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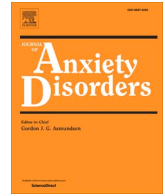
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The influence of environmental crisis perception and trait anxiety on the level of eco-worry and climate anxiety

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ABSTRACT

Eco-anxiety, which refers to the anxiety experienced in response to worsening environmental conditions, is a growing global phenomenon. Climate change anxiety, due to the escalating impact of ongoing climate change, stands out as the most commonly recognized form of eco-anxiety. Nevertheless, numerous uncertainties persist regarding the relationship of this eco-anxiety response to pro-environmental behaviors, as well as its connection with trait anxiety and the perception of the environmental crisis. In this study, we conducted an analysis with a sample size of 431 participants to elucidate the respective implications of these factors, delving into the different facets of the eco-anxiety response: worry and anxiety-related impairments. We measured eco-worry using a brief 5-item scale and assessed climate anxiety-related impairments using the Climate Change Anxiety Scale (CCAS). Our findings reveal that eco-worry acts as a mediator between the perception of the environmental crisis and the manifestation of climate anxiety-related impairments. Furthermore, eco-worry plays a constructive role in relation to the commitment to pro-environmental behaviors, with no additional contribution from the climate anxiety reaction involving impairments. In summary, our findings underscore the existence of distinct constructs within the anxiety response to climate change and environmental issues, each with different contributing factors.

1. Introduction

The scientific consensus on climate change, mass extinction of species and pollution (Masson-Delmotte et al., 2021; Steffen et al., 2015) has received extensive media coverage in many countries (Hase et al., 2021; Imundo & Rapp, 2022). Nonetheless, climate change, and the broader environmental crisis, are associated with beliefs, particularly regarding their anthropogenic causes and potential consequences for individuals or society as a whole, such as heat waves, food shortages, floods, water shortages, economic problems. The perception of these issues as threats depends on individuals' personal experiences with environmental disasters, their understanding of available information, and their values (Goodwin et al., 2017; van der Linden, 2017). Simultaneously, negative reactions and eco-emotions have emerged on a global scale and have been extensively documented (Albrecht et al., 2007; Cunsolo & Ellis, 2018; Ojala et al., 2021; Pihkala, 2020). Of these

individual responses to environmental concerns, eco-worry and eco-anxiety appear to be among the most prevalent (Heeren et al., 2022; Hickman et al., 2021; Hogg et al., 2021; Ogunbode et al., 2021; Searle & Gow, 2010). Therefore, gaining a deeper understanding of the nature, range and correlates of these eco-emotions (Coffey et al., 2021) is important, as they may significantly impact mental well-being in many countries (Clayton, 2020; Hickman et al., 2021; Hrabok et al., 2020; Ogunbode et al., 2021).

Eco-anxiety and eco-worry have been subjects of study for a decade, sometimes without clear distinctions (Coffey et al., 2021; Pihkala, 2020). Initially, eco-anxiety was defined as the "generalized sense that the ecological foundations of existence are in the process of collapse" (Albrecht, 2012, p. 250). More recently, it has been characterized as "the chronic fear of ecological doom" (Clayton et al., 2017, p. 68). Eco-anxiety is the term most commonly used to refer to the apprehension of the consequences of the environmental crisis or climate change,

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and it encompasses varying degrees of eco-worry (Lutz et al., 2023). It is worth noting that while eco-anxiety is a broader concept than climate change anxiety, both terms are often used interchangeably. This interchangeability arises from the fact that climate change and the broader environmental crisis share many commonalities, such as their global impact, human origin, and the scale of their consequences.

1.1. Eco-anxiety, eco-worry and pro-environmental engagement

Smith and Lazarus (1990) proposed a cognitive motivational relational theory of emotions, which posits that emotions are triggered based on an individual's personal appraisal of the meaning of a situation, including its potential impact on well-being and the available coping options. These emotions then motivate individuals to cope with and adapt to the situation. Recent research has further highlighted the significance of affects and emotions in predicting climate change risk perception (van der Linden, 2015), and individual willingness to engage in climate change mitigation behaviors or support climate change policies (Bouman et al., 2020; van Valkengoed & Steg, 2019; Wang et al., 2018) or both (Xie et al., 2019). In a recent review, Brosch (2021) has consolidated the current view that emotions are triggered through appraisals of event relevance to personal concerns and have an impact on decision-making, beliefs, and motivation. Understanding the underlying mechanisms in the context of climate change or other ecological issues is crucial for addressing environment-related challenges effectively.

Both worry and anxiety are aversive emotional experiences related to anticipated future events. Worry primarily involves the cognitive aspect of the reaction, while anxiety encompasses the affective state (Grupe & Nitschke, 2013; Kelly, 2008; Ojala et al., 2021). They have been characterized as separate constructs when focusing on coping strategies (Davey et al., 1992). Both are normal and adaptive responses when anticipating future threats as they contribute to problem-solving or self-regulation behaviors under conditions of uncertainty (Davey et al., 1992; Sweeny & Dooley, 2017). In other words, they prompt adaptive behavioral responses aimed at reducing the perceived threat. For instance, non-pathological worry can enhance motivation and lead to problem-focused actions (Sweeny & Dooley, 2017; Watkins, 2008).

In line with the idea that worry serves as an adaptive response to an anticipated threat, eco- or climate worry has been found to be positively associated with engagement in pro-environmental behaviors (PEB) (Bouman et al., 2020; Reser, 2012; Verplanken et al., 2020; Verplanken & Roy, 2013; Wang et al., 2018). In this study, we aimed to investigate the relationship between the perception of the environmental crisis as a threat, levels of the eco-anxiety reactions, including eco-worry, and engagement in PEB. We anticipated finding positive correlations between these variables and explored the possibility of eco-anxiety reactions playing a mediating role between the perception of the environmental crisis and PEB engagement.

1.2. Perception of the environmental crisis and the eco-anxiety reaction

Individual risk perception involves making subjective assessments of the likelihood and severity of present or future harm associated with an uncertain event (Slovic, 1987). Individuals form these judgments by interpreting signals from various sources related to the event (van der Linden, 2017). These judgments manifest as beliefs about the event's probability, characteristics (such as controllability), and the associated threats. When applied to climate change, it encompasses beliefs about the reality of climate change, its anthropogenic causes, and its potential impacts on oneself or others within specific time and space frames (e.g. whether it is perceived as a threat only for future generations or for people in distant regions) (Van Valkengoed, Steg, & Perlaviciute, 2021).

Numerous studies have explored the relationship between perception of climate change or other environmental issues as reality, risk or actual threat, and pro-environmental attitudes and behaviors (Bradley et al., 2020; Reser, 2012; van Valkengoed & Steg, 2019; Xie et al., 2019).

However, there is limited data analyzing the correlation between the level of environmental crisis perception and eco-anxiety (Brosch, 2021; Jalin et al., 2023; Lutz et al., 2023; van der Linden, 2017; Reese et al., 2022). According to several researchers, individuals who more accurately perceive the objective consequences of environmental issues, their interconnected causes and associated dangers are likely to experience higher levels of eco-anxiety (e.g. Ojala et al., 2021; Pihkala, 2020). Our objective was to further investigate this relationship, taking into account different beliefs contributing to the perception of the environmental crisis as a threat.

1.3. Trait anxiety and the eco-anxiety reaction

Several scholars argue that eco-anxiety represents an adaptive emotional response to the current environmental challenges, rather than a pathological anxiety reaction (e.g. Kurth & Pihkala, 2022; Pihkala, 2020; Verplanken & Roy, 2013; Wullenkord et al., 2021). Therefore, the level of eco-anxiety may not exhibit a strong correlation with trait anxiety, which represents a stable disposition to perceive various events as threatening (Spielberger, 1983). Instead, the perception of the environmental crisis may exert a greater influence on the eco-anxiety reaction. In this study, our aim was to assess the relative significance of trait anxiety compared to other factors as correlates of the eco-anxiety reaction.

1.4. Eco-worry and eco-anxiety related impairments

Eco- or climate worry scales have seen extensive use in research (e.g. Bouman et al., 2020; Helm et al., 2018; Hickman et al., 2021; Reser, 2012; Stewart, 2021; Verplanken et al., 2020; Whitmarsh et al., 2022). These scales vary in length, ranging from one item (Hickman et al., 2021) to twelve items (Verplanken et al., 2020). When compared, they show consistent positive relationship with PEB, as well as with aspects of the environmental crisis perception such as the belief in climate change (Lutz et al., 2023). However, they do not take into account distressing symptoms associated with intense worry or other burdensome symptoms of eco-anxiety.

Indeed, worry can become distressing (Davey et al., 1996). When it becomes uncontrollable, excessive, and generalized to many anticipated events, it is associated with trait anxiety and is a characteristic feature of generalized anxiety disorder (Gomez & Francis, 2003; Hoge et al., 2012). Additionally, extreme levels of worry can lead to impairments such as difficulty concentrating, disturbed sleep, and irritability (Newman et al., 2013). Therefore, the increasing prevalence of eco-anxiety raises concerns about its potential impact on global mental health (Clayton, 2020; Gibson et al., 2020; Heeren & Asmundson, 2023; Taylor, 2020).

To address the distressing symptoms associated with worry and anxiety in the context of environmental concerns, including climate change, recent specific measures of eco-anxiety have been developed. Clayton and Karazsia (2020) developed a Climate Change Anxiety Scale (CCAS) that assesses impairments commonly observed in forms of anxiety requiring clinical attention such as generalized anxiety disorder (GAD). This scale evaluates emotional and cognitive impairments (e.g. disturbed sleep, difficulty concentrating and rumination) as well as functional impairments (e.g. interference with work and/or study capacity) in reaction to climate change perception. These two dimensions have been found to correlate with a general assessment of anxiety and depression. They have shown null (Clayton & Karazsia, 2020; Lutz et al., 2023) to medium-sized (Heeren et al., 2022; Wullenkord et al., 2021) correlations with pro-environmental behaviors.

Another measure, the eco-anxiety scale (HEAS) proposed by Hogg et al. (2021), focuses on the environmental crisis in general. Similar to the CCAS, it contains items assessing behavioral symptoms and rumination symptoms (Hogg et al., 2023). It also addresses some affective symptoms, based on the GAD-7 scale as well as anxiety about one's

personal impact on the Earth. These different factors, particularly the affective and behavioral symptoms, have demonstrated moderate to high correlations with mental health outcomes such as stress, depression, and anxiety. Interestingly, these subscales have no (affective and behavioral symptoms) or weak (personal impact, and rumination subscales) relationships with belief in climate change (Hogg et al., 2021).

The discrepancies between eco-worry scales and eco-anxiety related impairment scales concerning correlates such as pro-environmental behavioral engagement and beliefs about the environmental crisis required clarification. By utilizing both a worry and an anxiety-related impairment scale to measure the eco-anxiety response in this study, our aim was to examine the relationships of each scale with respect to the perception of the environmental crisis and commitment to pro-environmental behaviors.

2. The present study

The relationships between the perception of environmental change, the eco-anxiety reaction and pro-environmental behaviors are indeed complex. In this study, our aim was to clarify these relationships by differentiating between worry and anxiety with impairments within the eco-anxiety reaction, using specific scales. We employed an eco-worry scale to measure worry about the environmental crisis, including climate change. Additionally, we utilized the CCAS, which has previously undergone validation with French-speaking samples, to measure impairments associated with anxiety about climate change. As both scales anticipate similar threats, we expected eco-worry and climate anxiety-related impairment scores to be correlated (Hypothesis 1). We hypothesized that the more individuals perceive the characteristics of the environmental crisis and its associated danger, the more likely they are to experience eco-worry (Hypothesis 2a) and climate anxiety-related impairments (Hypothesis 2b). Simultaneously, we expected trait anxiety to play a minor role in predicting eco-worry (Hypothesis 3a) and climate anxiety-related impairments (Hypothesis 3b), compared to other factors such as environmental crisis perception. We anticipated that both eco-worry (Hypothesis 4a) and climate anxiety with impairments (Hypothesis 4b) would partially mediate the connection between the perception of the environmental crisis and the commitment to pro-environmental behaviors.

3. Methods

3.1. Sample and procedures

The study conducted an online survey using Qualtrics® in April 2022. We presented the survey as a study on perceptions of current societal and environmental issues. We recruited the participants through French digital social networks that focused on eco-anxiety, as well as through the personal networks of the authors. We employed the snowball sampling method, encouraging participants to share the survey.

No remuneration or retribution was provided to the participants for their participation in the study. We took care of including participants who may not have had strong eco-concerns in order to obtain a diverse sample. We considered only questionnaires completed within a minimum duration of 240 s for analysis. This resulted in a final sample size of 431 participants, consisting of 119 men, 309 women, and 3 participants who chose not to answer the gender question. The participants' ages ranged from 18 to 78, with a mean age of 37.6 and a standard deviation of 14.6.

3.2. Ethics

The authors complied with the ethical principles of the declaration of Helsinki and the ethic code for researchers of the French Society of Psychology (<https://www.sfpsy.org/2020/11/03/deontologie/code-ethique-de-la-recherche-sfp-02deontologie/code-dethique-des-cherche>

urs/), as implemented in the partner universities and laboratories. Participation in the research was voluntary and written informed consent was obtained from all participants. Participants could stop the survey at any time and were provided with contact information for the authors at the beginning of the questionnaire.

3.3. Statistical procedures

We considered that our data did not violate the normality hypothesis when skewness and kurtosis coefficients of the different variables fitted within the respective range of ± 2 and ± 6 (Curran et al., 1996; Westfall & Henning, 2013).

We established a minimal sample of 290 using G*Power 3 to meet the requirements for linear multiple regression analysis. The calculation considered a small effect size of 0.05, an alpha of 0.05, a power of 0.90 and up to six predictors (e.g. three subscales of EC perception, trait anxiety, eco-worry) (Faul et al., 2007). For the mediation analysis, we determined a minimum sample size of 397 participants to achieve a power of 0.80, assuming a medium effect size of 0.39 for each path of the indirect effect and a null effect size for the direct effect (corresponding to a full mediating effect). This estimate was based on empirical estimates (Fritz & MacKinnon, 2007). An alternative estimate based on bootstrap resampling, suggested a sample size of 110 participants assuming an effect size of 0.3 for each path of the indirect effect and a null effect size of the direct effect (Steffener, 2021). Our sample size also adhered to accepted ratios of 10 cases per indicator variable, and 20 cases per estimated parameter for factor analysis. Additionally, our sample size exceeded 400, which was adequate for CFA with two indicators per factor (Kyriazos, 2018).

We conducted statistical analysis using *Jamovi* (The Jamovi project, 2021). We calculated all correlations using Spearman coefficients. Since two items of the EC perception scale violated the normality assumption, we employed a Satorra-Bentler adjustment to account for multivariate non-normality (Finney & DiStefano, 2013) for the confirmatory factor analysis (CFA) conducted on this scale. All mediation analyses were performed using bootstrapping with 1000 resamplings to estimate confidence intervals.

3.4. Measures

Table 1 provides information on the internal consistency of all measures. Except for the CCAS and STAI-Y scales, which already have validated French translations (Mougouyama-Daouda et al., 2022; Spielberg et al., 1993), the items from the remaining scales were originally formulated in French, translated into English using the DeepL translator (DeepL, GmbH), and subsequently back-translated into French to ensure accuracy.

3.4.1. Environmental crisis perception

To evaluate the perception of the environmental crisis as an actual threat, we developed a 9-item scale called the Environmental Crisis Perception Scale (EC perception scale). Participants rated each item on a 5-point scale, ranging from "strongly disagree" to "strongly agree". Of the 9 items, six focused on climate change, while the remaining three addressed environmental issues more broadly. The items aimed to evaluate beliefs pertaining to the spatial and temporal scope of the threat (e.g. "climate change will impact the whole planet"), the human-caused nature of the problem (e.g. "Human activity is the main cause of climate change"), and the perception of both relative (e.g. "climate change is dangerous for ourselves or the future generations") and high (e.g. "if we continue like this, we or future generations may not survive the environmental crisis") danger. An average EC perception score was calculated. All items of the EC perception scale exhibited significant correlation with each other ($0.26 < r < 0.72, p < .001$) (Table S1). This EC perception scale demonstrated good internal consistency, as indicated by a Cronbach's alpha score of 0.858 (Table 1). Based on the

Table 1
Descriptive statistics of the variables.

		Nb of items	M (SD)	Skewness (SD)	Kurtosis (SD)	Cronbach's α	McDonald's ω
1.	Trait anxiety	20	45.7 (10.0)	0.20 (0.12)	-0.46 (0.24)	0.91	0.91
2.	EC perception	9	4.54 (0.49)	-1.23 (0.12)	1.54 (0.24)	0.86	0.88
3.	Eco-worry	5	3.55 (0.89)	-0.48 (0.12)	-0.43 (0.24)	0.85	0.86
4.	Climate anxiety CEI	8	1.84 (0.72)	0.98 (0.12)	0.61 (0.24)	0.87	0.87
5.	Climate anxiety FI	5	1.83 (0.81)	0.97 (0.12)	0.38 (0.24)	0.85	0.86
6.	PEB commitment	2	3.66 (0.90)	-0.43 (0.12)	-0.37 (0.24)	0.74 ^a	n.a.

Note. ^aFor two-items scale, the Spearman-Brown coefficient was calculated as in Eisinga et al. (2013). n.a. means non-applicable.

different categories of beliefs investigated, the EC perception scale revealed a three-factor structure supported by Confirmatory Factor Analysis (CFA) (Kline, 2005), with a superior fit observed for the three-factor model compared to the one-factor model (Tables S2 and S3). The goodness of fit was tested using the χ^2 test, as well as the Standardized Root Mean Square Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker Lewis index (TLI). These three factors corresponded to the perceived danger of the crisis, the perceived extent of the crisis in time and space, and the perceived anthropogenic cause of the crisis. All factor loadings for the items in the scale exceeded 0.5, indicating satisfactory item-factor relationships. In the result section, we used the global EC perception score for simplicity and because we had no ground to hypothesize that the three subscales would exhibit different behaviors. Indeed, previous research found “perceived risk” and “human influence” to be strongly interconnected and combined these measures into a composite variable for analyzing predictors of pro-environmental behavior (Aitken et al., 2011). Data related to the three subscales are presented in supplementary tables.

3.4.2. Eco-worry

We developed a concise five-item Eco-Worry Scale (EWS). Participants rated all items on a 5-point scale, ranging from “not at all” to “extremely”, except for item 1 which ranged from “never” to “almost always”. These five items were designed based on existing scales, with the objective to assess the frequency (item 1) and relative intensity (item 2) of worrying thoughts related to environmental issues in general, including a specific item addressing climate change (item 3). To encompass various aspects of worry related to current environmental issues, we included two additional items reflecting apprehension about one's personal impact on the planet, as described in the HEAS (Hogg et al., 2021). An average eco-worry score was calculated. All items within the eco-worry scale exhibited significant and relatively strong correlations with each other ($r > .45, p < .001$), regardless of whether they pertained to climate change or the environmental crisis in general (Table S4). The scale demonstrated good internal consistency, as indicated by a Cronbach's alpha coefficient of 0.851 (Table 1). Exploratory factor analysis supported a one-factor structure for the scale (Table S4), with factor loadings ranging from 0.65 to 0.85 for all items.

3.4.3. Climate anxiety-related impairments

We assessed climate anxiety-related impairments using the first 13 items from the Clayton and Karazsia (2020) Climate Change Anxiety Scale (CCAS). In contrast to the eco-worry scale, which does not measure any impairment, the CCAS items address both cognitive-emotional impairments (8 items) and functional impairments (5 items). Recently, this scale was translated into French (Mouguiana-Daouda et al., 2022). However, some items (items 3, 4, 5, 7, 8) exhibited lower factor loading scores compared to the original analysis. In this study, we made slight modifications to the translation of items 4, 5 and 7 and utilized these revised items (Table S5). All responses were measured using a 5-point scale, ranging from “never” to “almost always”. The CCAS was initially found to consist of two factors: cognitive-emotional impairment and functional impairment (Clayton & Karazsia, 2020;

Mouguiana-Daouda et al., 2022). We tested the two-factor model on our sample, and it exhibited good to acceptable fit with the observed data: $\chi^2(64) = 277, p < .001$, CFI = 0.92, TLI = 0.91, SRMR = 0.045, RMSEA = 0.069 (CI90% = 0.059 – 0.078). All factor loadings exceeded 0.50 (Table S5). This was consistent with a climate anxiety scale measuring two variables: cognitive-emotional impairment (CEI) and functional impairment (FI). In line with previous findings, we observed a strong correlation between these two variables (Table 2, $r = .74; p < .001$) (Clayton & Karazsia, 2020; Mouguiana-Daouda et al., 2022).

3.4.4. Trait anxiety

We employed the 20-item Spielberger Trait Anxiety Scale (STAI-Y) to assess participants' trait anxiety (Knowles & Olatunji, 2020; Spielberger et al., 1983), more precisely its validated French translation (Bruchon-Schweitzer & Paulhan, 1990; Spielberger et al., 1993). Participants rated all items on a 4-point scale ranging from “Almost Never” to “Almost Always”. This scale includes items such as “I worry too much over something that really doesn't matter” and “I am content; I am a steady person.”

3.4.5. Pro-environmental behavioral commitment (PEB commitment)

This variable aimed to gauge an individual's commitment to pro-environmental behaviors for the purpose of mitigating climate change or addressing environmental crises, regardless of the specific behaviors undertaken. Consequently, the first item reads, ‘I take action to prevent climate change.’ Drawing from Bouman et al. (2020), who identified a strong association between the feeling of personal responsibility and pro-environmental behaviors, we introduced a second item to assess the sense of responsibility in taking action: ‘I feel personally responsible for taking action for the environment.’ A 5-point Likert scale was employed, ranging from “not at all” to “completely”, and the average score was calculated. The inter-item Spearman coefficient of correlation was 0.60.

4. Results

4.1. Eco-worry and climate anxiety-related impairments measurements

We conducted a confirmatory factor analysis to determine whether the eco-worry scale, which does not measure impairments, represents a distinct construct from CEI and FI. The results indicated a good to acceptable fit for a model where eco-worry, CEI and FI were separate factors: $\chi^2(132) = 407, p < .001$, CFI = 0.93, TLI = 0.92, SRMR = 0.045, RMSEA = 0.069 (CI90% = 0.062 – 0.077), with all factor loadings exceeding 0.50 (Table S6). This suggests that eco-worry, CEI, and FI can be considered as distinct variables.

Our findings revealed strong correlations between eco-worry and both CEI and FI ($r = .66; p < .001$ and $r = .60; p < .001$, respectively) (Table 2), supporting our first hypothesis that eco-worry and climate anxiety-related impairments are correlated, as they are part of an anxiety reaction to a similar environmental threat.

Table 2

Correlation between different variables used in the study (under diagonal) and partial correlation with eco-worry as a control variable (above diagonal).

Variables		1.	2.	3.	4.	5.	6.
1.	Trait anxiety	-	.11*	-	.17***	.19***	-.19***
2.	EC perception	.19***	-	-	-.02	-.01	-.09
3.	Eco-worry	.18***	.60***	-	-	-	-
4.	Climate anxiety CEI	.24***	.39***	.66***	-	.57***	-.00
5.	Climate anxiety FI	.26***	.35***	.60***	.74***	-	.04
6.	PEB commitment	.02	.41***	.77***	.51***	.48***	-

Note. Coefficients are Spearman. * $p < .05$ *** $p < .001$.

4.2. Eco-worry

4.2.1. Perception of the environmental crisis and trait anxiety as predictive factors of eco-worry

We identified a significant and strong positive correlation between eco-worry and the EC perception scale ($r = .60, p < .001$) (Table 2), as well as with each of the three factors of this latter scale (Table S7). This validates hypothesis H2a, that EC perception is positively correlated with eco-worry. Eco-worry and trait anxiety were also significantly, albeit weakly, correlated ($r = .18, p < .001$).

To explore the relative contributions of EC perception and trait anxiety in predicting the level of eco-worry, we conducted a multiple regression analysis. The model explained 36% of the variance ($F(428) = 122, p < .001; R^2 = .36$). Our findings revealed that EC perception significantly predicted eco-worry ($\beta = .59, p < .001$), whereas trait anxiety did not have a significant association ($\beta = .06, p = 0.102$). These results support H3a, that the association between trait anxiety and eco-worry is weaker compared to the association between environmental crisis perception and eco-worry. Similar results were obtained when considering the three underlying factors of the EC perception scale along with trait anxiety (Table S8).

4.2.2. Eco-worry and PEB commitment

We observed a strong correlation between the level of eco-worry and commitment to pro-environmental behaviors ($r = .77, p < .001$). Consistent with other findings (Bradley et al., 2020; Reser, 2012), we also found a positive correlation between perceived environmental crisis and PEB commitment ($r = .41, p < .001$) (Table 2). This correlation held true regardless of the factor of the environmental crisis perception scale (Table S7). To investigate the potential mediating role of eco-worry in the relationship between EC perception and PEB commitment, we controlled for eco-worry: the positive correlation between EC perception and PEB commitment became non-significant ($r = -.09, p = 0.051$) (Table 2 and S7). Further mediation analysis revealed that the direct path between EC perception and PEB commitment was not significant (12%, $Z = -1.72, p = 0.085$), whereas the indirect path with eco-worry as a mediator was largely predominant and significant (88%, $Z = 12.86, p < .001$) (Table S9). Similar results were obtained when considering the different factors of the EC perception scale (Table S9). These findings indicate that eco-worry acts as a mediating variable between the perception of the environmental crisis and the commitment to pro-environmental behaviors, supporting Hypothesis 4a.

In conclusion, our results demonstrate a positive relationship between EC perception and the level of eco-worry, with trait anxiety having a non-significant marginal influence. Furthermore, eco-worry strongly correlates with PEB engagement and serves as a mediating variable between EC perception and PEB engagement.

4.3. Climate anxiety-related impairments

4.3.1. Climate anxiety-related impairments and their relationship with EC perception, eco-worry and trait anxiety

Both factors of the CCAS exhibited positive and significant correlations with the EC perception scale ($r = .39, p < .001$ for CEI and $r = .35, p < .001$ for FI) (Table 2). Similarly, each factor of the EC perception

scale demonstrated a correlation in the low to medium range with CEI and FI (Table S7). These findings confirm hypothesis H2b, which posited that EC perception and CCAS factors are positively correlated. It is noteworthy that the correlation coefficients between EC perception and CCAS factors were smaller in magnitude compared to the correlation coefficient between EC perception and eco-worry (Tables 2 and S7). This pattern remained consistent for each individual item of the EC perception scale, whether it pertained to climate change or other environmental issues (Table 3). Therefore, these differences in correlation coefficients do not reflect differences related to the objects of the anxiety reaction (climate change versus other environmental issues). Instead, they signify distinct relationships between EC perception, eco-worry and CCAS factors.

To gain insight into these relationships, we assessed the relative contribution of perception of the environmental crisis, eco-worry and trait anxiety as predictors of climate-anxiety related impairments (Table 4). The multiple regression models explained 42% and 38% of the variance for CEI and FI respectively. Both eco-worry and trait anxiety significantly predicted CEI and FI, whereas EC perception did not. This finding remained consistent for each factor of the EC perception scale (Table S10). Consequently, our data demonstrate that both eco-worry and trait anxiety are predictors of climate-anxiety related impairments, with eco-worry playing a more prominent role. These findings align with Hypothesis 3b, which proposed that trait anxiety has a minor role as a predictor of climate anxiety-related impairments, compared to other predictors. However, we did not anticipate the absence of a significant contribution from EC perception. This outcome suggests that eco-worry acts as a mediating variable between EC perception and climate anxiety-related impairments. Partial correlation data support this interpretation: when controlling for eco-worry, correlation coefficients between CCAS variables and EC perception are non-significant

Table 3

Correlation of EC perception scale items with eco-worry and climate anxiety factors.

Item	Eco-worry	Climate anxiety CEI	Climate anxiety FI
If we continue like this, we or future generations may not survive the environmental crisis ¹	0.44***	0.33***	0.27***
Because of CC, the survival of the Human species is at stake ^{1, a}	0.43***	0.30***	0.20***
CC is dangerous for us or the future generations ^{1, a}	0.49***	0.34***	0.33***
If we do not act now on CC, it will be too late to turn back ^{1, a}	0.41***	0.26***	0.26***
CC is real ^{2, a}	0.45***	0.28***	0.26***
CC will impact the entire planet ^{2, a}	0.42***	0.27***	0.28***
It is urgent to act if we want to limit the extinction of species ²	0.44***	0.27***	0.24***
Human activity is the main cause of CC ^{3, a}	0.41***	0.25***	0.29***
Human activity is the main cause of pollution ³	0.37***	0.19***	0.24***

Notes. Coefficients are Spearman. ¹ Factor 1 (danger) ² Factor 2 (extent) ³ Factor 3 (human) of EC perception scale. ^a Climate change specific items of EC perception scale. *** $p < .001$

Table 4
Regression model for CCAS variables.

CEI prediction Predictor	R ²	F (3;427)	p	β	CI	t	p
	0.42	103	< .001				
Eco-worry				0.62	0.53–0.71	13.42	< .001
Trait anxiety				0.18	0.10–0.25	4.67	< .001
EC perception				-0.04	-0.13 – 0.05	-0.95	0.340
FI prediction Predictor	R ²	F (3;427)	p	β	CI	t	p
	0.38	86.2	< .001				
Eco-worry				0.55	0.46–0.65	11.54	< .001
Trait anxiety				0.22	0.14–0.29	5.55	< .001
EC perception				-0.02	-0.12 – 0.07	-0.52	0.603

Note. β are standardized estimates.

($r = -.02$, $p = 0.718$ for CEI and $r = -.01$, $p = 0.774$ for FI) (Tables 2 and S7). Mediation analysis further confirms that the direct path between EC perception and climate CEI is not significant (5%, $Z = -0.48$, $p = 0.632$), while the indirect path with eco-worry as a mediator is predominant and significant (95%, $Z = 10.31$, $p < 0.001$) (Table S11). The same pattern is observed for climate FI (indirect path: 99%, $Z = 9.33$, $p < 0.001$) (Table S11). Also, similar results are obtained for each EC perception factor (Table S11). These results indicate that eco-worry mediates the relationship between EC perception and climate anxiety-related impairments.

In conclusion, climate anxiety-related impairments are predicted by eco-worry and, to a lesser extent, by trait anxiety, but not by perception of the environmental crisis. Eco-worry appears to be a mediating variable between perception of the environmental crisis and climate anxiety-related impairments.

4.3.2. Climate anxiety-related impairments and PEB commitment

We found a positive correlation between each factor of the CCAS and PEB commitment (CEI: $r = .51$, $p < .001$ and FI: $r = .48$, $p < .001$) (Table 2). We assessed the relative contribution of eco-worry and each climate anxiety impairment factor to PEB commitment through multiple regression analysis. The model explained 61% of the variance ($F(3;427) = 221$, $p < .001$; $R^2 = .61$). Our findings revealed that eco-worry significantly predicted PEB commitment ($\beta = .77$, $p < .001$), whereas CEI and FI did not exhibit a significant association (CEI: $\beta = -.03$, $p = 0.715$; FI: $\beta = .04$, $p = 0.495$).

These findings indicate that the observed association between climate anxiety-related impairment scores and PEB commitment is primarily driven by the link between eco-worry and each of these variables. Thus, the aspect of the eco-anxiety reaction related to PEB commitment is predominantly eco-worry, with minimal direct contribution from the climate anxiety reaction associated with unsettling symptoms. In conclusion, our results do not support hypothesis H4b, which suggested that climate anxiety reaction with impairments partly mediates the relationship between perception of the environmental crisis and PEB commitment.

5. Discussion

Our objective was to gain a deeper understanding of the relationships between EC perception, trait anxiety, eco-worry, CCAS impairment variables and PEB engagement.

Our findings revealed that eco-worry is a distinct variable separate from the two impairment variables within the CCAS. Moreover, eco-worry emerges as a mediating factor between EC perception and these impairments. Additionally, we observed a robust association between eco-worry and PEB engagement, with no additional contribution from the CCAS impairment variables. On the other hand, trait anxiety was found to be linked to the CCAS impairment variables but not to eco-

worry.

5.1. Measurements of eco-anxiety reactions

We evaluated anxiety reactions to environmental crisis and climate change using two distinct scales. The first scale, as previously described, was the CCAS (Clayton & Karazsia, 2020), which has been recently utilized in samples from various countries, including a French sample (Heeren et al., 2022; Larionow et al., 2022, 2022; Mouguiama-Daouda et al., 2022; Reyes et al., 2023; Tam et al., 2023; Whitmarsh et al., 2022; Wullenkord et al., 2021). The second scale was a concise eco-worry scale, designed to address concern about environmental issues in general, with one item specifically dedicated to climate change. This scale measured not only worry about the impact of the environmental crisis on oneself, but also worry about one's personal impact on the Earth, similar to specific items of the HEAS (Hogg et al., 2021). This eco-worry scale focused exclusively on concern and worry, intentionally excluding various emotions like anger, sadness or frustration, which are occasionally included in other scales (Kurth & Pihkala, 2022). This focus on worry may explain why this eco-worry scale primarily identified a single factor, as determined by EFA. Given its emphasis on worry, and the absence of a specific focus on climate change, this scale may prove valuable for future research exploring the relationship between worry and other emotions associated with environmental issues, such as grief over the loss of natural habitats or biodiversity.

In our study, we established that the eco-worry scale effectively measured a distinct variable separate from the two impairments variables of the CCAS. Moreover, it emerged as a strong predictor of these two impairment variables. These findings support the existence of different constructs underlying the eco-anxiety response. In line with this, the authors of a recent eco-anxiety questionnaire also distinguished between habitual ecological worry and negative consequences of eco-anxiety, which behaved as separate constructs (Agoston et al., 2022). Interestingly, even though this questionnaire contained a mix of items addressing either the environmental issues in general or climate change more specifically, factor analysis did not identify factors based on the object of concern (the environment or climate change), but found factors corresponding to worry and impairments, regardless of the specific object of concern. This further strengthens the presence of a worry variable and at least an impairment variable within the eco-anxiety reaction, which may be measured indifferently by considering environmental issues or climate change.

These outcomes prompt us to consider whether the terms “eco-anxiety” and “climate anxiety” should encompass all dimensions of the anxiety response, including non-pathological worry, or if they should be reserved exclusively for more severe anxiety symptoms such as rumination or behavioral impairments (Coffey et al., 2021; Pihkala, 2020). Given that recent eco-anxiety scales (Clayton & Karazsia, 2020; Hogg et al., 2021) predominantly focus on negative and intense anxiety

symptoms, we believe it is important to consider eco-worry as a distinct construct, based on our findings.

5.2. Eco-worry as an intermediate reaction between EC perception and climate anxiety-related impairments, and the impact of trait anxiety

When examining the correlation between eco-anxiety scales and the belief in climate change, previous studies reported low correlations with the CCAS and HEAS (Hogg et al., 2021; Lutz et al., 2023; Tam et al., 2023). This unexpected finding suggests that eco-anxiety might be more reflective of an inherent predisposition to experience anxiety or depression, regardless of the specific object of the anxiety reaction, rather than being solely a response to the threat of climate change or other environmental issues. However, the notion of eco-anxiety as a dimension of pre-existing anxiety tendencies is not widely supported among scholars and remains an open question (e.g. Crandon et al., 2022; Pihkala, 2020; Taylor, 2020). Moreover, the available data regarding correlations with existing anxiety disorders scales are inconsistent and vary from low to medium-sized correlations (Clayton & Karazsia, 2020; Hogg et al., 2021; Innocenti et al., 2021; Schwartz et al., 2022; Wullenkord et al., 2021). In contrast, the prevailing view considers eco-anxiety as a reaction of individuals who not only believe in climate change and/or the existence of an environmental crisis, but also have a more accurate perception of its consequences (e.g. Ojala et al., 2021; Pihkala, 2020; Whitmarsh et al., 2022). In our study, the measurement of “trait anxiety” and “perception of the environmental crisis” allowed us to distinguish between these perspectives.

The nine items of the EC perception scale did not show a stronger correlation with CCAS scores compared to eco-worry scores, even when assessing high levels of threat. A recent study by Lutz et al. (2023), which used various eco- or climate-worry scales in conjunction with the CCAS, reported a similar difference in the degree of correlation with the belief in climate change. These findings suggest that the observed pattern is not unique to the specific eco-worry scale employed in our study. In our investigation, applying partial correlation and mediation analyses revealed that eco-worry played a mediating role between EC perception and impairments measured by the CCAS. This outcome underscores the significance of incorporating the construct of worry within the eco-anxiety reaction for a better understanding of the relationships with other variables. Furthermore, it reinforces the notion that these relationships persist consistently, within the frame of the environmental crisis, even when the objects of concern are not entirely identical. As a prospective direction, gaining a more comprehensive understanding of the relationships between crisis perception, eco-worry, and eco-anxiety-related impairments could benefit from considering additional aspects of crisis perception such as the psychological distance to climate change (Maiella et al., 2020) and the perception of interconnectedness of different risk factors (Ballew et al., 2019). Additionally, distinguishing between micro-worry (concern for oneself concerning the environmental crisis) and macro-worry (concern for the planet, animals, other individuals, and future generations) as suggested by Wullenkord and Ojala (2023) could yield valuable insights.

Importantly, the lack of contribution of trait anxiety to eco-worry in addition to EC perception, as well as its minor contribution to CCAS variables alongside eco-worry, suggests that the eco-anxiety response is not primarily driven by an internal predisposition to experience anxiety or a pre-existing anxiety disorder. However, the significant relationship with one construct of the eco-anxiety reaction but not the other highlights the distinction between these entities and raises further questions about their specific correlates.

5.3. Constructiveness of the eco-anxiety response in terms of PEB engagement

Numerous studies have discussed the constructiveness of the eco-anxiety response, considering both PEB engagement and individual

well-being (Brosch, 2021; Ojala, 2022; Ojala et al., 2021; Pihkala, 2020; Stanley et al., 2021). While previous research consistently demonstrates a correlation between eco- or climate worry and PEB commitment (e.g. Ágoston et al., 2022; Bouman et al., 2020; Helm et al., 2018; Lutz et al., 2023; Reser, 2012; Verplanken et al., 2020; Whitmarsh et al., 2022), studies focusing on distressing symptoms of climate or eco-anxiety have yielded mixed results. Some studies report no positive correlation (Clayton & Karazsia, 2020), while others find a negative (Stanley et al., 2021) or significant positive correlation (Innocenti et al., 2021; Lutz et al., 2023; Mouguiama-Daouda et al., 2022; Wullenkord et al., 2021). Interestingly, the work by Heeren et al. (2022) found that individuals with lower anxiety scores, according to the CCAS, exhibited significantly higher correlation with pro-environmental behaviors than those with higher scores, raising questions about the adaptive function of severe climate anxiety reactions. We found a stronger correlation between PEB engagement and eco-worry compared to CCAS scores. Similar findings were observed in another study that examined different eco-worry variables, the CCAS and pro-environmental consumption behaviors (Lutz et al., 2023). These consistent results across scales suggest that the stronger correlation between PEB and eco-worry is not specific to our study. Our regression analyses further revealed that PEB commitment is primarily associated with eco-worry, with no significant additional contribution from climate anxiety reaction with impairments. Overall, our findings suggest that the eco-worry stage of the climate anxiety reaction is linked to adaptive or constructive aspects, particularly in terms of PEB commitment. However, it is important to note that our study only focused on PEB commitment and did not explore a variety of pro-environmental actions.

The relationship between eco-anxiety and pro-environmental behaviors may vary depending on the specific actions considered, in particular when distinguishing between individual and collective behaviors, including activism. A study by Whitmarsh et al. (2022) found that higher levels of climate anxiety, as measured by the CCAS, predicted certain pro-environmental behaviors that require effort and challenge the consumption-based society. These behaviors included activities such as encouraging energy-saving, buying second-hand items, borrowing or renting items, and repurposing items. However, the level of CCAS climate anxiety did not appear to influence behaviors like buying products with less packaging or reducing food waste. Another study by Ágoston et al. (2022), using their own scales to measure eco-anxiety, found that sorting trash for recycling had a stronger correlation with the eco-anxiety factor corresponding to habitual ecological worry, while using second-hand clothes and consuming dairy products or eggs had a stronger correlation with the eco-anxiety factor associated to impairments. These findings suggest that the types of pro-environmental behaviors may differ based on the level of eco-anxiety. When considering collective actions and activism, a study by Lutz et al. (2023) observed lower correlation levels between collective behaviors and CCAS scores compared to eco-worry scores, similar to pro-environmental consumption behaviors. A recent study found differences in the level of correlation between CCAS climate anxiety and various PEB like sustainable diet, climate activism or resource conservation (Tam et al., 2023). Further research that explores a wider range of pro-environmental behaviors would provide valuable insights into potential differences across the various facets of the eco-anxiety reaction.

5.4. Limitations of the study

While this study makes significant contributions to the existing literature, it is important to acknowledge several limitations. Firstly, we cannot draw conclusions that are representative for the entire French population, as this would have required a random sampling procedure representative of this population. Secondly, caution is warranted when attempting to generalize our current findings to other contexts. Different cultures exhibit diverse emotional responses to the environmental crisis (Kleres & Wettergren, 2017). Therefore, it is possible that our

conclusions hold true primarily for French, European, or industrialized Western nations. Thirdly, the cross-sectional nature of our data limits the interpretation in terms of causality or directionality. For instance, it is conceivable that individuals experiencing eco-worry are more prone to perceive the dangers associated with climate change. Similarly, engaging in pro-environmental behaviors might lead to increased worry when one encounters the limitations of such actions (Ojala, 2022). Fourthly, it is worth mentioning that the scale for pro-environmental behavioral engagement is constructed with only two items. Despite these limitations, the current study provides an important step towards understanding the relationships between eco-worry, climate anxiety-related impairments, and the commitment to pro-environmental behaviors.

5.5. Conclusion

Our systematic exploration of the relationships between variables associated with the eco-anxiety reaction, namely eco-worry and climate anxiety-related impairments, along with EC perception and PEB commitment, has revealed the central role of eco-worry in relation to these variables. These findings align with theories emphasizing the significance of emotions in addressing the environmental situation. Additionally, our study provides a framework that can be further examined using different samples and methodologies. This framework holds promise for gaining a deeper understanding of the adaptive and constructive nature of the different eco-anxiety variables.

Declaration of Competing Interest

The authors declare no conflict of interest.

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Statement

During the preparation of this work the authors used ChatGPT (GPT3.5) in order to improve the language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.janxdis.2023.102799](https://doi.org/10.1016/j.janxdis.2023.102799).

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