questionnaire (ERQ, (Gross & John, 2003), together with the study of Wolgast et al. (2013) that empirically examined the constructs of cognitive ER strategies. We omitted items that could not be meaningfully adjusted to the context of the climate crisis (e.g., 'I think about the mistakes I have made in this matter'; 'I am preoccupied with what I think and feel about what I have experienced'). The final list of strategies comprised rumination, cognitive reappraisal, constructive refocusing, distraction, resignation, avoidance, other-blame, and acceptance. In the following section, we will briefly discuss the current literature on each emotion regulation strategy and how they might be expected to predict pro-environmental behaviour.

Rumination refers to contemplating the reasons and outcomes of a stressor or an emotionally important event (Nolen-Hoeksema, 1991). Various subtypes of rumination exist, such as depressive rumination, i.e., dwelling about one's depressed mood (Nolen-Hoeksema, 2000), anger rumination, i.e., recurrently thinking about frustrating events (Sukhodolsky et al., 2001), self-critical rumination, where ruminative thoughts revolve around one's failures and shortcomings (Smart et al., 2016), and positive rumination, where pleasant events and positive affective states are contemplated (Gilbert et al., 2017). Ruminative thoughts can be categorised based on their content, e.g., rumination about COVID-19 during the pandemic (Kovács et al., 2021), body image/food in eating disorders (Fürtjes et al., 2018), or about environmental losses (Hogg et al., 2021). In the context of the climate crisis, some authors conceptualise rumination as a subfacet of eco-anxiety, where ruminating about the climate crisis is considered a symptom of eco-anxiety (e.g., Clayton & Karazsia, 2020; Hogg et al., 2021). It is important to note that rumination and worry are closely associated constructs, to which some authors collectively refer to as repetitive negative thought or perseverative cognition, therefore there is an ongoing debate in the field whether the two variables should be combined or kept separate (e.g., McEvoy et al., 2010; Topper et al., 2014). A recent meta-analysis only found moderate correlations between rumination and worry, suggesting to treat them separately (Stade & Ruscio, 2023). In the same vein, in the current study we treat rumination and eco-anxiety as two separate constructs, where rumination about the climate crisis is assumed to be associated with negative climate emotions or climate change distress (Wullenkord et al., 2021), one of which is eco-anxiety. In line with the emotional cascade model (Selby & Joiner, 2009), we assume that negative climate emotions evoke ruminative thoughts about the climate crisis, which in turn leads to more intense negative climate emotions, which in turn lead to more pro-environmental action.

Cognitive reappraisal describes the process of reframing one's thoughts or interpretations about the meaning of a situation or event to alter its emotional impact (McRae et al., 2012). In the context of climate emotions, a study showed that participants who tend to use cognitive reappraisal more frequently reported to engage in more pro-environmental behaviour compared to those with a lower tendency (Panno et al., 2015). However, cognitive reappraisal in other contexts has shown to downregulate negative emotions and increase well-being (Gross & John, 2003), therefore, it could be assumed that this strategy contributes to reducing negative climate emotions. Hence, we hypothesised that cognitive reappraisal might moderate the relationship between negative climate emotions and pro-environmental behaviour, with more usage of cognitive reappraisal linked with a weaker relationship between the two.

Constructive refocusing is directing one's attention to the potential positive aspects of a challenging situation (Wolgast et al., 2013). In contrast to similar emotion regulation strategies like cognitive reappraisal, constructive refocusing refers to the reinterpretation of the consequences and behavioural aspects of a situation. Due to its capability to reduce negative emotions, constructive refocusing is considered an adaptive emotion regulation strategy (Wolgast & Lundh, 2017). People use cognitive refocusing to downregulate negative emotions in different contexts (e.g., climate emotions), hence it might moderate the association between negative emotions and pro-environmental behaviour, where their relationship is weaker among people who tend to apply constructive refocusing.

Distraction refers to diverting one's attention away from an emotionally distressing situation or stimulus (Thiruchselvam et al., 2011). The process of distraction includes disengagement or generating neutral thoughts. While possibly providing short-term relief from negative emotions, distraction is generally considered maladaptive, as it is associated with higher distress in the long run (Shafir et al., 2015). However, producing unrelated thoughts towards a specific content like the climate crisis might decrease one's own context-related emotionality. Therefore, distraction might also decrease negative climate emotions and moderates the effect between negative emotions and proenvironmental behaviour, such that their association is weaker when distraction is deployed.

Resignation is the passive endurance of negative feelings, believing there is little to be done to alter the situation (Wolgast et al., 2013). Resignation can be seen as both maladaptive and adaptive, depending on the context: while resignation may help escape negative emotions, it could hinder problem solving (Garnefski et al., 2001). It has been proposed to differentiate between resignation and active acceptance, the latter of which can be considered a more active and self-affirming, therefore, more adaptive strategy (Nakamura & Orth, 2005). It can be assumed that resignation moderates the relationship between negative emotions and pro-environmental behaviour, where resigned people would have a lower tendency to act.

Avoidance is defined as a process of refraining from certain thoughts to reduce distress (Naragon-Gainey et al., 2017). In the long run, increased usage of avoidance is associated with higher distress and avoidance is therefore often considered as a maladaptive ER strategy (Bardeen, 2015). Regarding climate emotions, both disadvantages and benefits of avoidance have been previously discussed: while avoidance could be associated with less negative climate emotions and therefore less pro-environmental behaviour, it was highlighted as a healthy strategy for the individual's well-being when used in a balanced way (Pihkala, 2022b; Wullenkord & Ojala, 2023). Therefore, we hypothesised that avoidance may function as a moderator in the relationship of negative emotions and pro-environmental behaviour, where their relationship is weaker among people who tend to apply avoidance.

Other-blame is attributing the responsibility for negative events, outcomes, or circumstances to external factors or other people, rather than taking personal responsibility for their role in the situation (Garnefski & Kraaij, 2006). Other-blame is generally considered a maladaptive strategy, as putting the blame on others might prevent effective adaptation to negative life events (Garnefski et al., 2001) and lead to depressive symptoms and anxiety (Domaradzka & Fajkowska, 2018; Garnefski et al., 2001). However, the role of other-blame also depends on the context (Kuppens & Van Mechelen, 2007): for global issues such as the climate crisis, it appears both ethical and rational to assign blame

to other parties, such as governments or fossil fuel companies. At the same time, in situations where the individuals' responsibility is ambiguous, such as the climate crisis, holding oneself accountable could lead to eco-guilt. Nevertheless, ethicists advocate for individual responsibility to a certain extent in mitigating the climate crisis (e.g., Cripps, 2013; Hourdequin, 2010). As other-blame in the context of the climate crisis might lead to feeling less responsible to take climate action, it could moderate the effect between negative emotions and pro-environmental behaviour with higher usage of other-blame linked with a weaker relationship between the two.

Acceptance, a core concept of mindfulness, refers to experiencing and acknowledging one's feelings, whether positive or negative, without attempting to suppress or alter them (Lindsay & Creswell, 2019). In contrast to other emotion regulation strategies, acceptance does not actively focus on changing current emotions, however, the habitual use of acceptance has been shown to decrease negative emotions (Garnefski & Kraaij, 2006; Shallcross et al., 2010; Troy et al., 2018). Individuals might use acceptance as a strategy to cope with negative climate emotions, thereby decreasing their intensity. Thus, we hypothesise that acceptance might moderate the relationship between negative emotions and pro-environmental behaviour, where their association is weaker when acceptance is deployed.

Taken together, it appears that negative emotions motivate climate action (Whitmarsh et al., 2022). Downregulating negative climate emotions, while potentially beneficial for mental health, may limit one's motivation to take climate action via decreasing exposure to or the perceived threat of the climate crisis. This is in line with the coping literature, where it has been found that coping strategies that decrease the exposure to information on the climate crisis or relativize the problem are associated with less pro-environmental behaviour (Homburg et al., 2007; Ojala, 2012b).

It is important to note that coping and worry are psychological constructs that overlap with ER strategies and are often examined in response to the climate crisis: ER strategies can also be viewed as coping in some cases, and worry is sometimes conceptualised as an ER strategy. Since the climate crisis can be viewed as a stressor, responding to it can also be seen as coping. However, we have chosen to use the framework of ER over coping because climate emotions often tend to be transient that may be evoked in everyday situations and then decline (as opposed to strong stress reactions) (Brosch, 2021). Furthermore, acknowledging the severity of the climate crisis may also serve as a catalyst for climate action, although it is not necessarily accompanied by a stress response (Lee et al., 2015; Steynor et al., 2021).

1.3. The present study

The present study aimed to investigate which emotional responses to the climate crisis are related to more pro-environmental behaviour, and how certain ER strategies may alter this association, which, to our knowledge, has not been studied elsewhere. We aimed to measure climate emotions with a positive and a negative emotional composite, where we selected emotions that have been subject of strong scholarly interest in the context of the climate crisis, including reviews and meta-analyses (e.g., anger: Panno et al., 2021; Sabherwal et al., 2021; Stanley et al., 2021; anxiety: Brosch, 2021; Clayton, 2020; Coffey et al., 2021; Gago et al., 2023; sadness: Ágoston et al., 2022; Comtesse et al., 2021; Ojala et al., 2021; guilt: Harth et al., 2013; Kleres & Wettergren, 2017; Moore & Yang, 2020; motivated: Brick et al., 2021; hope: Feldman & Hart, 2018; Geiger et al., 2023; Pleeging et al., 2021; van Zomeren et al., 2019) and that were assumed to load on the same factor, but their correlation would not be too high (as one could expect for instance for 'angry' and 'frustrated'). We decided to use emotional composite scores for multiple reasons. First, people generally experience a wide range of climate emotions depending on current stimuli; or numerous emotions may be experienced all at once instead of single well-defined emotions (Wang et al., 2018). We assessed these emotions on the trait level, and not the state level, therefore, the composite score differentiates participants who *generally* score higher on climate emotions from participants who do not. Looking at the relationship of emotional composites and ER strategies rather than specific emotions appears to be a better choice due to our cross-sectional design; specific emotions evoked by specific situations and their relationship with ER strategies could be better captured with experience sampling studies, where participants are asked daily or multiple times a day whether they experienced certain climate emotions on that day or within the last few hours, and if so, did they implement certain ER strategies in response (Catterson et al., 2017). Second, these emotions are moderately correlated with one another (see Table A5 and A6 of the Appendices), therefore, all other emotions should be controlled for in each analysis, increasing the number of predictors and decreasing statistical power. Third, it is true that certain emotions are more strongly associated with certain strategies (see Table A5 and A6 of the Appendices); however, measuring ER strategies in an emotion-specific way would be an oversimplification, as there is no strict one-to-one correspondence between emotions and emotion regulation strategies (Boemo et al., 2022). Although beyond the scope of this paper, we acknowledge that it would be important to study single climate emotions and their relationship with ER strategies in future studies.

In the current study, two major hypotheses were tested, the first of which was that negative emotional responses to the climate crisis are associated with a higher degree of pro-environmental behaviour. It was also hypothesised that this association would be mediated by rumination, so that negative emotions related to the climate crisis would be associated with higher tendencies of rumination, which in turn would be associated with increased pro-environmental behaviour. Although the role of rumination in the context of the climate crisis is understudied, based on the emotional cascade model (Selby et al., 2008), we hypothesise that negative climate emotions may trigger rumination about the climate crisis, which in turn leads to more intense negative climate emotions. In this circular relationship, pro-environmental behaviour could serve as a means to stop ruminative thoughts. Furthermore, we hypothesised that cognitive reappraisal, constructive refocusing, distraction, resignation, avoidance, other-blame and acceptance would moderate the associations between negative emotions about the climate crisis and pro-environmental behaviour, i.e., when the use of these ER strategies is low, we assumed a stronger association between negative emotions and pro-environmental behaviour, but when usage is high, we assumed that this positive association would be weaker. Rumination was hypothesised to be a mediator in order to test a potential mechanism, i.e., that high negative climate emotions lead to more rumination and that may influence climate action. In the case of the other emotion regulation strategies, it does not seem plausible to assume that high negative climate emotions lead to the use of those strategies; we can only assume that in the presence of high negative climate emotions one may adopt a certain strategy or another, which may affect their behaviour, therefore, they were conceptualised as moderators.

The second major hypothesis regarded the role of positive emotions: positive emotions about the climate crisis, such as being hopeful or motivated, would be associated with a higher degree of pro-environmental behaviour. The hypothesised associations are demonstrated in Fig. 1.

Furthermore, most studies focus on the relationship between single emotions and pro-environmental behaviour (e.g., Gao et al., 2021; Maartensson & Loi, 2022; Van Der Linden, 2015), while the complex view of these emotional patterns is understudied (Pong & Tam, 2023). In real life, numerous emotions may be experienced all at once instead of single well-defined emotions; therefore, examining the interplay of climate emotions may yield a better insight of people's emotional profiles, and how that may relate to taking pro-environmental action (Wang et al., 2018). Therefore, we performed latent profile analyses, where we sought to identify latent classes within our samples based on their

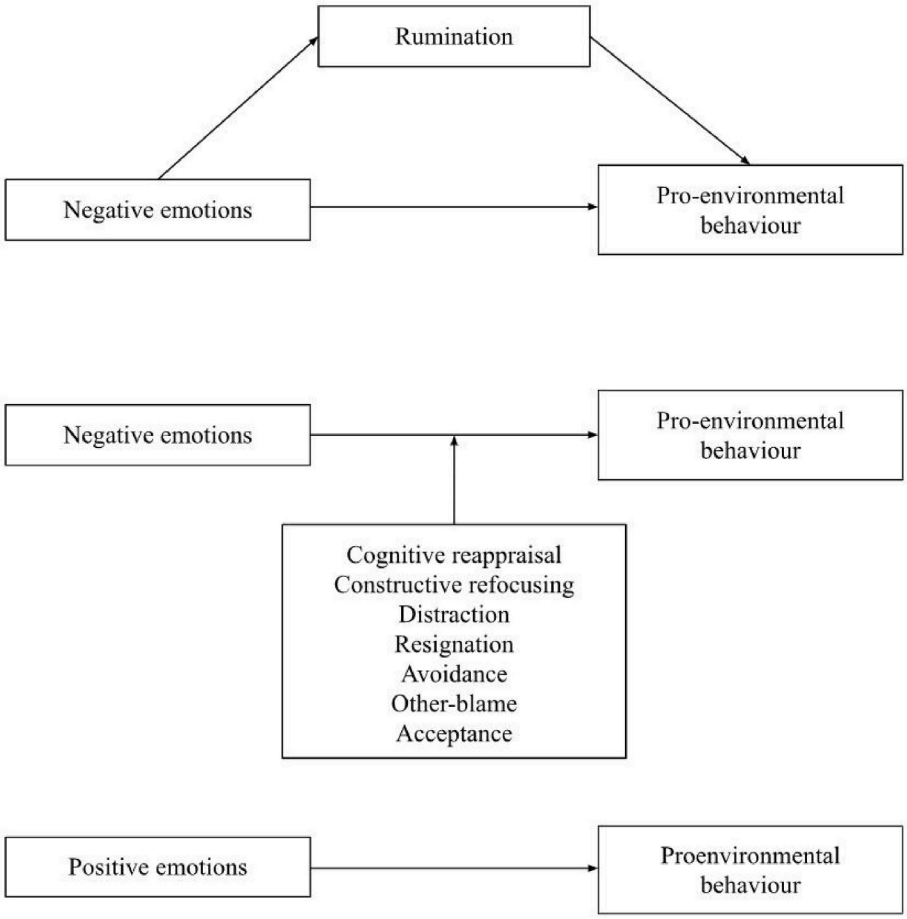

Fig. 1. The proposed associations of our study.

patterns of climate emotions. Then, we also explored whether the identified latent classes differ in their use of ER strategies and pro-environmental behaviour.

We tested our hypotheses on two distinct samples on two continents, which we considered important for more robust conclusions, as cultural factors, geographical location and local and governmental policies highly impact people's cognitive, emotional and behavioural responses to the climate crisis (Grilli & Curtis, 2021; Ojala et al., 2021). For this reason, we controlled for country of residence in the European sample, alongside with sex/gender[1] and age in both samples, as women and younger generations generally tend to experience more intense climate emotions and take more pro-environmental action (Clayton & Karazsia, 2020; Heeren et al., 2022).

2. Materials and methods

2.1. Sample and Procedure

This study was preregistered at https://osf.io/ujqd3/?view_only=7bfb235e6910441b9ff812c55e74f603. Data and analysis scripts are available at https://osf.io/uzfer/?view_only=0769d9dc5ca247ce9bd2272b58d19ce3. Two datasets were collected through self-report online surveys. Dataset #1 was collected in the United States using the online recruitment platform Prolific, where participants received monetary compensation for taking part in the study (£1.15 per survey, corresponding to an average rate of £14 per hour). Dataset #2 was collected in six European countries (United Kingdom, Germany, Austria, Sweden, France, and Hungary) through a convenience sampling method, i.e., mailing lists, social media platforms, flyers, and snowballing, where participants did not receive monetary compensation for their participation. Participants had to answer an online questionnaire that assessed pro-environmental behaviours, emotions and ER strategies related to the climate crisis, and demographic questions. The survey took approximately 5 min to complete. Participation was voluntary and anonymous. For Dataset #2, items unavailable in any of the languages of the study (i.e., Swedish, French, German, Hungarian) were translated using forward and back translations. Team members who were native speakers of the target languages translated the English items, and an independent person fluent in both languages translated them back into English. The original and back-translated English versions were then compared by a native English-speaking team member (B.H.) and a team member highly fluent in English residing in the UK (I.Z.). Necessary modifications were made until the scales had identical meanings in all languages.

The study was approved by the institutional ethical committee of (masked for review) (approval number: 2022/557) and was carried out in accordance with the Declaration of Helsinki. Participants who indicated strong negative feelings about the climate crisis were provided with links to different approaches on how to deal with climate anxiety. Finally, all participants received a debriefing message with a link to more information about the project and an email address in case they had further questions.

Participants consisted of people over 18 years of age who were fluent

[1] For the European sample, we controlled for gender identity (as dummy variables) throughout the analyses. However, given that the US sample is representative of biological sex, and quotas are only available for biological sex and not for gender, we controlled for biological sex for the US sample throughout the analyses, but also report descriptive gender identity data.

in one of the languages available for the survey. Participants who either did not complete the whole survey, failed the attention check item, completed the survey in less than 120 s, or had a missing data percentage above 15 were excluded from the analyses. For Dataset #1 (US Prolific sample), the final sample comprised 1040 participants (534 females and 499 males, 6 nonbinary participants, and one person who did not wish to share their gender) residing in the United States aged between 18 and 93 years ($M = 45.81$ years, $SD = 15.99$), whereas the final sample of Dataset #2 (European multi-country convenience sample) consisted of 1307 participants (869 females, 396 males, 23 nonbinary, 6 otherwise identifying participants, and 13 participants who preferred not to share their gender identity) aged between 18 and 79 years ($M = 30.04$ years, $SD = 11.98$). More detailed demographic information about the two datasets is described in Table A1 and A2 of the Appendices.

2.2. Measures

Pro-environmental behaviour was measured using the total score of three items based on the scale of Rooney-Varga et al. (2018). One item focused on private actions: 'Take action to reduce my personal carbon footprint, e.g., ride my bike more, walk short distances, use public transport, repair goods, buy less or second-hand items, reduce food waste, eat less meat (especially beef), take shorter showers, use less plastic packaging etc'. Engaging in activism was measured with two items, one focusing on low-threshold actions: 'Take steps about climate change/environmental protection, e.g., join mailing list, sign a petition, discuss with friends/family, share related articles on social media'; and the other focusing on high-threshold actions: 'Take some form of activism about climate change/environmental protection, e.g., Volunteer at a pro-environmental organisation, attend demonstrations, recruit others to get involved, discuss climate change with strangers'. Participants could respond using a four-point Likert scale ranging from hardly ever or never (1) to very often (4).

Emotions related to climate change,[2] namely sad, anxious, hopeful, angry, motivated, and guilty, were assessed on a scale of 0 (not at all) to 100 (a great deal) with the following instruction: 'Does climate change make you feel any of the following?'

Emotion regulation in response to climate change (ERCC): we aimed to assess eight ER strategies that focused on the regulation of climate emotions, namely rumination, cognitive reappraisal, other-blame, avoidance, acceptance, distraction, resignation, and constructive refocusing. Items of existing ER measures that could be related to the context of the climate crisis were carefully selected by the authors of the paper who had to reach expert consensus, and then modified their wordings so that they focused on climate emotions.

Rumination was measured using the four-item COVID-related Rumination Scale (CRS, Kovács et al., 2021), where the content of ruminative thoughts was modified from COVID-19 to the climate crisis. An example item of this scale is: *'My thoughts about climate change keep coming into my head even when I do not wish to think about them'*. Cognitive reappraisal was measured with two items of the cognitive reappraisal subscale of the Emotion Regulation Questionnaire (ERQ, Gross & John, 2003), e.g., *'When I'm faced with climate change, I make myself think about it in a way that helps me stay calm'*. The items for other-blame were based on the other-blame subscale of the short version of the Cognitive Emotion Regulation Questionnaire (CERQ-short, Garnefski & Kraaij, 2006), e.g.: *'I feel that others are responsible for climate change'*. Avoidance was measured using two items based on the White Bear Suppression Inventory (WBSI, Höping & De Jong-Meyer, 2003), e.g., *'I have thoughts about climate change that I try to avoid'*. For the measurement of distraction, one item was retrieved from the positive refocusing subscale of the CERQ and modified to climate change *('I control my emotions about climate change by thinking of something nice instead')*, and one item was based on an item of the distraction and suppression subscale of the Multidimensional Experiential Avoidance Questionnaire (MEAQ, Gámez et al., 2011):*'When a negative thought about climate change comes up, I immediately try to think of something else.'*

Since ER strategies are often operationalised in ambiguous ways and therefore scales with identical names may not measure the same construct, whereas strategies that are supposed to be distinct often show substantial overlap, in the current study the classifications and names described by Wolgast et al. (2013) were followed for resignation and constructive refocusing. Constructive refocusing was measured with two items of the CERQ positive reappraisal subscale (e.g., *'I think about the positive sides climate change may have')* and one item of the CERQ putting into perspective subscale, e.g., *'I tell myself that there are worse things in life than climate change'*. Resignation was measured with three items of the CERQ Acceptance subscale, e.g., *'I think that I must learn to live with climate change'*. Acceptance was measured with two modified items of the Tolerating subscale of the Affective Style Questionnaire (ASQ, Hofmann & Kashdan, 2010), e.g., 'I can accept having strong emotions about climate change'. In case of acceptance/resignation, it is important to differentiate what is being accepted: the situation, or one's emotional response given to it (Wolgast et al., 2013). The items selected for Resignation (that belong to the 'Acceptance' subscale of the CERQ) reflect the acceptance of the situation and the notion that nothing can be done to change it, which were labelled as Resignation in Wolgast and colleagues' conceptual analysis that we followed in our study. The Acceptance subscale, on the other hand, refers to accepting one's own feelings about the climate crisis. We considered this differentiation important as we hypothesised that Resignation (i.e., accepting the *situation*) may be associated with reduced motivation to take climate action, whereas Acceptance (i.e., accepting *one's own feelings*) may not.

Participants responded to all items using a five-point Likert scale ranging from not at all (1) to a great deal (5). The final items and subscales of the ERCC (after performing factor analyses on our samples) are presented in Table 1 of the Results section.

Demographic information, such as gender, age, residential area, nationality, country of residence, and fluency in the language of the survey were also collected for both samples.

2.3. Statistical analyses

The analyses were conducted in R (v 4.2.3, R Core Team, 2023), Mplus (version 8.8, Muthén & Muthén, 2023) and JASP (v 0.17.2.1, JASP Team, 2023) for the two samples separately. For the computations, the R packages *tidyverse* (Wickham et al., 2019), *lmtest* (Zeileis & Hothorn, 2002), *car* (Fox & Weisberg, 2019) and *lavaan* (Rosseel, 2012). First, we examined the psychometric properties of the assessed measures on both samples: we performed confirmatory factor analyses with varimax rotation to see whether our proposed factor solution for the ERCC demonstrated adequate fit on our samples. Since the originally proposed model demonstrated poor fit on both samples, we conducted exploratory factor analyses on the two datasets separately. We performed principal component analysis (PCA) on positive climate emotions, negative climate emotions, and the items measuring pro-environmental behaviour to see whether they indexed together. Then, we performed structural equation modelling to test whether the relationship between negative emotions and pro-environmental behaviour is mediated by rumination. In the US sample, age and gender were defined as observed variables in the model and all other variables were defined as latent. In the European sample, the outcome variable was defined as latent, and all other variables were defined as observed. This was necessary because the European dataset was administered in six countries on five different languages, therefore we presumed these variables would not work as latent (indeed, when running the model with latent variables, we

[2] Please note that throughout the manuscript we used the expression 'climate crisis' as it adequately reflects the gravity of the situation. However, throughout our survey, we used the expression 'climate change' which we considered more well-known and neutral.

Table 1
Emotion regulation in response to climate change scale.

Subscale	Items	Subscales items originally belonged to	Cronbach alpha US/ EUR
ERCC Shift of focus	I control my emotions about climate change by thinking of something nice instead. When I'm faced with climate change, I make myself think about it in a way that helps me stay calm. When a negative thought about climate change comes up, I immediately try to think of something else. When I want to feel less negative emotion about climate change, I change the way I'm thinking about it	cognitive reappraisal, distraction	0.82/0.67
ERCC Rumination	My thoughts about climate change keep coming into my head even when I do not wish to think about them. I have thoughts about climate change that I try to avoid. Thoughts about climate change interfere with my concentration. Sometimes I stay busy just to keep thoughts about climate change from intruding on my mind. If I start thinking about climate change, I find it difficult to stop.	Rumination, avoidance	0.88/0.80
ERCC Other-blame	I feel that others are responsible for climate change. I feel that basically the cause of climate change lies with others.	other-blame	0.85/0.83
ERCC Resignation	I think that I must learn to live with climate change. I think that I have to accept climate change	resignation	0.81/0.71
ERCC Acceptance	I can accept having strong emotions about climate change. There is nothing wrong with feeling very emotional about climate change. I think I can learn something from climate change.	Acceptance, positive refocusing	0.70/NA

Note. The identified subscales of the Emotion Regulation in Response to Climate Change Scale and their internal consistency values. $N_{(US)}$=1040, $N_{(EUR)}$=1307.

received identical results with poorer model fit). Throughout the analyses, we performed bootstrapping or applied maximum likelihood robust (MLR) estimation that is robust to non-normality. Our inference criteria for Structural Equation Modelling (SEM) included model fit statistics such as *CFI*, *TLI* (acceptable values are around or higher than 0.90-0.95, *RMSEA* (below 0.06 indicates a good fit, while a value above 0.10 indicates poor fit), *SRMR* (below 0.08 is considered a good fit), and χ^2 (where lower and insignificant values indicate better fit) (Hooper et al., 2008; Hu & Bentler, 1999), together with the *p* values of the path coefficients. To test whether the relationship between negative emotions about the climate crisis and pro-environmental behaviour is moderated by resignation, other blame and shift of focus (i.e., cognitive reappraisal & distraction), we performed linear regression models with interaction terms. Negative climate emotions and ER strategies were standardised for the moderation analyses. Linear regression models were used to test the relationship between positive emotions about the climate crisis and pro-environmental behaviour. For the linear regression analyses *p* values, *F* statistics, R^2 values and degrees of freedom were considered as inference criteria. Model diagnostics to check homoscedasticity, normality of residuals, multicollinearity and model outliers were also performed.

Next, we carried out latent profile analyses to identify latent groups based on emotions about the climate crisis. The number of latent groups were identified based on the following fit indices: entropy, Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Sample Size Adjusted Bayesian Information Criterion (SSA-BIC), Lo-Mendel-Rubin Adjusted Likelihood Ratio Test (LMRT), where the model with lower values of AIC, BIC, SSA-BIC demonstrates better fit, and an entropy index over 0.8 is expected (Clark & Muthén, 2009). A non-significant ($p > 0.05$) LMRT value indicates that including further classes would not improve model fit. The associations between class membership and covariates (pro-environmental behaviour, emotion regulation strategies) were explored with multinomial logistic regressions. using the 3-step method All models were controlled for age and sex/gender. In the European sample, we also controlled for country of residence.

3. Results

3.1. Psychometric properties of the assessed measures

First, we examined the factor structure of the assessed measures, as well as their internal consistency. The originally proposed 8-factor solution demonstrated insufficient fit on both the US ($\chi^2 = 1446.290$; *CFI* = 0.861; *TLI* = 0.814; *RMSEA* = 0.094; *SRMR* = 0.077) and the European ($\chi^2 = 1197.063$; *CFI* = 0.847; *TLI* = 0.795; *RMSEA* = 0.076; *SRMR* = 0.065) samples, therefore, as a next step, we ran an exploratory factor analysis with MLR estimation on both datasets separately. On the US sample, a five–factor solution emerged with excellent model fit ($\chi^2 = 194.225$; *CFI* = 0.982; *TLI* = 0.955; *RMSEA* = 0.053; *SRMR* = 0.017, four of which emerged identically in the European dataset (model fit indices: $\chi^2 = 1446.290$; *CFI* = 0.973; *TLI* = 0.935; *RMSEA* = 0.072; *SRMR* = 0.022). We only used the four factors that were identified in both samples for hypothesis testing. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus. Since we measured cognitive ER strategies, the items chosen for distraction (e.g., *When a negative thought about climate change comes up, I immediately try to think of something else*) and cognitive reappraisal (e.g., *When I want to feel less negative emotion about climate change, I change the way I'm thinking about it*) are close to each other in meaning, that is reflected in their loading on the same factor. For more clarity, we added that shift of focus comprises these two strategies throughout the manuscript. Items that originally loaded on the rumination and the avoidance subscales loaded on one factor, and after a thorough content check, we labelled this factor as rumination. This could be explained by the content of the scales used to measure these constructs. The White Bear Suppression Inventory, reworded in this study to measure avoidance, includes items that represent cognitive avoidance, i.e., the avoidance of difficult thoughts (e.g., I have thoughts about climate change that I try to avoid) rather than behavioural avoidance, i.e., avoiding certain situations (De Castella et al., 2018), bringing the meaning of the items close to rumination. Similarly, items of acceptance and positive refocusing loaded on one single factor, which we named acceptance based on the items' content (however, this factor only emerged in the US sample, and therefore was not included in our analyses). The identified factors of the ERCC and their internal consistency values are demonstrated in Table 1. The factor loadings for the US and the European sample are presented in Table A3 and A4 of the Appendices, respectively.

Next, we ran principal component analyses (PCA) on positive climate emotions, negative climate emotions, and the items measuring pro-environmental behaviour to see whether they indexed together. When loading on a single factor, negative climate emotions (sad, anxious, angry, guilty) explained 74.75% (US sample) and 61% (European

sample) of the variance, with a Cronbach-alpha value of 0.89/0.79 (respectively), indicating that they can be indexed together as a negative climate emotion composite. The PCA for positive emotions (hopeful, motivated) indicated that when loading on a single factor, these two items explained 72.4% and 70% of the variance in the US and European samples respectively, however, their corresponding Cronbach alpha values were 0.61 and 0.53, indicating that they do not index well together. Therefore, we kept them separate for hypothesis testing. Items measuring pro-environmental behaviour explained 68.13% and 62.88% of the variance as a single factor in the US and European samples respectively, with a Cronbach alpha value of 0.76 (US sample) and 0.70 (European sample), indicating that it can be treated as a single-factor measure, therefore, the total score of the three items was used throughout our analyses.

3.2. Descriptive statistics of the assessed measures

Means and standard deviations of the assessed measures for both samples, alongside their correlations, are reported in Table 2. As hypothesised, pro-environmental behaviour correlated positively with negative affect in both samples ($r = 0.51$, $p \leq 0.001$ in the US, and $r = 0.42$, $p \leq 0.001$ in the European sample). As demonstrated by the distribution plots (Figs. 2 and 3), the distribution of pro-environmental behaviour is skewed towards lower values in both samples, with considerably higher levels of negative climate emotions.

3.3. Mediation analyses

We computed mediation analyses with bootstrapping to test whether the association between negative emotions and pro-environmental behaviour is mediated by rumination. In both the US and the European sample, the relationship between negative affect and pro-environmental behaviour was mediated by rumination (see Figs. 4 and 5). All variables were entered in the model as latent for the US sample, while pro-environmental behaviour was entered as latent, negative emotions and rumination were entered as observed in the European sample. This was necessary because due to the multi-language aspect of the European sample, keeping all variables latent would have resulted in poorer model fit. We chose to keep pro-environmental behaviour latent to obtain a more precise estimation on the level of the outcome of the model. For the US sample, the standardised indirect effect was 0.248 ($p < 0.001$). The model fits for the US sample were adequate ($\chi^2 = 7229.388$, $df = 90$, $RMSEA = 0.081$, and $SRMR = 0.069$, $CFI = 0.932$, $TLI = 0.914$). In the European sample, the standardised indirect effect was 0.215 ($p < 0.001$). The European sample demonstrated excellent model fit ($\chi^2 = 78.004$, $df = 16$, $RMSEA = 0.055$, $SRMR = 0.017$, $CFI = 0.966$ and $TLI = 0.928$).

3.4. Linear regression analyses

Next, we investigated whether negative emotions and shift of focus (i.e., cognitive reappraisal and distraction), resignation, and other-blame were significant predictors of pro-environmental behaviour, and whether the relationship between negative emotions about the climate crisis and pro-environmental behaviour were moderated by these three ER strategies. The total score of negative climate emotions and ER subscales were entered in the model. In the US sample, negative climate emotions and all three ER strategies were significantly associated with pro-environmental behaviour after controlling for sex and age, and resignation moderated the association between negative emotions and pro-environmental behaviour. Entering the interaction terms in the model contributed 0.7% to the explained variance. Results are described in Table 3 and the significant interaction of negative affect and resignation is plotted on Fig. 6.

Note. $N = 1040$. Negative climate emotions and resignation were standardised. Low, medium, and high value cut-offs for resignation were

Table 2
Means, standard deviations and Spearman correlations of the assessed measures.

	US sample ($N = 1040$)								European sample ($N = 1307$)							
Measure	Mean (SD)	1.	2.	3.	4.	5.	6.	7.	Mean (SD)	1.	2.	3.	4.	5.	6.	7.
1. pro-environmental behaviour	5.58 (2.03)	–							6.27 (1.94)	–						
2. negative climate emotions	171.46 (112.73)	0.51***	–						214.81 (91.74)	0.42***	–					
3. hopeful	22.58 (25.67)	0.25***	0.12***	–					23.29 (22.74)	0.06*	0.01	–				
4. motivated	40.36 (30.26)	0.61***	0.54***	0.48***	–				40.43 (27.24)	0.37***	0.33***	0.43***	–			
5. resignation	6.58 (2.18)	0.03	0.04	0.11***	0.05	–			6.81 (2.02)	0.02	−0.02	−0.03	−0.01	–		
6. rumination	8.59 (4.19)	0.52***	0.54***	0.28***	0.47***	0.13***	–		9.95 (4.02)	0.45***	0.60***	−0.02	0.19***	0.04	–	
7. shift of focus	9.42 (3.75)	0.33***	0.27***	0.35***	0.36***	0.36***	0.59***	–	8.98 (3.12)	0.11***	0.26***	0.09**	0.13***	0.23***	0.42***	–
8. other-blame	6.09 (2.39)	0.21***	0.29***	−0.004	0.14***	0.20***	0.29***	0.24***	6.19 (2.23)	0.04	0.08**	−0.11***	−0.09**	0.06*	0.13***	0.13***

Note. *$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

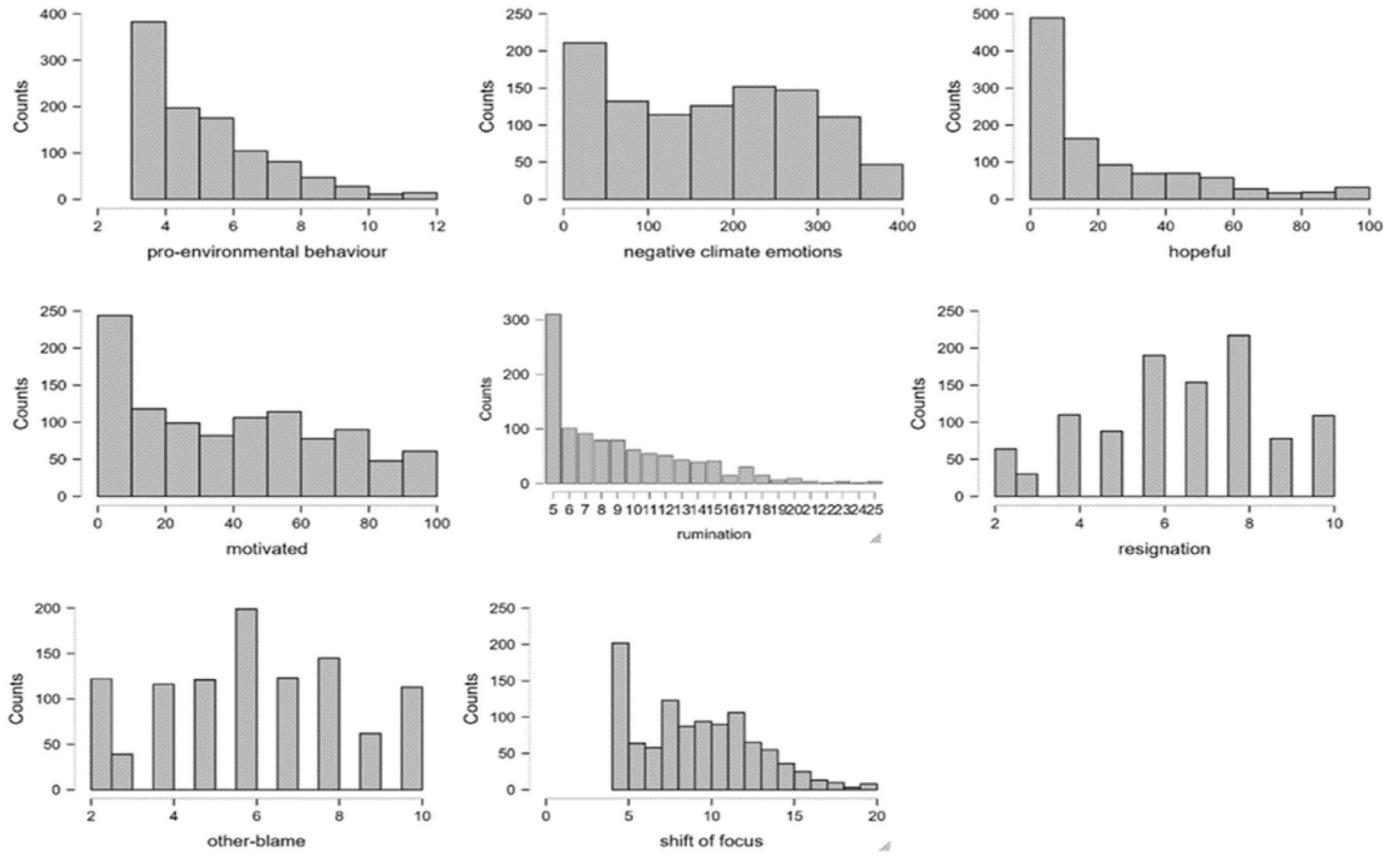

Fig. 2. Distribution plots of the assessed measures for the US sample. N = 1040.

established based on quartiles.

In the European sample, negative climate emotions and other-blame were significant predictors of pro-environmental behaviour after controlling for gender, age, and country of residence, and the relationship between negative emotions and pro-environmental behaviour was significantly moderated by shift of focus and other-blame. Entering the interaction terms in the model contributed 1% to the explained variance. Results are described in Table 4 and the significant interaction terms are plotted on Figs. 7 and 8.

Next, we examined whether positive climate emotions, namely being hopeful and motivated about the climate crisis, were associated with pro-environmental behaviour, after controlling for gender/sex, age, and country of residence for the European sample. In the US sample, being motivated was associated with pro-environmental behaviour (Table 5), while in the European sample, both being hopeful and motivated were significant predictors of pro-environmental behaviour (Table 6).

3.5. Latent profile analyses

We performed latent profile analyses to identify latent groups based on their climate emotions (namely sad, anxious, angry, motivated, and guilty) in both samples, as most studies only assess single emotions or emotional composites, and results about unique emotional patterns and their relationship with pro-environmental behaviour are scarce. Since being hopeful demonstrated weak correlations with all the assessed emotions except for motivated, whereas all other emotions were strongly or moderately correlated with one another (see Table A5 and A6 of the Appendices), it was considered an outlier and therefore not included in the latent profile analyses. In the US sample the 5-class model solution demonstrated the best fit, whereas in the European sample the 4-class solution was the best fit. Model fit indices are demonstrated in Table 7.

Fig. 9 demonstrates the identified classes of the US sample: Class 1 ($N = 296$, 28.4%) had low scores on all emotions ($M = 7.49$–19.57; low emotions group), Class 2 ($N = 174$, 16.73%) had moderate scores on all emotions ($M = 25.47$–36.78, moderate emotions group), Class 3 ($N = 76$, 7.3%) demonstrated high scores for sad and relatively higher scores for motivated ($M_{sad} = 75.70$, $M_{motivated} = 41.94$, sad and motivated group), Class 4 ($N = 275$, 26.4%) demonstrated high scores on sad and anxious, and moderate scores for angry, motivated and guilty ($M = 69.88$-41.73; sad and anxious group), whereas Class 5 ($N = 219$, 21.06%) had high scores on all emotions ($M = 60.37$–88.67; high emotions group). Means and standard deviations for all emotion scores for all latent classes are reported in Table A7 of the Appendices.

Fig. 10 demonstrates the identified classes for the European sample: Class 1 ($N = 241$, 18.4%) demonstrated low scores on all emotions ($M = 15.06$–24.10; low emotions group), Class 2 ($N = 280$, 21.2%) scored high on sad and anxious, and moderate on angry, motivated and guilty ($M = 34.90$–59.74, sad-anxious group), Class 3 ($N = 176$, 15.0%) scored high on sad and angry, and moderate on anxious, motivated and guilty ($M_{sad} = 59.61$, $M_{angry} = 67.71$, sad and angry group). Class 4 ($N = 610$, 45.4%) scored the highest on all emotions, especially on sad, anxious, and angry ($M = 47.52$–80.55; high emotions group). Means and standard deviations for all emotion scores for all latent classes are reported in Table A8 of the Appendices.

Then, we performed multinomial logistic regression analyses on the models in both samples, where sex/gender, age, emotion regulation strategies and pro-environmental behaviour explained class membership, the results of which are demonstrated in Table 8 for the US and Table 9 for the European sample. We also performed ANOVAs that reflect group differences between each class on these variables, that are presented in Table A9 and A10 of the Appendices.

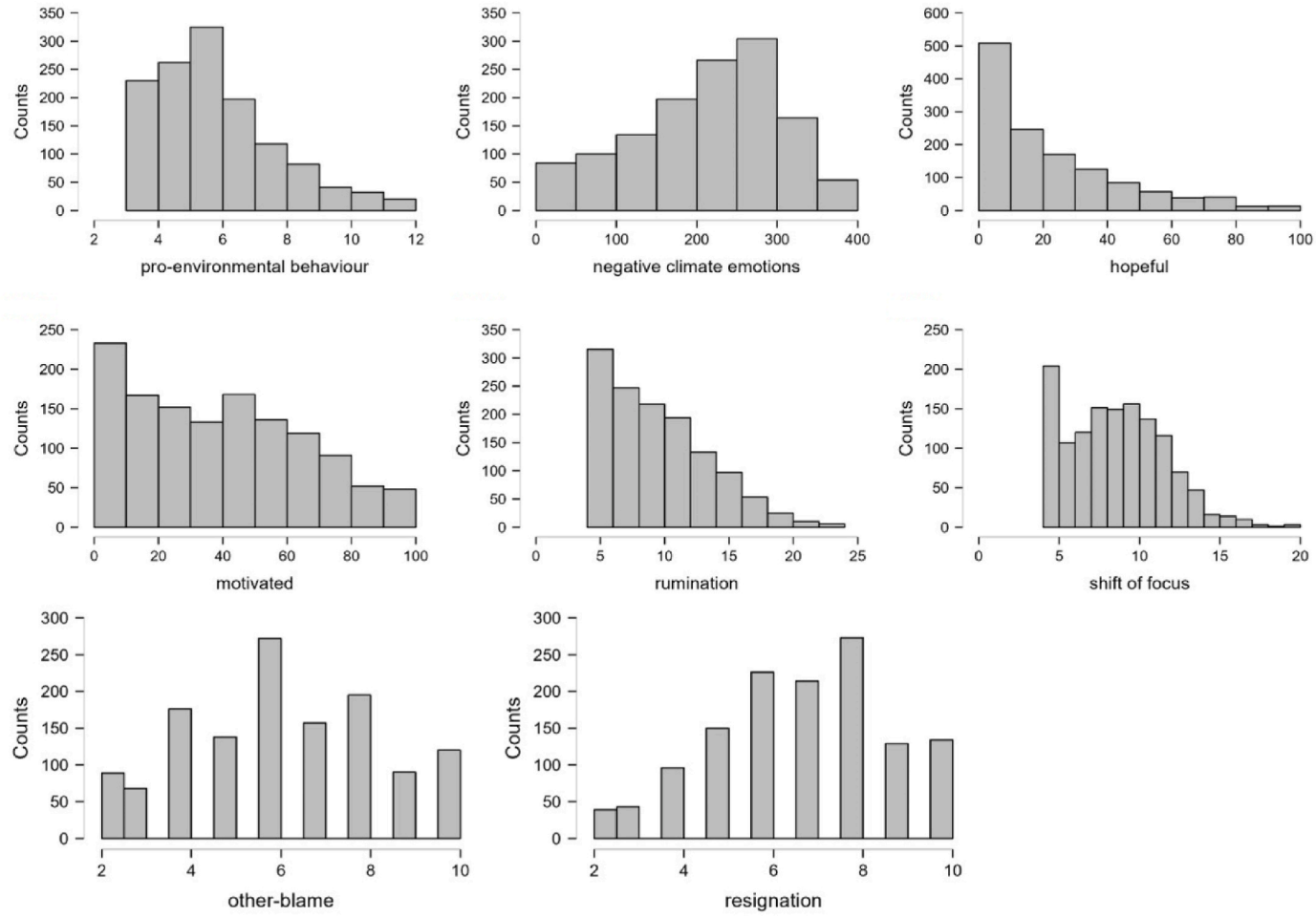

Fig. 3. Distribution plots of the assessed measures for the European sample. N = 1307.

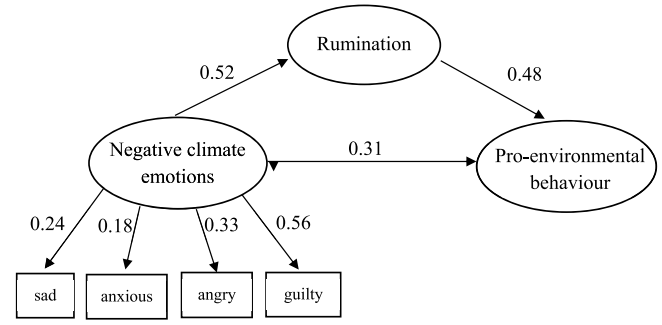

Fig. 4. Mediation Analysis of the US sample with standardised path coefficients.

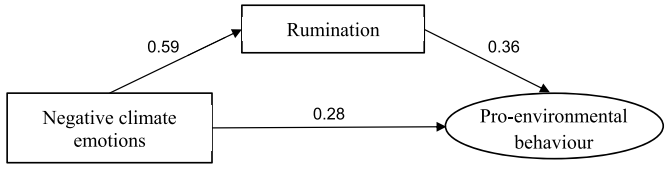

Fig. 5. Mediation Analysis of the European sample with standardised path coefficients.

Table 3
Linear regression with interaction terms on the US sample.

Model	β	*t*	*p*	R^2
Model 1				
Sex	−0.034	0.304	0.761	
Age	0.106	3.791	<0.001	
Negative climate emotions	0.390	13.414	<0.001	
Other-blame	0.086	2.856	0.004	
Resignation	−0.084	2.880	0.004	
Shift of focus	0.251	8.411	<0.001	*0.276*
Model 2				
Sex	−0.043	0.391	0.696	
Age	0.107	3.814	<0.001	
Negative climate emotions	0.386	13.232	<0.001	
Other-blame	0.074	2.413	0.016	
Resignation	−0.093	3.199	<0.001	
Shift of focus	0.242	8.070	<0.001	
Negative affect * Other-blame	−0.015	0.514	0.607	
Negative affect * Resignation	−0.065	2.200	0.028	
Negative affect * Shift of focus	−0.034	1.112	0.266	*0.283*

Note. $N = 1040$. Outcome measure: pro-environmental behaviour. For continuous variables, standardised estimates are reported. Negative climate emotions, other-blame, resignation and shift of focus were standardised. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

4. Discussion

The present study aimed to investigate which emotions and ER strategies in response to the climate crisis are related to pro-

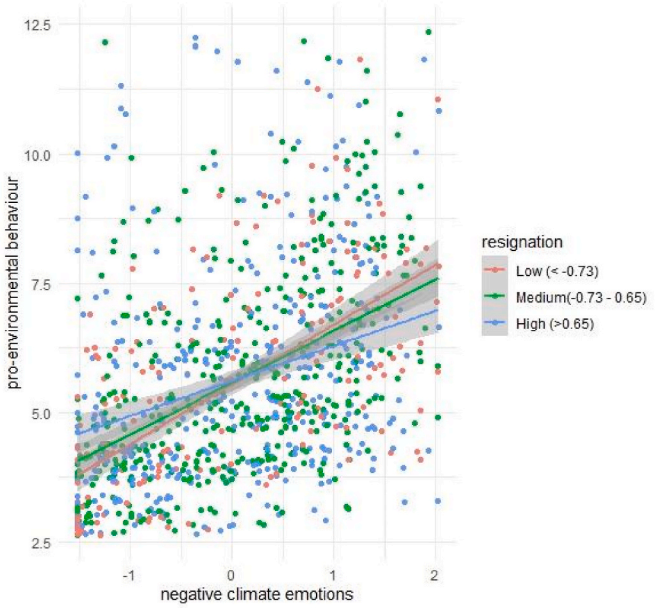

Fig. 6. Illustration of the interaction between negative climate emotions and resignation in the US sample (outcome measure: pro-environmental behaviour).

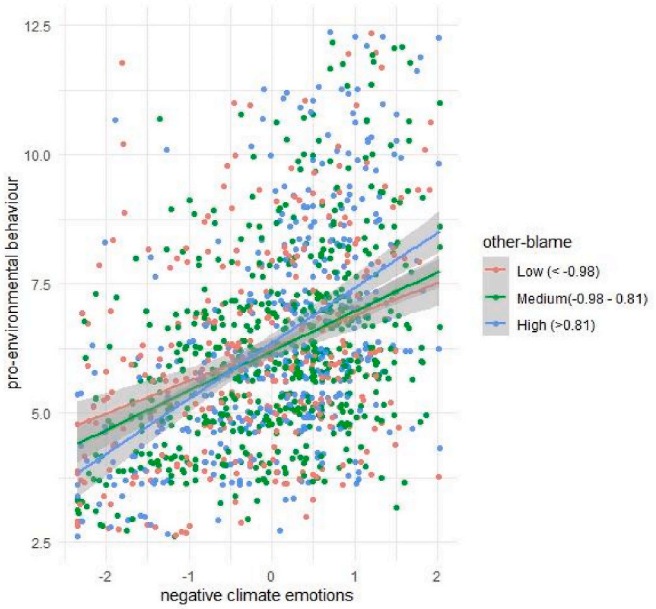

Fig. 7. Illustration of the interaction between negative climate emotions and other-blame in the European sample (outcome measure: pro-environmental behaviour).

Table 4
Linear regression with interaction terms on the European sample.

Model	B/β	*t*	*p*	R^2
Model 1				
Gender - female	−0.019	*0.172*	*0.864*	
Gender – nonbinary/other/prefer not to say	0.677	*2.022*	*0.043*	
Age	0.089	3.438	<0.001	
Country of residence - France	−0.981	5.786	<0.001	
Country of residence - Germany	−0.822	5.220	<0.001	
Country of residence - Hungary	−0.894	5.550	<0.001	
Country of residence - Sweden	−1.076	−6.171	<0.001	
Country of residence - UK	−1.250	6.888	<0.001	
Negative climate emotions	0.435	16.086	<0.001	
Other-blame	0.056	2.107	0.035	
Resignation	−0.014	0.532	0.595	
Shift of focus	0.007	0.250	0.803	*0.229*
Model 2				
Gender - female	−0.051	0.464	0.643	
Gender – nonbinary/other/prefer not to say	0.686	2.060	0.040	
Age	0.091	3.535	<0.001	
Country of residence - France	−1.26	6.69	<0.001	
Country of residence - Germany	−0.809	5.163	<0.001	
Country of residence - Hungary	−0.891	5.562	<0.001	
Country of residence - Sweden	−1.073	6.165	<0.001	
Country of residence - UK	−1.280	7.075	<0.001	
Negative climate emotions	0.433	15.865	<0.001	
Other-blame	0.062	2.357	0.019	
Resignation	−0.012	0.437	0.662	
Shift of focus	0.008	0.308	0.758	
Negative affect * Other-blame	0.097	3.788	<0.001	
Negative affect * Resignation	0.019	0.756	0.450	
Negative affect * Shift of focus	−0.057	2.154	0.031	*0.239*

Note. $N = 1307$. Outcome measure: pro-environmental behaviour. Negative climate emotions, other-blame, resignation and shift of focus were standardised. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus. Country of residence is dummy coded, reference level = Austria. Gender is dummy coded, reference level = male. For continuous variables, standardised estimates are reported. For categorical variables, unstandardized estimates are reported.

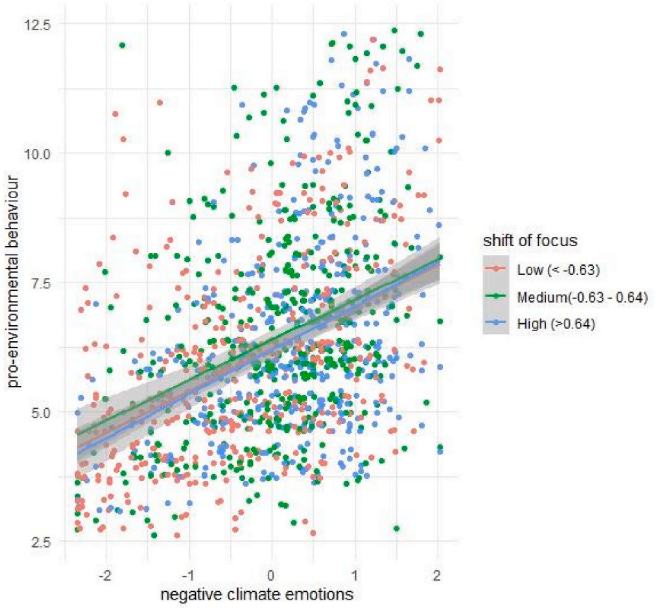

Fig. 8. Illustration of the interaction between negative climate emotions and shift of focus in the European sample (outcome measure: pro-environmental behaviour).

Table 5
Linear regression on the US sample.

Model	B/β	*t*	*p*	R^2
Sex	0.01	0.11	0.92	
Age	−0.01	2.16	0.03	
Hopeful	0.04	1.45	0.15	
Motivated	0.56	19.35	<0.001	*0.33*

Note. $N = 1040$. Outcome measure: pro-environmental behaviour. For continuous variables, standardised estimates are reported. For categorical variables, unstandardized estimates are reported.

Table 6
Linear regression on the European sample.

Model	B/β	*t*	*p*	R^2
Gender - female	0.26	2.44	0.02	
Gender - nonbinary/other/prefer not to say	1.2	3.50	<0.001	
Age	−0.03	1.02	0.31	
Country of residence - France	−1.04	6.03	<0.001	
Country of residence - Germany	−0.73	4.53	<0.001	
Country of residence - Hungary	−0.95	5.96	<0.001	
Country of residence - Sweden	−1.10	4.53	<0.001	
Country of residence - UK	−1.02	5.65	<0.001	
Hopeful	−0.14	4.91	<0.001	
Motivated	0.43	15.25	<0.001	*0.20*

Note. $N = 1307$. Outcome measure: pro-environmental behaviour. Country of residence is dummy coded, reference level = Austria. Gender is dummy coded, reference level = male. For continuous variables, standardised coefficients are reported. For categorical variables, unstandardized coefficients are reported.

environmental behaviour. The findings show that individuals that report experiencing negative emotions related to the climate crisis (namely sadness, anger, anxiety, and guilt) also report engaging in more pro-environmental behaviour, which replicates and supports findings within the established literature (Stanley et al., 2021). However, the distribution of measures suggests that while negative climate emotions and pro-environmental behaviour are related, pro-environmental behaviour tends to occur at notably lower levels than negative affect. This is in line with the notion that although climate emotions have consistently been associated with pro-environmental behaviour, they are not always followed by actions, as other internal factors such as knowledge, values, attitudes, subjective feeling of power, as well as external factors such as demographic, economic, and socio-cultural aspects may also be important to consider (Dong et al., 2021; Kollmuss & Agyeman, 2002; Redondo & Puelles, 2017). Addressing this disconnect between affect and action is where the sights of interventions should lie, although further research will be required to address the origin of such a discrepancy. The use of emotion regulation strategies is one such potential aspect to examine.

Consistent with our hypotheses, rumination mediated the relationship between negative climate emotions and pro-environmental behaviour in both samples. In other words, it appears that negative climate emotions may lead to increased rumination, which potentially exacerbates negative climate emotions, which in turn leads to increased pro-environmental behaviour. It is also plausible that these associations are bidirectional: in line with the emotional cascade model (Selby et al., 2008), in this escalating emotional phenomenon, pro-environmental behaviour may also be considered an adaptive attempt to reduce negative emotions about the climate crisis and therefore disengage from rumination. Therefore, in this context, rumination may not be considered maladaptive in terms of behavioural outcome, as opposed to other contexts, where it is generally associated with either inaction (e.g., Moulds et al., 2007) or maladaptive behaviour (e.g. Devynck et al., 2019; Selby et al., 2008), however, it could still be maladaptive for the individuals' mental health by amplifying negative climate emotions (Wullenkord et al., 2021). On the other hand, it has been argued that rumination about the climate crisis does not always lead to more affective and behavioural symptoms, while such symptoms could arise without the presence of rumination as well, therefore, exploring whether there is an the optimum of rumination and eco-anxiety for one's mental health as well as taking climate action would be an important line of research (Hogg et al., 2021). Taken together, considering how urgently we need to solve the climate crisis, having too little concern about it could be viewed just as maladaptive as having too much anxiety (Dodds, 2021). Further research should also investigate these associations with longitudinal designs to reveal whether performing pro-environmental behaviour has a backlash-effect by reducing negative emotion and therefore be beneficial for one's mental health but potentially reduce the motivation to act, or whether engaging in pro-environmental behaviours could enhance an environmentally friendly lifestyle change by becoming part of one's daily routine.

Other-blame was positively (although weakly) associated with pro-

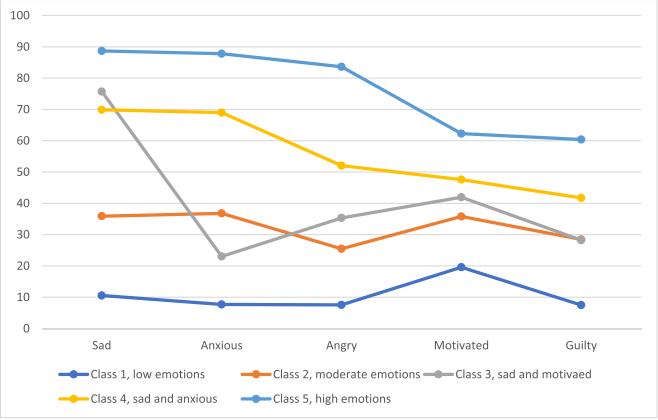

Fig. 9. Latent classes of climate emotions in the US sample (N = 1040).

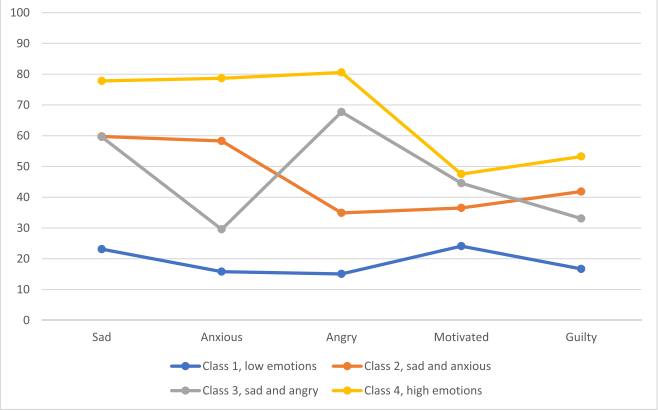

Fig. 10. Latent classes of climate emotions in the European sample (N = 1307).

Table 7
Model fit indices of the Latent Profile Analyses in both samples.

	US sample ($N = 1040$)						European sample ($N = 1307$)					
	AIC	BIC	SSA-BIC	Entropy	LMRT	*p*	AIC	BIC	SSA-BIC	Entropy	LMRT	*p*
2-class model	48358	48438	48387	0.911	2422.396	<0.001	60779	60862	60811	0.843	1544.735	<0.001
3-class model	47831	47940	47870	0.856	526.678	<0.001	60462	60576	60506	0.760	321.915	<0.001
4 class model	47692	47831	47742	0.841	147.178	0.022	**60314**	**60459**	**60370**	**0.805**	**156.390**	**<0.001**
5-class model	**47532**	**47700**	**47592**	**0.841**	**168.387**	**0.003**	60246	60422	60314	0.751	78.445	0.099
6-class model	47424	47622	47494	0.844	117.575	0.375	–	–	–	–	–	–

Note. AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria; SSA-BIC = Sample Size Adjusted Bayesian Information Criteria; LRT = Lo-Mendel-Rubin Adjusted Likelihood Ratio Test. The selected models are presented in bold.

Table 8
Multinomial logistic regression analysis to predict latent class membership in the US sample.

Model	Class 2, moderate emotions OR [95% CI]	Class 3, sad and motivated OR [95% CI]	Class 4, sad and anxious OR [95% CI]	Class 5, high emotions OR [95% CI]
Pro-environmental behaviour	2.16* [1.59–2.94]	2.32* [1.71–3.16]	2.19* [1.66–2.88]	2.90* [2.17–3.88]
Rumination	1.69* [1.34–2.14]	1.33* [1.01–1.75]	1.71* [1.36–2.14]	1.92* [1.52–2.41]
Shift of focus	0.95 [0.86–1.06]	0.90 [0.80–1.03]	0.95 [0.86–1.04]	0.85 [0.76–0.95]
Other-blame	1.18* [1.03–1.35]	1.24* [1.07–1.44]	1.26* [1.13–1.41]	1.34* [1.17–1.54]
Resignation	1.11 [0.97–1.28]	1.02 [0.89–1.17]	1.15* [1.02–1.29]	1.01 [0.88–1.16]
Sex	1.60 [0.89–2.91]	2.00* [1.03–3.88]	2.84* [1.73–4.68]	4.32* [2.38–7.84]
Age	0.98* [0.96–1.00]	1.01 [0.99–1.03]	0.97* [0.95–0.99]	0.98 [0.96–1.00]

Note. Reference group is low emotions (Class 1). $N = 1040$. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

Table 9
Multinomial logistic regression analysis to predict latent class membership in the European sample.

Model	Class 2, sad and anxious OR [95% CI]	Class 3, sad and angry OR [95% CI]	Class 4, high emotions OR [95% CI]
Pro-environmental behaviour	1.24 [0.99–1.54]	1.70* [1.34–2.15]	2.00* [1.59–2.5]
Rumination	1.79* [1.54–2.08]	1.55* [1.33–1.81]	2.10* [1.81–2.42]
Shift of focus	1.05 [0.96–1.15]	0.95 [0.87–1.04]	0.99 [0.91–1.08]
Other-blame	1.02 [0.90–1.14]	1.07 [0.95–1.21]	1.20* [1.07–1.34]
Resignation	0.96 [0.84–1.10]	0.91 [0.80–1.03]	0.87* [0.77–0.98]
Gender - male	0.30* [0.16–0.54]	0.68 [0.40–1.18]	0.17* [0.10–0.30]
Gender - nonbinary/ other/prefer not to say	0.43 [0.07–2.64]	0.66 [0.08–5.28]	0.66 [0.14–3.07]
Age	0.99 [0.97–1.02]	1.00 [0.98–1.02]	0.98* [0.96–1.00]
Country of residence - UK	5.76* [1.98–16.78]	3.28* [1.11–9.74]	6.79* [2.50–18.47]
Country of residence - France	4.75* [1.94–11.66]	1.92 [0.72–5.10]	3.08* [1.31–7.26]
Country of residence - Hungary	3.17* [1.28–7.86]	3.28* [1.47–7.36]	3.28* [1.43–7.50]
Country of residence - Sweden	1.73 [0.68–4.43]	1.44 [0.60–3.46]	0.97 [0.39–2.37]
Country of residence - Germany	2.07 [0.86–4.95]	1.64 [0.68–3.95]	1.91 [0.86–4.28]

Note. Reference group is low emotions (Class 1). $N = 1307$. $^*p \leq 0.05$. Country of residence is dummy coded, reference level = Austria. Gender is dummy coded, reference level = female. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

environmental action in both samples. Furthermore, in the European sample, the association between negative climate emotions and pro-environmental behaviour was moderated by other-blame, meaning that when the use of other-blame is higher, the association between negative affect and pro-environmental behaviour is stronger, which contradicts our hypotheses. This finding could possibly be explained by the specific characteristics and challenges of the climate crisis: it is plausible that individuals experiencing higher levels of negative climate emotions are more aware of others' (e.g., humanity as a whole, industrial players, etc.) contribution to the exacerbation of the crisis, thus a recognition of others' involvement may not be accompanied by a reduced sense of personal responsibility and the motivation to act. Furthermore, this result is important because it is a common argument in the literature that while other parties (e.g., fossil fuel companies) could clearly be blamed for the climate crisis, individuals should take at least partial responsibility and action (e.g., Cripps; Marion, 2010). However, according to the findings of this study, the two processes can happen parallelly: being aware of others' role in the climate crisis does not appear to be accompanied by less individual climate action.

In the US sample, shift of focus (i.e., cognitive reappraisal and distraction) was positively related to pro-environmental behaviour, meaning that people who more frequently engage in this strategy tend to take more action. The underlying factor behind this unexpected association may be negative climate emotions: people who tend to experience more negative emotions appear to be more prone to acting, as well as implementing this ER strategy as an attempt to mitigate their negative emotions. Another potential explanation could be that people may reappraise their thoughts regarding the climate crisis in a way that there is more they could do about it, resulting in more climate action (Ojala, 2012b, 2013). In contrast, shift of focus (i.e., cognitive reappraisal and distraction) in the European sample significantly moderated the association between negative affect and pro-environmental behaviour in the expected direction, i.e., the association between negative climate emotions and pro-environmental behaviour was slightly weaker among those who used distracting or reframing strategies more often to regulate negative climate-related affect. This finding also aligns with the concept of emotion-focused coping, where individuals may consciously redirect their thoughts about the climate crisis in ways that help them maintain emotional calmness (Lazarus & Folkman, 1984). Findings on the European sample support the notion that those who successfully implement this strategy may feel less pressure to engage in action, potentially due to their reduced negative climate emotions. However, it is important to note that adding the interaction terms to the model only contributed an additional 1% to the explained variance in the European sample, showing that although significant, this is a weak association. Furthermore, the diverging findings of the two samples also indicate that cultural factors may be important to consider. Also, it is important to keep in mind that our shift of focus factor comprises items of both cognitive reappraisal and distraction, which further complicates interpretation. Therefore, more research is needed for robust conclusions about the role of distracting and reappraising ER strategies in the context of the climate crisis.

Resignation was negatively associated with pro-environmental behaviour in the US sample. Additionally, results of the US sample indicated that the relationship between negative affect and pro-environmental behaviour is slightly weaker among individuals who employ resignation as an emotion regulation strategy. In other words, when negative climate emotions are accompanied by feeling powerless, the tendency to take pro-environmental action will be somewhat lower. In contrast, no associations were found between resignation and pro-environmental behaviour in the European sample, which again underlines the possible role of cultural factors, as well as the need for more research on this topic for robust conclusions.

As for positive emotions, feeling motivated was positively associated with pro-environmental behaviour in both samples. In the European sample, there was negligible ($r = 0.06$) correlation between hope and pro-environmental behaviour, however, in the regression model, where gender, country of residence age, and feeling motivated were controlled

for, being hopeful was negatively associated with pro-environmental behaviour (β = −0.14). In the US sample, there was a weak correlation between hope and pro-environmental action (r = 0.25), and no association in the regression model when sex, gender and feeling motivated were also controlled for (β = 0.04). These findings indicate that feeling hopeful about the future of the planet may not be associated with taking action or might even hinder it in certain contexts. More specifically, a recent meta-analysis found that being hopeful about the results of climate action was associated with higher engagement (r = 0.40), while being hopeful because one does not think climate change is a serious issue was associated with less pro-environmental behaviour (r = −0.40)(Geiger et al., 2023), a moderator that was not accounted for in the current study. Results about hope should be taken into consideration when designing public information campaigns: while too strong messages might trigger resignation that was found to be related to less pro-environmental action, overly optimistic messages may raise high hopes that could also result in inaction; instead, messages strengthening hope that one could make a difference for a greener future could potentially increase engagement (e.g., Khalil et al., 2022; Moser, 2016; Ojala, 2012a).

Most studies in the field investigate the association between single emotions and pro-environmental behaviour, and the comprehensive picture of these emotional patterns is understudied (Pong & Tam, 2023). We conducted latent profile analyses to address this gap, and then investigated whether the identified latent groups differed in their use of ER strategies and pro-environmental behaviour. Five latent classes emerged in the US sample, and four latent classes were identified in the European sample. In both samples, an unemotional and a highly emotional group were identified, with two/three clusters of varying emotional intensity and pattern in between. More specifically, in the US sample, there was a group who scored moderate on all emotions, whereas another group demonstrated high sadness and motivation, and members of Class 4 scored high on sadness and anxiety, and relatively lower on the other emotions. In the European sample, besides the unemotional and the highly emotional group, a sad and angry group emerged with low levels of anxiety, and a sad and anxious group emerged with low levels of anger. A relevant study that looked at the interplay of 13 climate emotions (angry, irritated, fearful, despairing, powerless, ashamed, guilty, apathetic, bored, confused, hopeful, joyful, excited) identified four distinct profiles of emotion, which were labelled as ‘strong negative’, ‘weak negative’, no emotion’, and ‘ambivalent’. Although the emotions included in the analyses only partially overlap, and the statistical modelling was different (hierarchical clustering which is based on distance as opposed to latent profile analysis which is a probabilistic approach based on the distribution of data) (Hagenaars & McCutcheon, 2002; Leisch, 2004; Linzer & Lewis, 2011), the results of the two studies correspond in identifying a highly emotional cluster experiencing strong negative climate emotions, and an unemotional cluster, the members of which seem indifferent about the climate crisis. In between there are two to three clusters in the two studies with mixed negative feelings of moderate intensity. The emergence of distinct emotional profiles indicates that examining the complex patterns of eco-emotions rather than single emotions or positive/negative affect composites merits further research attention. Although beyond the scope of this paper, it would be worthwhile for future research to further investigate the differences between these classes not only in their tendency to engage in pro-environmental behaviour and regulating their eco-emotions, but other factors such as climate change risk perception, eco-values, demographic characteristics, etc.

Furthermore, pro-environmental behaviour and rumination predicted class membership in both samples. In other words, compared to the unemotional group, all groups reported to dwell more on the climate crisis and engage in more pro-environmental action. However, such between-cluster differences were not found for shift of focus (i.e., cognitive reappraisal & distraction). For highly emotional groups, shift of focus could serve as a means to take a break from negative climate emotions, meanwhile for groups with lower emotional intensity, this may be one of the mechanisms to keep an emotional distance from the climate crisis. Other-blame predicted class membership for each cluster in the US sample, whereas in the European sample, only the highly emotional group differed significantly from the unemotional group in terms of other-blame. Resignation only predicted class membership of the more emotional groups compared to the unemotional group in both samples.

Notably, there were much more participants in the highly emotional group in the European sample (N = 610, 45.4%) than in the US sample (N = 219, 21.06%), which is not surprising given that the European sample was uncompensated, therefore people who were genuinely interested in this topic tended to participate, meanwhile the representative US sample probably better reflects public opinion in the US. This illustrates the importance of emotional connections in driving public climate action. Using emotions to effectively communicate climate change and increase public action is also mentioned by other researchers (e.g., Brosch & Steg, 2021; Dahlstrom, 2014; Green et al., 2018). On this basis, it could be argued that it is important to keep informing the general public about the climate crisis to counteract the lower levels of climate emotions and in the long run, increase public climate actions. However, it is important that the information is tailored to the specific local contexts to highlight a sense of urgency and enhance the engagement capacities (Directorate-General for Climate Action and Kantar, 2019; Steg et al., 2018). This local framing can also deter cognitive dissonance preventing individuals from justifying behaviours to evade their discomfort (Harmon-Jones & Mills, 1999; Riley et al., 2021). Furthermore, the actions should be rather achievable and executable (Steg et al., 2018). Hence, effectively communicating the concept of collective responsibility through visible demonstrations of collective action and leadership, as underpinned by theories such as social practice and social identity (Shove, 2010; White & Habib, 2018), emerges as a viable avenue in climate communication (Riley et al., 2021). However, it is imperative to acknowledge that the efficacy of inducing behavioural change through information dissemination, communication and emotions also depends on the context (Steg et al., 2018). Hence, it is necessary to address the multifaceted barriers encompassing social dynamics, physical environments, and environmental factors as well as reduce the costs that impede behavioural action (Steg et al., 2018; Stokols, 1992).

Strengths of this research comprise the considerable sample size and reporting findings on two distinct large samples, one with 1040 participants from the United States, representative for sex, age, and ethnicity, and another one with 1307 participants from six European countries. In addition, to our knowledge, this is one of the first studies to look specifically at the role of emotion regulation strategies and the unique patterns of emotions (i.e., latent profile analyses) in relation to pro-environmental behaviour. Understanding which emotions and emotion regulation strategies help to curb and motivate pro-environmental behaviour is important for the collective pursuit for a more sustainable future. Therefore, the present research addresses a gap in the literature and holds important practical implications.

Despite valuable insights and considerable strengths, this study is not without its limitations. Using self-report measures to collect data on emotions and ER strategies related to pro-environmental behaviour creates potential risk for social desirability bias, especially considering recent surge in climate activism trends (Ares & Bolton, 2020). Furthermore, self-reported items may be interpreted differently by different participants living in different countries. Although beyond the scope of this paper, it would be worthwhile looking at whether there is a cultural difference in the interpretation of the items; e.g., to what extent do the items of the Resignation subscale reflect powerlessness in each sample, or how close the Acceptance subscale is to positive refocusing (reflected by the results of the American, but not the European sample). Another limitation regarding the wording of the items concerns other-blame: the items we used do not rule out the possibility that participants attribute

responsibility for the climate crisis to external factors, yet, still feel responsible themselves, curbing the interpretation of related results.

Moreover, although a representative sample for the US population was collected, the European sample was obtained via convenience sampling, running the risk of bias and uneven gender distribution. Furthermore, due to this difference in data collection methods, comparisons cannot be made between the samples, limiting the interpretability and generalizability of the results. The study employs a cross-sectional design; serving as a primary introduction to further exploration on the topic, but unable to investigate the relationship between specific emotions and emotion regulation strategies or infer any causality on the matter. However, it is important to note that the examined relationships are likely multidirectional and dynamic, therefore, assuming a linear chain of causality may be oversimplifying. In other words, the ER strategies may also circle back to the emotional experience and pro-environmental behaviour may also be a means of regulating emotions. This pattern of interplay between emotions and actions has been previously demonstrated within the framework of meaning-focused coping (i.e., positive reappraisal and trust in other entities in mitigating the climate crisis) (Ojala, 2016). Also, when defining our models, we studied ER strategies in the framework of strategy-based models dividing ER strategies into adaptive vs maladaptive (Naragon-Gainey et al., 2017), as opposed to the framework of temporal process models such as Gross's Process Model of Emotion Regulation (Gross, 1998, 2015). While strategy-based models may be over-simplifying as the adaptiveness of a certain ER strategy may be context-dependent (Aldao, 2013), examining ER strategies in the framework of temporal process models would be more adequate with experimental designs, for instance, by triggering climate emotions with certain stimuli and then looking at strategy selection, which is beyond the scope of this paper. Future research should extend this work by replicating our results and including more ER strategies that could be relevant in the context of the climate crisis. Furthermore, the effect of emotions on pro-environmental behaviour is likely to be a complex and dynamic system comprising emotions as well as cognitions, risk perception and personal values (Van Der Linden, 2017). In the same vein, one may argue that the climate crisis can be considered a stressor and therefore responses given to it could also be conceptualised as coping. However, understanding the gravity of the climate crisis on a cognitive level may also motivate climate action (Lee et al., 2015; Steynor et al., 2021), but the recognition of the problem may not necessarily or constantly be accompanied by a stress response or strong emotions, especially because most climate emotions tend to be transient (Brosch, 2021); therefore, in future research, it may be worth investigating the temporality of different climate emotions and their influence on pro-environmental behaviour. Furthermore, pro-environmental behaviours may also become part of one's daily routine that no longer require emotional triggers. Further exploring the complex dynamics within evoking emotions and related processes entailed for influencing decision making towards actions including thoughts and beliefs about the climate crisis, risk perception or coping strategies remains crucial for future research (Davidson & Kecinski, 2022; Myers et al., 2023).

The findings of this study hold significant importance for implementation. The climate crisis may evoke intense emotions and have severe impacts on mental health through several direct and indirect pathways such as exposure to changes of the environment, natural disasters, extreme weather conditions and their socioeconomic concomitants such as loss of income or involuntary migration, leading to despair and mental strain (Corvalan et al., 2022). On the other hand, engaging in climate action may have potential mental health benefits as a means of active coping that provides a sense of control, efficacy and fulfilment (Fritsche et al., 2018; Ojala, 2012b; World Health Organization, 2022). Therefore, interventions should specifically aim at teaching individuals how to constructively deal with climate emotions via emotion regulation or coping strategies without decreasing climate action, and recognise the role of pro-environmental behaviour as a means of coping. To sum up, our findings highlight the importance of emotions, and how one might take care of and regulate emotions evoked by the climate crisis whilst still acting in a pro-environmental way, causing us to act as we feel.

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Data availability statement

Data and analysis scripts are available at https://osf.io/uzfer/?view_only=0769d9dc5ca247ce9bd2272b58d19ce3.

CRediT authorship contribution statement

Lilla Nóra Kovács: Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Gesine Jordan:** Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Frida Berglund:** Writing – original draft, Investigation, Data curation, Conceptualization. **Benedict Holden:** Writing – original draft, Investigation, Data curation, Conceptualization. **Elena Niehoff:** Writing – original draft, Investigation, Data curation, Conceptualization. **Felicia Pohl:** Writing – original draft, Investigation, Data curation, Conceptualization. **Mariem Younssi:** Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Inés Zevallos:** Writing – original draft, Investigation, Data curation, Conceptualization. **Csilla Ágoston:** Writing – review & editing, Conceptualization. **Attila Varga:** Writing – review & editing, Conceptualization. **Gyöngyi Kökönyei:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of Competing interest

The authors declare no conflict of interest.

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Appendices.

Table A1
Demographic characteristics of the US sample

Characteristic	N	N = 1,040[1]
Gender	1040	
female		534 (51%)
male		499 (48%)
non-binary		6 (0.6%)
prefer not to say		1 (<0.1%)
age	1040	
Mean (SD)		46 (16)
Range		18,93
location	1040	
city		513 (49%)
state capital/capital		46 (4.4%)
town		391 (38%)
village		90 (8.7%)

[1] n (%).

Table A2
Demographic characteristics of the European sample

Characteristic	N	Overall N = 1307 [1]	AUS, N = 224 [1]	FR, N = 205[1]	GER, N = 258[1]	HU, N = 255[1]	SV, N = 199[1]	UK, N = 166[1]	p – value[2]
Gender	1307								
female		869 (66%)	161 (72%)	151 (74%)	178 (69%)	155 (61%)	118 (59%)	106 (64%)	
male		396 (30%)	59 (26%)	52 (25%)	70 (27%)	91 (36%)	72 (36%)	52 (31%)	
non-binary		23 (1.8%)	4 (1.8%)	1 (0.5%)	5 (1.9%)	5 (2.0%)	3 (1.5%)	5 (3.0%)	
other		6 (0.5%)	0 (0%)	0 (0%)	3 (1.2%)	0 (0%)	1 (0.5%)	2 (1.2%)	
prefer not to say		13 (1.0%)	0 (0%)	1 (0.5%)	2 (0.8%)	4 (1.6%)	5 (2.5%)	1 (0.6%)	
age	1307								<0.001
Mean (SD)		30 (12)	32 (12)	27 (10)	31 (13)	30 (13)	32 (12)	28 (12)	
Range		18,79	19,73	18,72	18,72	18,79	18,77	18,69	
location	1306								<0.001
city		538 (41%)	57 (25%)	141 (69%)	111 (43%)	69 (27 %)	115 (58%)	45 (27%)	
state capital/capital		287 (22%)	76 (34%)	16 (7.8%)	15 (5.8%)	128 (50%)	41 (21%)	11 (6.6%)	
town		304 (23%)	33 (15%)	25 (12%)	96 (37%)	44 (17%)	27 (14%)	79 (48%)	
village		177 (14%)	58 (26%)	23 (11%)	35 (14%)	14 (5.5%)	16 (8.0%)	31 (19%)	
Unknown		1	0	0	1	0	0	0	

[1]n (%).
[2]Kruskal-Wallis rank sum test; Pearson's Chi-squared test AUS = Austria, FR = France, GER = Germany, HU = Hungary, SV = Sweden, UK = United Kingdom.

Table A3
Factor loadings of the ERCC items in the US sample.

	Shift of focus	Rumination	Other-blame	Resignation	Acceptance
My thoughts about climate change keep coming into my head even when I do not wish to think about them		0.69*			
I control my emotions about climate change by thinking of something nice instead	0.74*				
I think that I must learn to live with climate change.				0.61*	
When I'm faced with climate change, I make myself think about it in a way that helps me stay calm.	0.62*				
I feel that others are responsible for climate change.			0.85*		
I have thoughts about climate change that I try to avoid.		0.55*			
I can accept having strong emotions about climate change.					0.67*
Thoughts about climate change interfere with my concentration.		0.81*			
When a negative thought about climate change comes up, I immediately try to think of something else.	0.63*				
I think that I have to accept climate change.				1.02*	
When I want to feel less negative emotion about climate change, I change the way I'm thinking about it.	0.75*				
I feel that basically the cause of climate change lies with others.			0.86*		
Sometimes I stay busy just to keep thoughts about climate change from intruding on my mind.		0.62*			
There is nothing wrong with feeling very emotional about climate change.					0.59*
I think I can learn something from climate change.					0.50*
If I start thinking about climate change, I find it difficult to stop.		0.84*			

Note. $N = 1040$. * $= p < 0.01$. ERCC = Emotion Regulation in Response to Climate Change Questionnaire. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

Table A4
Factor loadings of the ERCC items in the European sample.

	Shift of focus	Rumination	Other-blame	Resignation
My thoughts about climate change keep coming into my head even when I do not wish to think about them		0.77*		
I control my emotions about climate change by thinking of something nice instead	0.73*			
I think that I must learn to live with climate change.				1.01*
When I'm faced with climate change, I make myself think about it in a way that helps me stay calm.	0.59*			
I feel that others are responsible for climate change.			1.0*	
I have thoughts about climate change that I try to avoid.		0.56*		
Thoughts about climate change interfere with my concentration.		0.82*		
When a negative thought about climate change comes up, I immediately try to think of something else.	0.67*			
I think that I have to accept climate change.				0.62*
When I want to feel less negative emotion about climate change, I change the way I'm thinking about it.	0.79*			
I feel that basically the cause of climate change lies with others.			0.74*	
Sometimes I stay busy just to keep thoughts about climate change from intruding on my mind.		0.55*		
If I start thinking about climate change, I find it difficult to stop.		0.87*		

Note. $N = 1307$. * $= p < 0.01$. ERCC = Emotion Regulation in Response to Climate Change Questionnaire. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

Table A5
Spearman correlations of the assessed emotions and emotion regulation strategies in the US sample.

US sample ($N = 1040$)									
	Sad	Anxious	Hopeful	Angry	Motivated	Guilty	Other-blame	Shift of focus	Resignation
Anxious	0.79***	–	–	–	–	–	–	–	–
Hopeful	0.06	0.11***	–	–	–	–	–	–	–
Angry	0.73***	0.74***	0.08*	–	–	–	–	–	–
Motivated	0.48***	0.49***	0.48***	0.48***	–	–	–	–	–
Guilty	0.57**	0.63***	0.20***	0.58***	0.44***	–	–	–	–
Other-blame	0.28***	0.30***	< −0.01	0.34***	0.14***	0.10**	–	–	–
Shift of focus	0.20***	0.27***	0.35***	0.21***	0.36***	0.29***	0.24***	–	–
Resignation	0.03	0.07*	0.11***	<0.01	0.05	0.04	0.20***	0.36***	–
Rumination	0.43***	0.55***	0.28***	0.45***	0.47***	0.47***	0.29***	0.59***	0.13***

Note. *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

Table A6
Spearman correlations of the assessed emotions and emotion regulation strategies in the European sample.

European sample ($N = 1307$)									
	Sad	Anxious	Hopeful	Angry	Motivated	Guilty	Other-blame	Shift of focus	Resignation
Anxious	0.56***	–	–	–	–	–	–	–	–
Hopeful	0.04	−0.06*	–	–	–	–	–	–	–
Angry	0.54***	0.55***	0.02	–	–	–	–	–	–
Motivated	0.31***	0.19***	0.43***	0.30***	–	–	–	–	–
Guilty	0.36***	0.45***	0.07*	0.33***	0.27***	–	–	–	–
Other-blame	0.07*	0.11***	−0.11***	0.17***	−0.09**	−0.10***	–	–	–
Shift of focus	0.18***	0.24***	0.09**	0.14***	0.13***	0.25***	0.13***	–	–
Resignation	−0.03	−0.01	−0.03	−0.04	−0.01	< −0.01	0.06*	0.23***	–
Rumination	0.44***	0.59***	−0.02	0.46***	0.19***	0.40***	0.13***	0.42***	0.04

Note. *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001. Items that originally belonged to cognitive reappraisal and distraction loaded on a single factor that we labelled as shift of focus.

Table A7
Means and standard deviations of climate emotions for each latent class in the US sample.

Emotion	Class 1 Mean (SD)	Class 2 Mean (SD)	Class 3 Mean (SD)	Class 4 Mean (SD)	Class 5 Mean (SD)
Sad	10.544 (13.12)	35.897 (13.12)	75.696 (13.12)	69.881 (13.12)	88.671 (13.12)
Anxious	7.685 (12.62)	36.783 (12.63)	23.024 (12.63)	68.965 (12.63)	87.780 (12.63)
Angry	7.542 (19.63)	25.473 (19.63)	35.339 (19.63)	52.035 (19.63)	83.620 (19.63)
Motivated	19.567 (25.97)	35.799 (25.97)	41.944 (25.97)	47.569 (25.97)	62.256 (25.97)
Guilty	7.490 (22.24)	28.448 (22.24)	28.238 (22.24)	41.734 (22.24)	60.377 (22.24)

Note. $N = 1040$.

Table A8
Means and standard deviations of climate emotions for each latent class in the European sample.

Emotion	Class 1 Mean (SD)	Class 2 Mean (SD)	Class 3 Mean (SD)	Class 4 Mean (SD)
Sad	23.123 (19.63)	59.742 (19.64)	59.606 (19.64)	77.811 (19.64)
Anxious	15.807 (15.58)	58.294 (15.58)	29.558 (15.58)	78.680 (15.58)
Angry	15.061 (16.72)	34.895 (16.72)	67.711 (16.72)	80.552 (16.72)
Motivated	24.099 (25.77)	36.521 (25.77)	44.563 (25.77)	47.518 (25.77)
Guilty	16.692 (24.64)	41.853 (24.64)	33.079 (24.64)	53.240 (24.64)

Note. $N = 1307$.

Table A9
Descriptive statistics and group comparison of latent classes of climate emotion in the US sample.

	Class 1 Mean (SE)	Class 2 Mean (SE)	Class 3 Mean (SE)	Class 4 Mean (SE)	Class 5 Mean (SE)	Wald statistics	Significant group differences ($p < 0.05$)
Pro-environmental behaviour	4.34 (0.10)	5.29 (0.16)	5.82 (0.27)	5.73 (0.13)	7.18 (0.15)	282.3*	1 vs 2; 1 vs 3; 1 vs 4; 1 vs 5; 2 vs 4; 2 vs 5; 3 vs 5; 4 vs 5
Rumination	6.57 (0.20)	8.56 (0.35)	7.71 (0.54)	9.73 (0.27)	11.92 (0.31)	258.53*	1 vs 2; 1 vs 3; 1 vs 4; 1 vs 5; 2 vs 4; 2 vs 5; 3 vs 5; 4 vs 5
Shift of focus	7.99 (0.25)	9.60 (0.34)	8.80 (0.49)	10.27 (0.24)	10.38 (0.25)	68.10*	1 vs 2; 1 vs 4; 1 vs 5; 3 vs 4; 3 vs 5
Other-blame	4.99 (0.16)	6.07 (0.20)	6.17 (0.30)	6.64 (0.16)	6.86 (0.16)	93.70*	1 vs 2; 1 vs 3; 1 vs 4; 1 vs 5; 2 vs 4; 2 vs 5; 3 vs 5
Resignation	6.24 (0.16)	6.78 (0.17)	6.48 (0.27)	6.98 (0.13)	6.43 (0.17)	14.63*	1 vs 2; 1 vs 4; 4 vs 5

Note. *$p < 0.01$; SE: standard error; Class 1 = low emotions; Class 2 = moderate emotions; Class 3 = sad and motivated; Class 4 = sad and anxious; Class 5 = high emotions.

Table A10
Descriptive statistics and group comparison of latent classes of climate emotion in the European sample.

	Class 1	Class 2	Class 3	Class 4	Wald statistics	Significant group differences ($p < 0.05$)
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)		
Pro-environmental behaviour	4.88 (0.11)	5.52 (0.10)	6.34 (0.15)	7.15 (0.09)	295.4*	1 vs 2; 1 vs 3; 1 vs 4; 2 vs 3; 2 vs 4; 3 vs 4
Rumination	6.23 (0.13)	9.51 (0.26)	8.35 (0.29)	12.20 (0.17)	773.16*	1 vs 2; 1 vs 3; 1 vs 4; 2 vs 3; 2 vs 4; 3 vs 4
Shift of focus	7.44 (0.22)	9.67 (0.23)	7.87 (0.27)	9.66 (0.13)	100.26*	1 vs 2; 1 vs 4; 3 vs 4
Other-blame	5.87 (0.17)	5.79 (0.16)	5.99 (0.21)	6.57 (0.09)	27.08*	1 vs 4; 2 vs 4; 3 vs 4
Resignation	6.91 (0.16)	7.04 (0.15)	6.57 (0.17)	6.74 (0.09)	4.84	2 vs 3

Note. *$p < 0.01$; SE: standard error; Class 1 = low emotions; Class 2 = sad and anxious; Class 3 = sad and angry; Class 4 = high emotions.

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