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Abstract

I hypothesized that 1) Eco-anxiety increases during adolescence, as a result of the teens' growing awareness of environmental threats; 2) It is stronger in girls than in boys, in accordance with the anxiety research; 3) This difference emerges in early adolescence, based on Hill & Lynch's "gender intensification hypothesis". The 831 French participants were attending the three highest elementary school grades and the seven secondary school grades. They filled out the basic eco-anxiety scale for children and adolescents (BEASCA), a new six-item questionnaire, which proved to have acceptable psychometric properties for these ten grade groups. A grade-by-sex Anova revealed a rather large main effect of grade, with the five oldest groups reporting less eco-anxiety than the four youngest groups, and a medium sized main effect of sex, with girls being more eco-anxious than boys. A non-significant but tendential grade-by-sex interaction suggested that this sex difference emerges at the very end of elementary school. I discuss the origins of the unexpected decrease in eco-anxiety during early adolescence, and the utility of paying attention to children's worrying about environmental issues.

Keywords

Eco-Anxiety, Public Health, Children, Adolescents, Development

1. Introduction

In addition to diagnosable mental health problems like PTSD, from which youths may suffer as a consequence of direct exposure to environmental disasters (e.g., (Garcia & Sheehan, 2016)), those who are not directly exposed to such a disaster may experience eco-anxiety because they anticipate ecological crises. Eco-anxiety refers to "challenging emotions due to the awareness of climate change and environmental issues and threats" (Coffey et al., 2021: p. 2). Until now, no studies have

investigated the possibility of variations via the ontogenesis of a propensity for eco-anxiety. However, this issue is of interest to public-health policy makers. Eco-anxiety is not pathological in itself, but it may have a negative impact on health (Verplanken et al., 2020). My first aim was to explore the average development of eco-anxiety by relying on cross-sectional data obtained from students in the middle elementary school years to the end of secondary school. My second aim was to test the hypothesis that girls experience more anxiety than boys, and that this difference increases at the onset of adolescence.

1.1. Basic Eco-Anxiety as an Adaptive Personality Construct

Eco-anxiety is a typical kind of anxiety, since anxiety is characterized by sensitivity to indicators of potential threats (Miloyan et al., 2019). In their review, Coffey et al. (2021) stated that "eco-anxiety" refers to various emotions like fear, anger, or sadness that are elicited by several ecological problems, such as global warming or loss of biodiversity. Climate anxiety is included in eco-anxiety, together with other ecological issues. Accordingly, the climate-anxiety and eco-anxiety dimensions are closely related to each other and indicate the same patterns of associations in their nomological network (Hogg et al., 2023).

Pihkala (2020) observed that "As a general term for 'difficult feelings because of the ecological crisis', eco-anxiety seems to be quite suitable, because so many forms of these feelings have some characteristics of anxiety." (p. 14) The emotions subsumed by eco-anxiety (e.g., fear and anger) may have different behavioral consequences (Stanley et al., 2021), but they attempt to lessen the threat by different means (fight or flight). When adults used a four-point scale to rate how they felt when they thought about climate change, on nine emotional items, all items loaded on the same factor (for example, between the "anxiety" and "anger" scores, $r = 0.73$ (Searle & Gow, 2010)). In Fridja's approach to emotions as action readiness, "Emotions arise in response to events that are important to the individual's goals, motives, or concerns" (Fridja, 1988: p. 351). In this sense, eco-anxiety is an emotional propensity to feel concerned about environmental threats. Different states of action readiness (and emotional experiences) share the same conative orientation. The emotional plurality of eco-anxiety lies at the core of the construct.

The subjective and experiential features of eco-anxiety could fulfill an adaptive function, by prompting individuals to foresee future threats and to prepare for appropriate behavior (Damasio & Carvalho, 2013). Relying on Verplanken & Roy (2013)'s seminal work, several studies have acknowledged that eco-anxiety is not a mental-health disorder. Moreover, Pihkala (2020) noted in his review that eco-anxiety often leads to problem-solving attitudes.

1.2. Eco-Anxiety Development and Sex Difference

In the media, young people are frequently presented as being especially eco-anxious, and as innocent victims of the ecological crisis (Benoit et al., 2021). In

Hickman et al. (2021)'s survey, more than 50% of the participants between the ages of 16 and 25 reported feeling anxious, sad, and angry about climate change. However, no previous study has proven that eco-anxiety peaks in adolescence or early adulthood. Coffey et al. (2021) reported that the majority of the study samples were made of adults, in line with Léger-Goodes et al. (2022), who noted that little is known about eco-anxiety in children and adolescents. Hickman (2019)'s qualitative studies explored children's attitudes and feelings about ecological threats, and suggested that elementary school children are sensitive to this issue, but no research has been conducted on possible variations in the propensity to feel eco-anxious, as a personality construct, throughout childhood and adolescence.

Relying on the pioneering work by Inhelder & Piaget (1955), a large body of research supports the view that adolescence is characterized by a growing mastery of hypothetical-deductive reasoning (Moshman, 2011), which is likely to promote the logical understanding of the origins and consequences of the environmental crisis. The relevant scientific data have been widely diffused in the mass media, and taught in French classrooms in accordance with the climate agreement signed at the 2015 Conference of Parties (COP 21) of the United Nations. In addition, children and adolescents in Western countries are informed about the environmental crisis through interactions with family and classmates (Özdem et al., 2014). Insofar as anxiety corresponds to the cognitive appraisal of negative events (Frijda, 1988), this growth in understanding should enhance awareness of ecological issues and therefore, as I hypothesized, increase the propensity to feel eco-anxious among adolescents.

According to another hypothesis, girls could be expected to report more eco-anxiety than boys, which is in line with anxiety research (for a review, see (McLean & Anderson, 2009)). Eco-anxiety studies have consistently reported that women are more eco-anxious than men (Searle & Gow, 2010), but there has been no similar finding for children and adolescents. De Bolle et al. (2015) suggested that early adolescence is a key period for examining the emergence of sex differences in personality, due to pubertal transformations and the developmental task of endorsing new gender roles. More specifically, Hill & Lynch (1983) advanced the "gender intensification hypothesis", which states that in order to channel the emotional changes induced by pubertal transformations, youths are subjected to increasing socialization pressures to conform to traditional gender roles. These roles include emotional expressivity for girls and emotional restraint for boys. In the Crandon et al. (2022)'s social-ecological approach, the peer micro-system influences the way children and adolescents experience eco-anxiety. Children and adolescents are educated with same-age classmates, and they aggregate in same-sex informal groups, which play a major role in the gendered socialization of emotions (Rose & Rudolph, 2006). Accordingly, I hypothesized that during early adolescence, the sex difference in eco-anxiety emerges or increases across grades, as a consequence of the growing pressures to conform to the sex-typed expression of emotions.

1.3. The Present Study

This study was aimed at filling in the gap in our understanding of the normative development of eco-anxiety throughout childhood and adolescence. I hypothesized that 1) Eco-anxiety increases during adolescence; 2) Girls experience more eco-anxiety than boys; 3) The difference in boys' and girls' propensity to feel eco-anxious increases gradually during early adolescence.

2. Method

2.1. Ethical Approval

The study was performed in compliance with relevant laws and institutional guidelines, and it was approved by the Research Ethics Board of the University of Paris Nanterre (notification number 2022-07-03). It was part of a larger research project on children's and adolescents' perception of the future. Informed consent was obtained prior to data collection, which took place in classroom. Students were assured of the anonymity of their answers.

2.2. Participants and Procedure

A total of 831 French students (51.5% girls) from middle-to-high socio-economic levels participated. They were attending grades three to twelve in public schools located in an urban area. In France, students in 3rd, 4th, and 5th grades are in the elementary school (in addition to those in 1st and 2nd grades), students in 6th, 7th, 8th, and 9th grades are in the middle school, and those in 10th, 11th, and 12th grades are in the high school (afterwards they may attend higher education). The mean age and number of participants in each grade for boys and girls are presented in Table 1. There was no significant sex-by-grade interaction on age.

Table 1. Number and mean age (in years) of participants across the ten grades, for boys (N = 403) and girls (N = 428).

Grade	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth	Tenth	Eleventh	Twelfth
Boys										
N	34	31	38	50	47	41	46	39	40	37
M	8.86	9.90	10.92	11.49	12.52	13.75	14.63	15.60	16.75	17.60
Girls										
N	35	53	40	57	54	36	34	41	40	38
M	8.95	9.83	10.88	11.53	12.60	13.66	14.76	15.65	16.67	17.62

2.3. Design of the Basic Eco-Anxiety Scale for Children and Adolescents (BEASCA)

None of the scales that have been used so far to assess eco-anxiety in adulthood or late adolescence (Wu et al., 2023) were devised for younger participants. Moreover, they were designed to measure pathological anxiety (Clayton & Karazsia,

2020). Because I intended to study eco-anxiety as an adaptive anticipatory emotion (Miloyan et al., 2019), I needed a scale that did not target anxiety disorder symptoms (e.g., nightmares about climate change). The six items of the Basic Eco-Anxiety Scale for Children and Adolescents (BEASCA) were designed to target three emotions reported by research with adults to load on a single eco-anxiety dimension, whose facets were fear, sadness, and anger (Pihkala, 2020). The items assess the propensity to worry about ecological issues, with three items about "global warming", two about "ecological problems" and "the future of life on earth", and one about "species extinction". Overall, these worrying issues are very close to those tapped by Hogg et al. (2021)'s four-item "Affective Symptoms" scale, but the BEASCA items focus on ordinary thoughts like "I worry about", "it makes me upset", rather than more dramatic wordings like "feeling on edge".

The items were written so as to be appropriate to adolescents as well as to children as young as eight or nine years old, since children in this age range are able to use mental cues to understand their own emotions of fear, sadness, and anger, and to assess the extent to which they experience each of them in their everyday life (Pons et al., 2004). In particular, I wanted to avoid causing any psychological distress among the younger participants. In a pilot study, twenty third through fifth graders were interviewed about their understanding of the items, and how they felt about these issues. All of the children were able to rephrase the six items without changing their meaning, they said they were familiar with information on environmental threats, and no one appeared to be at all confused. The participants filled out the questionnaires on a five-point Likert scale ranging from 1 (does not describe me at all) to 5 (definitely describes me).

2.4. Data Analyses

To determine whether the BEASCA can be used as a reliable instrument to compare the grade and sex groups, I analyzed its basic psychometric properties, namely the distribution of the participants' responses on the items, the one-dimensional nature of the scale, and its internal consistency for each age group. The age groups of interest were those defined by the ten school grades, since they correspond to significant steps in the socialization process. To test our hypotheses related to the effects of grade level and the sex of the participant on eco-anxiety, I conducted a two-factor analysis of variance (ANOVA), with participant's sex and grade as two between-subject independent variables, and eco-anxiety as the dependent variable.

3. Results

3.1. Psychometric Properties of the BEASCA

I first examined the distribution of the BEASCA items. The mean, standard deviation, skewness, and kurtosis for each item are presented in **Table 2**. The means ranged from 3.07 to 4.08, and the standard deviations from 1.14 to 1.38. Skewness and kurtosis ranged from −0.07 to −1.20 and from −0.12 to −0.17, respectively, so

that no floor or ceiling effect was detected, and suggesting that non-normality was not a concern (Hair et al., 2019).

Table 2. Skewness, kurtosis, and component loading for the items devised for the child and adolescent eco-anxiety scale (N = 831).

Items	*M*	*SD*	Skewness	Kurtosis	Factor Loading
1. When I think about global warming, it sounds scary to me.	3.79	1.28	−0.84	−0.32	−0.82
2. I am concerned about life on earth.	3.96	1.17	−1.02	0.21	−0.80
3. I worry about the ecological problems of the planet.	3.84	1.18	−0.85	−0.12	−0.83
4. Without wanting to, I often think about global warming and it frightens me.	3.07	1.38	−0.07	−1.17	−0.73
5. When I think that there are more and more animal species that might disappear, I feel sad.	4.08	1.14	−1.20	−0.61	−0.74
6. Global warming makes me angry.	3.26	1.39	−0.23	−1.13	−0.75
% variance explained					60.45%

Consistently with the expected one-dimensional factorial structure, the principal component analysis performed on the six items yielded only one eigenvalue greater than 1, namely 3.63, which explained 60.45% of the variance. The loadings of the items, which are presented in Table 2, ranged from 0.72 to 0.83, with an average inter-item *r* of 0.53, and an alpha coefficient of 0.89. In the ten age groups, the six items were positively correlated, the averaged inter-item *r* ranging from 0.32 to 0.72, and the Cronbach's alpha ranged from 0.73 to 0.93. For the entire sample of participants, the mean, standard deviation, skewness, and kurtosis were 3.81, 0.96, −0.83, and 0.32, respectively. In accordance with these correct psychometric properties, the items were averaged.

3.2. Sex and Grade Effects on Eco-Anxiety

The Anova revealed that girls reported more eco-anxiety than boys (*M*s = 3.89 and 3.43, *SD*s = 0.88 and 1.01, respectively), $F(1, 811) = 55.94$, $p < 0.001$, partial $\eta^2 = 0.07$, 95% CI [0.04, 0.10]. For the grade level, there was a significant effect, $F(9, 811) = 12.83$, $p < 0.001$, partial $\eta^2 = 0.12$, 95% CI [0.08, 0.16]. The grade-by-sex interaction was only tendential, with $F(1, 811) = 1.99$, $p < 0.05$, partial $\eta^2 = 0.02$, 95% CI [0.00, 0.03].

To compare grade-group means, post hoc tests were performed, and because the Anova compared a large number of grade groups ($n = 10$), I used the conservative Tukey HSD test. The students in the five oldest grades (grades 8 to 12) reported significantly ($p < 0.001$) less eco-anxiety than the students in the four youngest grades (grades 3 to 6). The seventh graders differed significantly ($p < 0.01$) from the third and eleventh graders only.

The descriptive statistics are presented in Table 3 and the non-significant grade-by-sex interaction is illustrated by Figure 1. The observed means of the grade-by-sex groups suggest a greater decrease with age for boys than for girls. The means of boys and girls were quite similar for the two youngest age groups, whereas girls scored higher than boys for the other eight age groups. According to the grade-by-sex group post-hoc Tukey HSD test, the sex difference was significant ($p < 0.01$) for students in all grades except the two youngest groups (third and fourth grades) and the ninth graders.

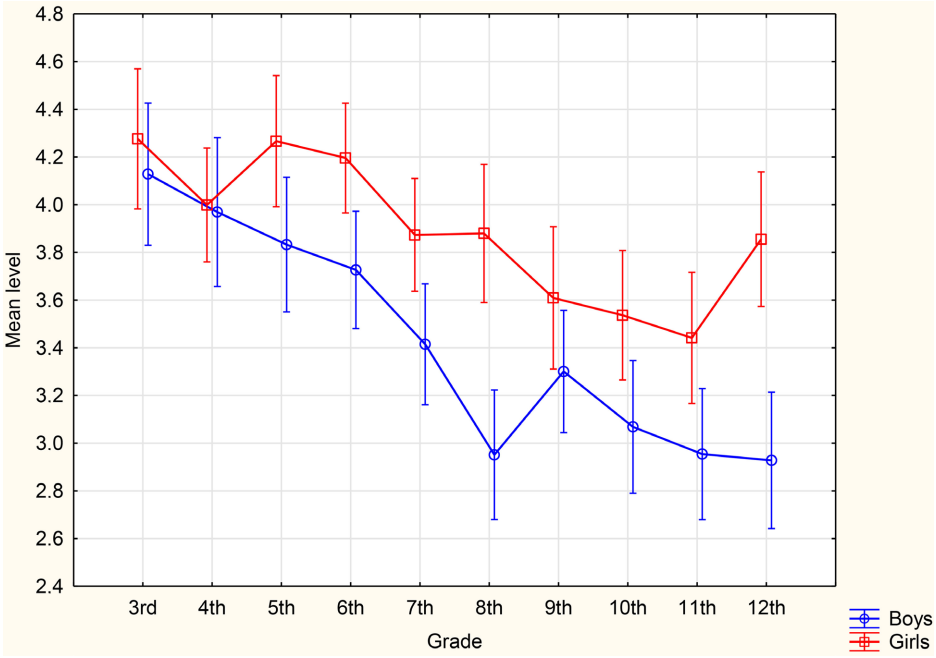

Figure 1. Eco-anxiety mean level by grade and sex (vertical bars denote 0,95 confidence intervals).

To more accurately describe the non-significant grade-by-sex interaction, I computed the effect size of grade separately for boys and girls. Partial η^2 was 0.17, 95% CI [0.09, 0.22] for boys, but only 0.10, 95% CI [0.04, 0.14] for girls.

Table 3. Means and standards deviations on the basic of eco-anxiety scale for children and adolescents (BEASCA) across the ten grades for boys (N = 403) and girls (N = 428).

Grade	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth	Tenth	Eleventh	Twelfth
Boys										
M	4.13	3.97	3.83	3.73	3.42	2.95	3.30	3.07	2.95	2.93
SD	0.84	0.84	0.91	0.89	0.97	1.15	0.98	0.83	1.01	0.76
Girls										
M	4.28	4.00	4.27	4.20	3.87	3.88	3.61	3.54	3.44	3.86
SD	0.83	0.72	0.71	0.81	0.94	0.90	1.01	0.86	0.95	0.66

4. Discussion

4.1. Basic Eco-Anxiety as a Reliable Personality Construct Starting from Eight or Nine Years of Age

To assess children's and adolescents' propensity to feel eco-anxious, I devised the BEASCA, which includes six easily understandable items that do not refer to pathological symptoms. All six items were positively and significantly inter-correlated in the ten age groups even though their contents referred to different facets of eco-anxiety, including three emotions (fear, sadness, and anger) and different environmental issues. This suggests that children as young as eight to nine years old experience eco-anxiety as a complex emotion that varies consistently from individual to individual and constitutes a personality feature. Further research could examine its rank-order stability at different ages, in order to find out whether it remains fluid throughout ontogenesis.

4.2. Differences Across Grades

I hypothesized that eco-anxiety would increase with age throughout adolescence, as a consequence of the growth in understanding and awareness of the consequences of the environmental crisis. My results showed, on the contrary, that eco-anxiety was significantly lower in students attending the five highest grades (Grades 8 to 12) than in students attending the four youngest grades (Grades 3 to 6). So, a large, decreasing effect of age seems to occur between Grade 6 and Grade 8, which are the first and second-to-last school years of middle school in France. Eco-anxiety plateaued at quite a high level, and then at a moderate level, respectively, before and after this decrease.

An explanation of this finding is that adolescents' growing understanding of the physical and social world (Moshman, 2011) leads to a more complex appraisal of ecological issues, enabling these European youths to relativize the consequences of the ecological crisis, compared to more short-term threats like earning a living, and to compare their own situation to those of populations directly exposed to disasters. Such a comparison has been reported to be an efficient "meaning-focused" strategy used by adolescents to cope with eco-anxiety (Ojala, 2012). The eco-anxiety decrease observed here is consistent with the fact that ecological issues are not the top priority for the majority of young adults (Corner et al., 2015).

This result is also consistent with Hickman (2024)'s contention, based on her clinical psychotherapy work, that the current ecological crisis affects children the most. Nevertheless, although the children exposed directly to an environmental disaster are at risk of developing a mental disorder (UNICEF, 2021), my results do not support Hickman's assumption that children who have not faced eco-catastrophes are impacted by the ecological crisis by way of various mental disorders. In fact, there is no reason to interpret a high level of eco-anxiety as symptoms of a mental impairment. Furthermore, the present results suggest that normative development leads to a large eco-anxiety decrease as children become adolescents. This decrease can be seen as part of a broader developmental transition toward a

more "realistic" view of one's life. For example, the prevalence of fantasy-based career aspirations decreases during early adolescence, leaving room for more pragmatic ones (Cook et al., 1998).

4.3. Sex Differences

The girls' higher scores on eco-anxiety are consistent with the anxiety research (McLean & Anderson, 2009). For example, Oztemel (2014) found that adolescent girls were more anxious about career decision-making than were their male counterparts. The hypothesized age-by-sex interaction failed to reach significance. Nevertheless, in the two youngest groups of children, boys and girls had exactly the same mean level, contrary to the other eight age groups, seven of which displayed a significant sex difference.

This pattern provides the first evidence that the eco-anxiety sex difference reported in adults (Searle, & Gow, 2010) emerges at the end of elementary school, after which it remains roughly constant throughout adolescence, and perhaps even beyond. The children who were attending the highest elementary school grade were about 11 years old, an age at which many girls are overtly undergoing pubertal transformations, unlike boys (Tanner, 1989). This discrepancy is perceived by youths and impacts their gender role endorsement, thereby affecting the emotions they experience and express (Clemans et al., 2010). Furthermore, since they have reached the end of the "children's school", they are aware that they will soon have to behave like adolescents. The emergence of the eco-anxiety sex difference at this moment is in line with the Hill & Lynch (1983)'s gender intensification hypothesis.

4.4. Health Implications

The high mean eco-anxiety level of eco-anxiety observed in the four youngest age groups of European children (between around 9 and 12 years of age) does not correspond to a high prevalence of mental disorders, but calls instead for a prevention policy. According to Kose (2023), eco-anxiety is "an emotionally compatible and constructive response to climate and biodiversity crises" (p. 1). She suggested that school counselors should support children's reflections about what they can do for the environment, in order to help them to cope with their eco-anxiety. This is supported by Ojala (2012)'s empirical finding showing that youths who cope with climate-change anxiety by searching for things they can do to contribute to mitigating climate change are those who feel the most hope about climate global warming.

Rather than pure vulnerability to psychopathology, youths' eco-anxiety can be assumed to reflect individual reactivity to environmental influences, which can have a positive effect on mental health, provided that the social context offers opportunities to cope efficiently with ecological threats. Eco-anxiety as a personality trait can be seen as an example of Belsky's "differential susceptibility hypothesis" (for an overview, see Belsky & Pluess, 2009), according to which individual who

are more vulnerable to certain stressing situations are the very same ones who can reap the most benefit from this situation.

4.5. Limitations

This study did not take into account autonomic reactions (e.g., perspiring), which are part of the anxiety response (Michalska et al., 2022). An improvement of the BEASCA could include items referring to such reactions.

Since youths' eco-anxiety can be assumed to become a long-standing public health concern, it would be wise to carry out a follow-up study, in addition to this cross-sectional study, in order to distinguish the normative ontogenesis of this personality feature from its possible historical evolution.

5. Conclusion

The findings of the study can be summarized in four points: 1) Elementary school children are more eco-anxious than adolescents; 2) Early adolescence is characterized by a large decrease in eco-anxiety; 3) Eco-anxiety can be measured as a consistent personality trait as early as age eight or nine; 4) Starting at the very end of elementary school, girls are more eco-anxious than boys.

In addition to the aforementioned health implications, these results call for more prevention research focused on children, since eco-anxiety is a consistent individual construct in children as young as eight or nine. Furthermore, among the ten age groups that participated in this study, children were the ones who reported the highest mean eco-anxiety level. Such prevention research could assess the effectiveness of programs devised to help children feel confident in the ability of human beings to confront the most difficult situations. Regarding adolescents, although they reported a lower mean level of eco-anxiety, it remained relatively high, especially for girls. One of the most useful ways to assist them in coping with eco-anxiety could be to encourage them to look more closely at how they might take ecological issues into account in planning their future career and personal lives.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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