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Testing the properties of the Eco-Anxiety questionnaire (EAQ) for exploring eco-anxiety phenomenon

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Abstract

Introduction. Eco-anxiety has gained attention in recent years. While anxiety is typically viewed as a disorder, eco-anxiety may also be seen as a rational response to environmental threats, potentially driving pro-environmental behavior. The present study aimed to develop and validate a new brief tool, the Eco-Anxiety Questionnaire (EAQ), to assess psychological symptoms, intrusive thoughts, and a sense of responsibility associated with eco-anxiety.

Methods. An online survey collected data from 228 Italian adults (Mean age= 31.29, SD = 13.71; age range: 18–60; 77% women). The EAQ was developed from an initial pool of 50 items and refined through Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to a final set of 25 items across three factors, rated on a 5-point Likert scale. Convergent validity was assessed with measures of climate change anxiety, climate change worry, generalized anxiety, and depressive symptoms.

Results. EFA supported a three-factor structure explaining 62% of the variance, with good sampling adequacy (Bartlett's test $p < .001$). The EAQ showed excellent internal reliability ($\alpha = .95$ for the total scale; $\alpha = .89$–$.94$ for subscales). CFA confirmed the model's adequacy (CFI = .966; TLI = .963; NFI = .95; GFI = .969; IFI = .97; SRMR = .07; RMSEA = .09). Strong correlations emerged with the Climate Change Anxiety Scale and the Climate Change Worry Scale, while moderate associations with GAD-7 and PHQ-9 confirmed the distinctiveness of eco-anxiety from general distress.

Conclusions. The EAQ demonstrates strong psychometric properties and offers a multidimensional assessment of eco-anxiety. Its brevity and conceptual breadth represent key strengths. However, the study's non-representative and relatively young sample limits generalizability. Future research should validate the tool in broader populations and explore its predictive value for behavioral and psychological outcomes.

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1. Introduction

The negative impact of the industrial revolution on multiple aspects of human life, including environmental health, has been highlighted over the years. Recently, due to the alarming data from scientists about the brief and long-term consequences of human activities on the earth's health and human survival, there has been a notable increase in attention from both the worldwide population and institutions. The same alarming data impacts cognitive representations of environmental crises and the mental representation of climate change. When considered in conjunction with personological dimensions, these representations are one of the main causes of eco-anxiety (Manning & Clayton, 2018). The term "eco-anxiety", coined by Albrecht in 2011, is a complex construct that can be simplified as the fear of environmental doom (Albrecht, 2011). However, despite its recognition as a condition rooted in general anxiety with similarities in symptoms and related distress, it appears to be a rational consequence of the concern about human and environmental survival, and its current theoretical framework does not consider it a mental illness (Hickman, 2020). From an evolutionary perspective, anxiety serves to alert the organism to potential danger and to enhance its detection of the surrounding environment, facilitating the acquisition of information about potential risks and solutions. Anxiety is closely associated with the fear emotion and emerges in situations perceived as threatening and uncertain. As suggested by Hickman et al. (2020), anxiety may serve as a natural consequence and an adaptive mechanism in response to ecological problems and climate crises, potentially facilitating proactive behavior aimed at saving the planet. Although this positive perspective of eco-anxiety as a possible starting point for adaptive change addressed to the welfare of the planet, the authors admit that the uncertainty that characterizes the climate crisis is complex and lacks a clear solution. This limit may lead to exacerbation of anxiety to a degree that is maladaptive and can easily become too intense and even overwhelming (Hickman, 2020). The causes and triggers of eco-anxiety are similar to those of other anxiety disorders. They range from direct exposure to traumatic events, such as extreme weather conditions caused directly or indirectly by human pollution, to the potential impact of human activities on the environment. This includes risks such as land loss and water scarcity (Pihkala, 2020). Despite the shared characteristics of eco-anxiety with anxiety disorders is not currently included in the diagnostic manuals for mental health disorders (Wang et al., 2023). However, as suggested by Hrabok et al. (2020), the psychological impacts of extreme environmental events may be placed on a continuum from mild impaired reactions to posttraumatic stress disorder symptomatology (Lutz et al., 2023). In the context of psychology, a recent systematic review (Boluda-Verdu et al., 2022) has indicated that eco-anxiety would is associated with a range of emotional states, including worry, fear, anger, grief, guilt, and shame. This finding suggests that eco-anxiety is a

complex construct that is intertwined with multiple psychological dimensions (e.g., Pinto & Grove-White, 2020; Strife, 2012).

Recently, a large meta-analysis synthesizing data from over 170,000 participants in 27 countries confirmed that climate change anxiety has increased significantly in the past decade and is particularly prevalent among young adults, women, individuals with strong environmental values, and those exposed to climate-related information (Kühner et al., 2025). The same meta-analysis identified key antecedents of eco-anxiety, including neuroticism, sociopolitical orientation, perceived scientific consensus, and climate-related beliefs, as well as consequences such as reductions in wellbeing, increases in psychological strain, and higher engagement in pro-environmental behaviors. These findings illustrate that eco-anxiety is shaped by multiple psychological, sociocultural, and informational variables. Parallel evidence emphasizes that eco-anxiety is not a unitary phenomenon. Recent work demonstrates that its components, such as affective symptoms, behavioral impairment, rumination, and perceived personal responsibility, are differently related to wellbeing and environmental action (Hogg et al., 2024). Affective and behavioral symptoms tend to predict poorer mental health, whereas rumination and personal impact anxiety more strongly predict pro-environmental behaviors (Cosh et al., 2024). Such results reinforce the need for multidimensional assessment tools sensitive to the heterogeneity of climate-related distress.

To gain a deeper understanding of the construct within the research field, it is essential to develop an appropriate measurement tool that considers the construct in a range from healthy to pathological. Measurement should also consider other related yet distinct constructs, such as eco-anger and eco-depression in adults (Stanley & Williamson, 2021). Based on these premises, different tools were developed to assess the preliminary features of eco-anxiety. For example, the Hogg Eco-Anxiety Scale (Hogg et al., 2021), which has been validated in different contexts (e.g., Rocchi et al., 2023), allows for the assessment of dimensions such as affective symptoms, rumination, behavioral symptoms, and anxiety about personal impact on the environment via 13 items. Furthermore, the Climate Change Anxiety Scale (CCAS; Clayton & Karazsia, 2020; Innocenti et al., 2021) has been demonstrated to be a reliable instrument for evaluating four factors of climate change anxiety: cognitive-emotional impairment, functional impairment, experience of climate change, and behavioral engagement. Accordingly, we want to contribute to this theme by providing a new brief tool for the evaluation of different components of eco-anxiety, including both environmental pollution and climate change. Our approach goes beyond the mere assessment of worry and the intrusiveness of contents causing anxiety. Instead, we focus on the individual's sense of responsibility and the psychological characteristics of the experience.

The present study aims to develop and validate the Eco-Anxiety Questionnaire (EAQ) in an Italian adult sample, evaluating its factorial structure, internal reliability, and convergent and discriminant validity with established measures of climate anxiety, worry, general anxiety, and depressive symptoms. Specifically, we hypothesized that the EAQ would reflect a factorial organization coherent with the main characteristics of eco-anxiety (e.g., psychological symptoms, intrusive thoughts) with good internal consistency and satisfactory fit indices. Also, moderate-to-strong positive correlations with climate-specific measures to support the convergent validity were expected, considering previous validated scales such as the CCAS.

2. Method

2.1 Participants

An online survey collected data from 228 Italian participants aged 18 or over (mean age= 31.29; std.dev= 13.71; age range: 18-60; 77% women). Recruitment occurred online, and the final sample corresponds to all respondents who completed the survey. As shown in Table 1, the sample was predominantly female and young, with a wide distribution of educational levels and occupational categories.

Table 1

Characteristics of the sample

	n (%)
Gender	
Men	52 (23)
Woman	176 (77)
Other (not specified, not binary, other self-reported gender)	0 (0)
Education	
Post-Doc	17 (7)
Master's Degree	32 (14)
Bachelor's degree	58 (25)
High School	112 (49)
Middle School	9 (5)
Number of Inhabitants in own city	
< 10.000	41 (18)
Between 10.000 and 100.000	49 (22)
> 100.000	48 (21)
> 1.000.000	90 (39)
Occupation	
Student	120 (53)
Employed	76 (33)
Unemployed	11 (5)
Self-Employed	21 (9)
income bracket (x Year)	
< 15.000 €	80 (35)

15.000-28.000	75 (33)
28.000-50.000	53 (23)
50.000-75.000	9 (4)
> 75.000	11 (5)
In your work you deal with environmental issues?	
Yes	108 (47)
No	120 (53)
Ecological Habits	
Purchase of biological products	
Never	17 (8)
Rarely	30 (13)
Sometimes	98 (43)
Often	71 (31)
Always	12 (5)
Purchase of eco-friendly products	
Never	10 (4)
Rarely	25 (11)
Sometimes	88 (39)
Often	92 (40)
Always	13 (6)

2.2 Measures

Demographic Data: A brief demographic survey collected information concerning the respondents' age, gender, level of education, occupational status, socio-economic status, and place of residence. Moreover, information on lifestyle habits linked to ecological issues (i.e., dealing with environmental concerns in the workplace and purchasing eco-friendly and biological products) was collected.

Beliefs on ecological issues: To explore the respondents' thought on ecological and climate issues, seven ad hoc questions were included in the explorative study. These questions focused on how individuals perceive their influence on climate change and potential avenues for improvement (see Table 7 in the Results section). Respondents were required to indicate their level of agreement with each sentence on a scale from 1 to 10.

Eco Anxiety Questionnaire (EAQ): The EAQ was constructed from an initial pool of 50 items, which were created ad hoc according to the existing literature on eco-anxiety. Existing tools for evaluating eco-anxiety at the national and international levels were consulted, including the Hogg Eco-Anxiety Scale (Hogg et al., 2021), the Climate Change Anxiety Scale (Clayton & Karazsia, 2020), and the Climate Change Worry Scale (CCWS; Stewart, 2021). According to the aim of achieving a brief but comprehensive instrument for defining the core characteristics of eco-anxiety, a preliminary focus group selected the most suitable items. This focus group consisted of psychologists and therapists with expertise in psychopathological and anxiety disorders. The items were analyzed and selected according to their potential to more accurately

define behavioral and psychological characteristics associated with eco-anxiety. This process aimed to differentiate eco-anxiety from a general anxiety disorder. The final version of the questionnaire designed to assess eco-anxiety comprises 34 items presented on a 5-point Likert scale, ranging from 0 (never) to 4 (always). This version was subjected to an exploratory factor analysis (EFA) and a confirmatory factor analysis (CFA) to yield a final version of the EAQ comprising 25 items that assess three interdependent factors (psychological symptoms, intrusive thoughts, and sense of responsibility). The final version of the EAQ is reported in Supplement A. The internal reliability coefficients obtained in the present study were excellent (α = .94 for Psychological Symptoms, α = .89 for Intrusive Thoughts, α = .92 for Sense of Responsibility, α = .95 for the total score).

Climate Change Anxiety Scale (CCAS; Clayton & Karazsia, 2020. Italian version: Innocenti et al., 2021): developed to assess climate-change–related anxiety. In the original validation, the authors tested a 22-item version and identified a four-factor structure (Cognitive–Emotional Impairment, Functional Impairment, Behavioral Engagement, and Experience of Climate Change) with an internal reliability for the original subscales ranged from α = .81 to α = .97, and adequate CFA fit indices (CFI = .93; TLI = .92; RMSEA = .07). Further studies reported 13 items and two factors version of the CCAS, maintaining Cognitive Impairment and Functional Impairment. For the present study, we employed the Italian validated version of the 13-item CCAS supporting the two-factor structure and reporting a good internal consistency (*a = .78* for Cognitive Impairment; *a = .73* for Functional Impairment). The CCAS was utilized to assess convergent validity. In the current sample, internal reliability coefficients were α = 0.81 for Cognitive Impairment and α = 0.80 for Functional Impairment.

Climate Change Worry Scale (CCWS; Stewart, 2021. Italian version: Innocenti et al., 2022): A 10-item measure that was adopted to capture psychological responses (i.e., fear, anxiety, depression, and trauma) related to worry about climate change via a 5-point scale, ranging from "never" to "almost always". The original validation consisted of three studies, supporting a unidimensional factor structure for the 10-item scale. EFA showed excellent sampling adequacy (KMO = 0.95) and strong evidence of unidimensionality (ECV = 0.926; UniCo = 0.994) with a single factor explaining 73.6% of the variance. CFA indicated good model fit (CFI = 0.99; NNFI = 0.97; SRMR = 0.052), and internal reliability was excellent (α = .95; ω = .95). In the Italian validation, Exploratory and Confirmatory Factor Analyses supported a single-factor structure. Two items (Items 6 and 7) were removed due to inadequate factor loadings (< .70), resulting in an 8-item unidimensional version with excellent internal consistency (α = .975) and good model fit (SRMR = 0.06; CFI = 0.91). In our study, the Italian 8-item CCWS was

administered using a 5-point Likert scale (1 = Never to 5 = Always). Internal reliability in the present sample was $\alpha = 0.95$.

Generalized Anxiety Symptoms (GAD; Spitzer et al., 2006. Italian version: Bolgeo et al., 2023): A 7-item self-report questionnaire was utilized to assess generalized anxiety symptoms over the past two weeks. The questionnaire employed a 4-point Likert scale, ranging from 0 (never) to 3 (nearly every day) to quantify the frequency of generalized anxiety symptoms. The total score ranges from 0 to 21, with higher scores indicating more severe functional impairments because of anxiety. Reliability of the scale in our sample was $\alpha = 0.82$.

Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001. Italian version: Mazzotti et al. 2003): A self-administered screening tool for the assessment of depressive symptoms severity via 9 items over the immediately preceding two weeks. Each item of the PHQ-9 was scored on a Likert scale, ranging from 0 to 3 (0 = not at all; 1 = several days; 2 = more than a week; 3 = nearly every day). Reliability of the scale in our sample was $\alpha = 0.84$.

2.3 Procedure

This study employed a cross-sectional observational design. The study was conducted according to the Declaration of Helsinki and was approved by the Ethics Committee for Transdisciplinary Research of "Sapienza" University of Rome (protocol number: CERT_18F7CBDA3E9; date of approval 27/06/2024). Participants were recruited through an online cross-sectional survey disseminated via social media platforms (Facebook, Twitter, Instagram, Telegram) during the recruitment period of June to July 2024. At the beginning of the survey, informed consent was requested. The survey included the demographic questionnaire, items of the EAQ, and standardized questionnaires aimed to assess convergent validity and general psychological state. The time to complete the survey was approximately 20 min. No personal information that could be used to identify participants was collected, thus ensuring anonymity. All individuals who accessed the survey provided informed consent and completed the full protocol. No withdrawals, partial responses, or refusals were recorded. Therefore, the final sample corresponds to the total number of respondents (N = 228).

2.4 Data Analysis

Descriptive statistics were calculated for the overall sample and age groups, including means and standard deviations of numerical variables and frequency and percentage of categorical variables. Then, to explore the factorial structure of the questionnaire, exploratory factor analysis (EFA) was applied, considering Bartlett's Test of Sphericity and the Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy to assess the model of the scale. The Maximum likelihood (ML) was selected as the factor extraction method; eigenvalues greater than 1 and the

Kaiser criterion were checked for agreement. Moreover, confirmatory factor analysis (CFA) was conducted. The maximum likelihood (ML) estimation was also employed in CFA. The goodness-of-fit was assessed using a series of statistical indices, including the chi-square, comparative fit index (CFI), Tucker Lewis index (TLI), goodness of fit index (GFI), the incremental fit index (IFI), root mean square error of approximation (RMSEA), standardized root means square residual (SRMR), and normed fit index (NFI). The cut-off criteria for the fit indices were based on Kline's suggestions (Kline, 2013). The model was deemed to have an adequate fit when the following cut-offs were met: 0.90 for the CFI, IFI, and TLI, 0.95 for GFI, 0.08 for the RMSEA, and 0.08 for the SRMR. The reliability of the scale was calculated using Cronbach's alpha coefficient. The concurrent validity of the scales was explored by a series of two-tailed Pearson linear correlations. To analyze convergent validity, CCAS and CCWS were included in correlational analyses. Jasp and the open-source software R were used to perform statistical analyses in the current study.

3. Results

3.1 Evaluation of items

An initial evaluation of the items yielded the selection of only the most appropriate items in terms of validity and reliability. Consequently, 8 items were removed due to poor alpha reliability. The final scale for EFA resulted in 26 items. Cronbach's alpha of the final items included in the questionnaire reported good unidimensional reliability (alpha = 0.95; 95%CI: 0.94–0.96).

3.2 EFA

The EFA yielded a three factors structure of EAQ, consistent with the scree plot (Figure 1) and confirmed by the goodness of the KMO and Bartlett indices (Bartlett test < 0.001; RMSEA= 0.09; RLI= 0.87; CFI= 0.90). Table 2 reported the factorial structure and EFA factor loading of each item, supporting the hypothesized three-factor structure, with all retained items loading strongly on their respective components. One item with a low factor loading was removed from the original 26 items. As a result of the content analysis, each factor was found to be associated with a specific component of the eco-anxiety construct. The first factor, labeled "Psychological Symptoms" consisted of items measuring the presence of psychological distress. The second factor, "Intrusive Thoughts", assessed the frequency of unwanted, repetitive thoughts. The third factor, "Sense of responsibility" evaluated the extent to which individuals felt a sense of accountability for their actions.

Figure 1

Scree plot of the EFA

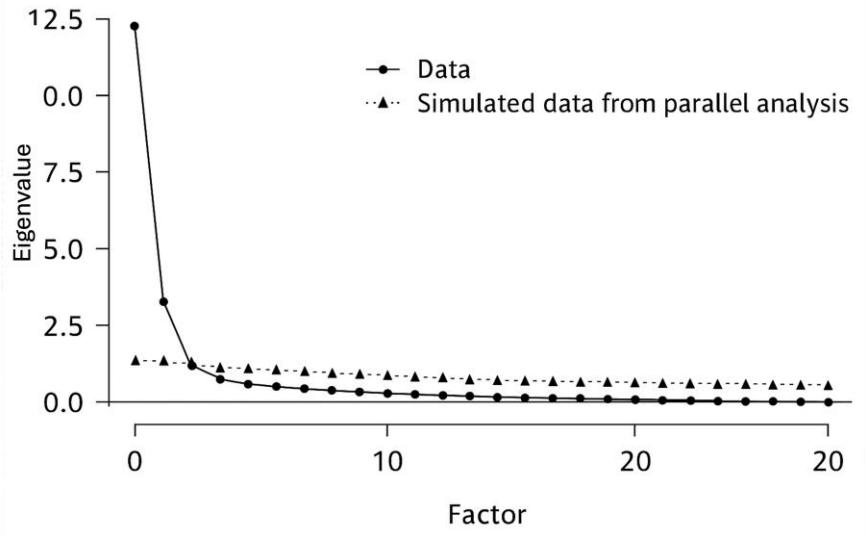


Table 2

Final factor loadings from EFA of the 25-item EAQ

	Factor 1: Psychological Symptoms	Factor 2: Intrusive Thoughts	Factor 3: Sense of Responsibility
Cumulative Proportion Variance with Rotated Solution	0.24	0.48	0.62
Item 1		0.47	
Item 2		0.55	
Item 3		0.59	
Item 4		0.89	
Item 5		0.70	
Item 6		0.90	
Item 7	0.55		
Item 8	0.92		
Item 9	0.86		
Item 10	0.93		
Item 11	0.92		
Item 12	0.87		
Item 13			
Item 14	0.76		
Item 15			0.49
Item 16			0.83
Item 17			0.72

Item 18		0.70
Item 19		0.72
Item 20	0.60	
Item 21		0.76
Item 22		0.79
Item 23		0.76
Item 24	0.58	
Item 25		0.66
Item 26		0.65

* Items of the questionnaire are reported in supplement A

3.3. Reliability

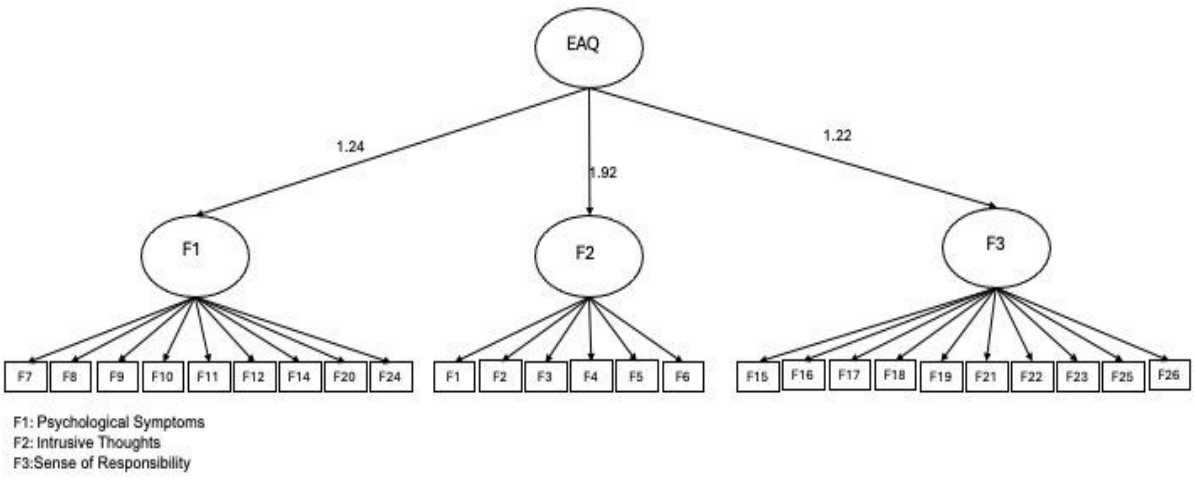
Good reliability for each factor was reported: Psychological Symptoms (N of items: 9; alfa= 0.94; 95% CI: 0.93-0.95); Intrusive Thoughts (N of items: 6; alfa= 0.89; 95% CI: 0.87-0.91), Sense of responsibility (N of items: 10; alfa= 0.92; 95% CI: 0.91-0.94).

3.4. CFA

CFA on the three-factor structure of the EAQ showed good model fit (CFI= 0.966; TLI= 0.963; NFI= 0.95; GFI= 0.969; IFI= 0.97; SRMR= 0.07; RMSEA= 0.09; see Figure 2). Factor analysis suggests that Eco-Anxiety comprises affective symptoms, rumination, behavioral symptoms, and anxiety. Moreover, a second-order model was suggested by both similar reliable fit-indices reported by a monofactorial CFA and by the high correlational indices between the subscales (all r >0.50; all p< 0.001, see Table 3). As shown in figure 2 all fit indices reached acceptable or good values, confirming the adequacy of the three-factor measurement model.

Figure 2

Model of EAQ



3.5. Convergent Validity of the EAQ

EAQ showed higher convergent validity with both CCAS and CCWS (all r > 0.49). Moreover, a positive but lower correlation was found with GAD-7 (r= 0.27), suggesting a general association with anxiety symptomatology that reinforces the nature of the eco-anxiety construct. The correlation matrix is shown in Table 3, illustrating the correlations among the constructs and showing strong associations between eco-anxiety and climate-related emotional measures, and moderate associations with general anxiety and depressive symptoms. Specifically, the linear correlations between EAQ and climate change beliefs, as reported by the respondents, demonstrated a significant association between the climatic change beliefs and the scales of Intrusive thoughts and Sense of Responsibility. However, no association emerged between the climatic change beliefs and psychological symptoms.

Table 3

Correlation between EAQ and other constructs

	Psychological Symptoms	Intrusive thoughts	Sense of responsibility	Global Score of EAQ	Generalized anxiety (GAD-7)	Psychopathological condition (PHQ-9)	Climate Change Anxiety (CCAS)
Intrusive thoughts	0.58 ***	—					
Sense of responsibility	0.50 ***	0.66 ***	—				
Global Score of EAQ	0.79 ***	0.89 ***	0.87 ***	—			
Generalized anxiety (GAD-7)	0.21 **	0.27 ***	0.21 **	0.27 ***	—		
Psychopathological condition (PHQ-9)	0.19 **	0.17 **	0.11	0.18 **	0.74 ***	—	
Climate Change Anxiety (CCAS)	0.56 ***	0.41 ***	0.33 ***	0.49 ***	0.61 ***	0.78 ***	—
Climate Change Worry (CCWS)	0.53 ***	0.63 ***	0.64 ***	0.71 ***	0.30 ***	0.26 ***	0.58 ***

Table 4

Correlation between EAQ subscales and climatic change beliefs

	Psychological symptoms	Intrusive thoughts	Sense of responsibility
Beliefs on climate change			
1.How real do you think climate change is?	0.02	0.37 ***	0.07
2.How much do you believe current climate change has been caused by human action?	0.07	0.43 ***	0.43 ***
3.How much do you believe that human action has the power to influence climate change?	0.05	0.39 ***	0.40 ***
4.How much do you believe human behavior has the power to cause climate change?	0.03	0.39 ***	0.39 ***
5.How much do you think future generations will be affected by climate change?	0.05	0.40 ***	0.39 ***
6.How true do you think the information on climate change provided by the media is?	0.10	0.30 ***	0.32 ***
7.How reversible do you think climate change is?	0.08	0.24 ***	0.22 ***

*p< 0.05; **p< 0.01; ***p< 0.001

3.6. Characteristics of the EAQ subscales

Each subscale's score was calculated considering the sum of the scores of the items converging in each factor (see Table 5). The global EAQ score was the sum of the scores of the three subscales. Seventeen percent of the overall sample (40/228) reported a global score over 1 standard deviation from the average of the sample, and 4 percent (8/228) reported a score over 2 standard deviations.

Table 5

Mean and standard deviation of EAQ and other questionnaire scores

	Means (Standard Deviation)
EAQ	
Psychological symptoms	6.28 (8.37)
Intrusive thoughts	13.53 (6.98)
Sense of responsibility	24.88 (12.32)
Total Score EAQ	44.67 (23.58)
GAD-7	8.73 (5.28)
PHQ-9	7.93 (5.81)
CCAS	12.61 (10.79)

CCSW	13.63(8.68)
Belief on climate change	
1.How real do you think climate change is?	8.26 (2.81)
2.How much do you believe current climate change has been caused by human action?	7.87 (2.76)
3.How much do you believe that human action has the power to influence climate change?	7.89 (2.77)
4.How much do you believe human behavior has the power to cause climate change?	8.04 (2.75)
5.How much do you think future generations will be affected by climate change?	8.28 (2.73)
6.How true do you think the information on climate change provided by the media is?	6.15 (2.72)
7.How reversible do you think climate change is?	4.91 (2.79)

4. Discussion

The present study aimed to provide the psychometric validation of a newly developed eco-anxiety questionnaire, which is designed to assess anxiety related to environmental issues, global pollution, and climate change. The results demonstrate that the questionnaire is reliable, has a good model fit in both EFA and CFA, and represents a valid alternative to the current tools available for assessing different characteristics of this still poorly explored phenomenon.

Prior research has documented the prevalence of anxiety related to environmental crises, which has led to the development of a comprehensive eco-anxiety construct (Clayton & Karazsia, 2020; Helferich et al., 2020) and questionnaires to measure this construct. Therefore, most recent studies around the world focused on analyzing the prevalence and characteristics of eco-anxiety. However, the findings have been inconsistent, with varying rates of occurrence and profiles reported across different contexts. For example, Patrick and colleagues (2023), in a large Australian survey (n= 5,483), reported that around 9% of respondents experienced significant levels of self-reported eco-anxiety. Uppalapati et al. (2023) indicated that 3% of 1,085 U.S. adults experienced critical levels of anxiety linked to climate changes (assessed via a scale for Generalized Anxiety directed to Climate), reaching 7% when distress was assessed via the Climate Change Perceived Distress Scale (CCPD; Searle & Gow, 2010). From these preliminary data emerges the importance of defining eco-anxiety phenomenon in the current society not exclusively in terms of its presence or absence but, more importantly, in terms of the multiple characteristics that it exhibits on a cross-sectional basis.

In this sense, our questionnaire appears to be an effective instrument for measuring the mental impact of environmental issues (i.e., psychological impact and intrusiveness of thought linked to climate change). Furthermore, it assesses strategies to cope with the occurrence and consequence of global pollution and climate change, such as a sense of responsibility. The results of the EAQ validation eco-anxiety indicate that eco-anxiety is a multidimensional

construct that includes psychological, cognitive, and behavioral dimensions, consistent with Clayton and Karazsia (2020) model for climate change anxiety.

Our multidimensional approach has confirmed the reliability of a three-factor structure, which confirms the existence of an eco-anxiety phenomenon that extends beyond the actual psychopathological symptomatology underlying anxiety, as confirmed by the modest correlation between our questionnaire subscales and generalized anxiety. The eco-anxiety encompasses a range of different responses to environmental threats. Considering these findings, it can be posited that those who experience eco-anxiety may be driven by a duality of factors, namely a sense of responsibility and intrusive thoughts pertaining to climatic change. These multiple components would be in line with a dimensional rather than categorical approach to the phenomenon. From a positive perspective, implementing strategies that facilitate pro-environmental behaviors may prove beneficial. From a negative perspective, an excessive sense of responsibility and high intrusiveness may influence psychological well-being and potentially contribute to the development of psychopathologies (Hickman, 2020). This opens a broader view of the construct, which can be analyzed from different perspectives that are useful for consideration in preventive and clinical practices.

From the perspective of cognitive psychology, eco-anxiety can be conceptualized as a cognitive appraisal of environmental threats. From this perspective, climate change is perceived as an existential threat, which triggers a cascade of cognitive and emotional responses that channel energies toward something that can improve the life health and well-being of the species via environmental health (Fritze et al., 2008; Lazarus, 1984). From a neuroscientific perspective, it can be postulated that eco-anxiety may involve the activation of brain regions associated with fear and anxiety, such as the amygdala and prefrontal cortex (PFC). The amygdala plays a key role in emotional threat processing, while the PFC is involved in regulating emotions and decision-making (Etkin et al., 2015). Persistent eco-anxiety may lead to heightened amygdala activity and challenges in PFC regulation, which could, in turn, lead to chronic stress and the development of maladaptive coping strategies (Sousa, 2016). These cognitive and neural processes highlight the importance of addressing eco-anxiety through interventions targeting emotional regulation and cognitive restructuring. When the brain perceives environmental threats, the hypothalamus activates the HPA axis, leading to cortisol release. While this is adaptive in the short term, prolonged cortisol release may contribute to the development of anxiety and depression (Sousa, 2016; Stoknes, 2015). From a psychodynamic perspective (Pihkala, 2020), anxiety for climate and the environment would be related to environmental melancholia (Lertzman, 2015), which includes grief associated with ecological crises and the social implications of a perceived learned helplessness. In this sense, this study contributes new

insights to the eco-anxiety literature, enhancing our confidence in the existence of affective and behavioral impairments due to climatic change. Moreover, it highlights the need for further research on the role of personal characteristics in the development of eco-anxiety, with an integrated perspective. For example, It may be beneficial to evaluate whether, akin to generalized anxiety, echo-anxiety has a detrimental impact on behavioral performance and is linked to alterations in the autonomic nervous system (e.g., Forte et al., 2021)

Another interesting result emerged from the linear correlations conducted between the EAQ factors, psychological indices of anxiety (GAD-7), psychological symptoms (PHQ-9), and the scores of respondents in other tools adopted to analyze climate change worry (CCWS; Stewart, 2021; Innocenti et al., 2022) and anxiety in response to climate change (CCAS; Clayton & Karazsia, 2020, 2020; Innocenti et al., 2021). The results indicated that the EAQ correlated positively with all the variables. Of particular interest is the observation that the correlation between EAQ and both CCWS and CCAS is more pronounced than that between EAQ and both GAD-7 and PHQ-9. This discrepancy would suggest that although eco-anxiety, as assessed by our questionnaire, is positively associated with generalized anxiety and psychopathological symptoms, it represents a construct with different features that are not merely an anxiety toward climate or environmental crisis. From these premises, we can support previous theoretical perspectives focused on the complexity of this phenomenon (Albrecht, 2011). This is further supported by findings on the association between climate change beliefs and EAQ factors, indicating that more individuals who believe in the urgency of climate change and identify a role of human beings in affecting it tend to experience greater intrusiveness of ecological issues, thoughts, and sense of responsibility toward them. On the contrary, these beliefs do not affect the psychological symptoms of eco-anxiety. Further studies should investigate these aspects in the context of behavioral coping strategies among climate and environmental activists, especially in the young population that is more sensitive to ecological crises (Rootes, 2004).

Overall, these results should be interpreted according to the characteristics of our sample. The main presence of young adults and women aligns with previous research showing that these groups tend to express higher levels of concern and emotional responses toward environmental and climate issues (Hickman et al., 2021; Stanley & Williamson, 2021). Moreover, the relatively high educational level and the widespread adoption of pro-environmental suggest that the sample was particularly engaged with ecological matters. Such engagement is known to increase exposure to climate-related information and to heighten emotional and cognitive reactions to environmental threats (Clayton & Karazsia, 2020; Wang et al., 2023). These characteristics likely facilitated the detection of eco-anxiety dimensions but may limit the generalizability of the findings to less environmentally involved populations.

5. Strengths and limitations

This study reported several strengths. It introduces a theoretically grounded and psychometrically robust tool for assessing eco-anxiety, developed through both exploratory and confirmatory factor analyses and validated against multiple established measures. The EAQ captures the multidimensional nature of eco-anxiety, encompassing psychological symptoms, intrusive thoughts, and a sense of responsibility, providing a broader assessment compared to existing unidimensional instruments. The adequate sample size also strengthens the reliability of the statistical analyses conducted.

However, several limitations should be acknowledged. While the sample size is adequate, it may not fully represent the diversity of the broader population, which could limit the generalizability of the findings. As the sample was predominantly young and female, and recruitment occurred through social media platforms, it is possible that individuals who are more environmentally engaged or more emotionally responsive to climate issues were overrepresented, potentially influencing the observed levels of eco-anxiety (Hickman et al., 2021; Léger-Goodes et al., 2022). Also, the exclusive adoption of self-report questionnaires may introduce biases such as social desirability and shared method variance, while the cross-sectional design prevents drawing causal inferences. Future research should validate the questionnaire across more diverse sociodemographic groups to ensure broader applicability. It would also be relevant to explore the relationship between eco-anxiety and actual environmental behaviors, such as activism or sustainable consumption, to assess the tool's predictive validity. In addition, group comparisons across age cohorts, cultural contexts, and urban versus rural settings could offer valuable insights for developing tailored policies and interventions addressing eco-anxiety (Crandon et al., 2022). Longitudinal and multimethod studies, including behavioral or physiological measures, would further strengthen the evidence base for the EAQ.

6. Conclusions

In conclusion, the newly validated eco-anxiety questionnaire provides a reliable and valid measure for assessing eco-anxiety in relation to climate change, environmental pollution, and the prospect of an ecological crisis from a multidimensional perspective. The psychometric properties of the questionnaire make it a valuable tool for researchers and practitioners. As concern about the environmental crisis grows, this questionnaire can play a crucial role in understanding and addressing the psychological impacts of climate change, which in some cases give rise to psychopathological manifestations and, in other cases, result in a state of heightened cognitive activity among some parts of the general population. Future studies could employ this tool to investigate the interplay between eco-anxiety and other psychological variables, such as

coping strategies or resilience, and its influence on environmental behavior (Hickman et al., 2021; Léger-Goodes et al., 2022). For practitioners in mental health and environmental education, the questionnaire serves as a diagnostic tool to identify individuals or groups with high eco-anxiety levels. Understanding the nuances of eco-anxiety can facilitate the development of targeted interventions to mitigate its psychological impact while promoting constructive environmental engagement. This study contributes to identify different aspects of eco-anxiety manifestations in Italy and suggests directions for future research. In these terms, our contribution represents an opportunity to expand scientific interest in eco-anxiety and its clinical implications for people vulnerable to climate change and its secondary impact on mental health.

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Ethics Committee for Transdisciplinary Research of "Sapienza" University of Rome (protocol code: CERT_18F7CBDA3E9; date of approval 27/06/2024).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Data are available and shared by the corresponding author upon reasonable request

Conflict of interest statement

The authors have no funding to disclose

Author Contributions

F.F. and G.F. (conceptualization, methodology, data collection, formal analysis writing original draft, writing – review & editing). M.C. (conceptualization, methodology, writing – review & editing). R.T. (conceptualization, supervision, project administration writing – review & editing.).

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Appendix A

Supplement 1.

EAQ- Instruction:

"Rispondi al seguente questionari indicando quanto spesso ti capita di provare le seguenti affermazioni o sentirle particolarmente vicine al tuo modo di pensare e vivere.

Indica se: Mai (0), Raramente (1), Qualche Volta (2), Spesso (3), Sempre (4)"

"'Answer the following questionnaire by indicating how often you experience the following statements or feel they are particularly close to your way of thinking and living.

Indicate whether: Never (0), Rarely (1), Sometimes (2), Often (3), Always (4)'

EAQ- Questionnaire: Items and related English translation

1. Mi preoccupo in modo eccessivo delle condizioni dell'ambiente

(I worry too much about the state of the environment)

2. Mi spaventano le problematiche ambientali

(I am afraid of environmental issues)

3. Ho paura di ciò che potrebbe accadere all'ambiente

(I am afraid of what might happen to the environment)

4. Non riesco a smettere di pensare alle problematiche ambientali che potrebbero verificarsi in futuro

(I can't stop thinking about environmental issues that might occur in the future)

5. Penso continuamente a eventi passati che hanno provocato danni all'ambiente

(I constantly think about past events that have caused damage to the environment)

6. Non riesco a smettere di pensare alle attuali problematiche ambientali

(I can't stop thinking about current environmental problems)

7. Pensare alle problematiche ambientali non mi permette di rilassarmi e sentirmi calmo

(Thinking about environmental issues does not allow me to relax and feel calm)

8. L'idea delle problematiche ambientali mi crea difficoltà nel dormire

(Thinking about environmental issues makes it difficult for me to sleep)

9. Le mie preoccupazioni per l'ambiente mi impediscono di godere delle situazioni sociali con famiglia e amici

(My worries about the environment prevent me from enjoying social situations with family and friends)

10. Pensare alle problematiche ambientali mi rende difficile lavorare e/o studiare

(Thinking about environmental issues makes it difficult for me to work and/or study)

11. Pensare alle problematiche ambientali non mi permette di concentrarmi

(Thinking about environmental issues does not allow me to concentrate)

12. La preoccupazione per le problematiche ambientali mi genera incubi ricorrenti

(Worrying about environmental issues gives me recurring nightmares)

13. Provo ansia se penso all'impatto dei miei comportamenti sulle problematiche ambientali **(delated)**

(I feel anxiety when I think about the impact of my behaviour on environmental issues)

14. La mia motivazione è compromessa dalle preoccupazioni riguardo le problematiche ambientali

(My motivation is impaired by worries about environmental issues?)

15. A causa della preoccupazione per le problematiche ambientali ho cambiato le mie abitudini alimentari in modo da ridurne l'impatto

(Because of the concern about environmental issues I have changed my eating habits in order to reduce the impact)

16. Mi preoccupo se metto in atto comportamenti che potrebbero danneggiare l'ambiente

(I am concerned if I engage in behaviour that could harm the environment)

17. Mi sento in colpa quando consumo troppa energia

(I feel guilty when I consume too much energy)

18. Mi sento in colpa per le attuali condizioni dell'ambiente

(I feel guilty about the current state of the environment)

19. Sento fortemente l'impulso a coinvolgere gli altri in comportamenti che non danneggino l'ambiente

(I feel a strong urge to involve others in behaviour that does not harm the environment)

20. Quando sento parlare di problematiche ambientali e del futuro del nostro pianeta avverto sensazioni fisiche spiacevoli (ad es: difficoltà respiratorie, tremori, aumento del battito cardiaco

(When I hear about environmental issues and the future of our planet, I experience unpleasant physical sensations (e.g., difficulty breathing, trembling, increased heartbeat))

21. Se penso agli attuali problemi ambientali, mi sento in colpa per le generazioni future

(When I think about current environmental problems, I feel guilty for future generations)

22. Provo un forte senso di rabbia quando vengo a conoscenza di eventi che possono danneggiare l'ambiente

(I feel a strong sense of anger when I learn about events that may damage the environment)

23. Provo una forte tensione quando vengo a conoscenza di eventi che possono danneggiare l'ambiente

(I feel a strong sense of tension when I learn about events that may harm the environment)

24. Sento un'agitazione incontrollabile quando penso alle problematiche ambientali

(I feel uncontrollable agitation when I think about environmental issues)

25. Mi sento molto frustrato nel leggere tante notizie catastrofiche relative alle problematiche ambientali

(I feel very frustrated when reading so many catastrophic news stories about environmental issues)

26. Gli altri dovrebbero condividere la mia preoccupazione riguardo le problematiche ambientali e renderle una priorità

(Others should share my concern about environmental issues and make it a priority)