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Keystone Environmental Experiences: An exploratory framework of transformative experiences that promote environmental awareness

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Abstract

The increasingly significant psychological effects of global environmental problems, particularly climate change anxiety and environmental responsibility, warrant an examination of emotional and motivational processes. We introduce the concept of Keystone Environmental Experience (KSEE). It is a moment of realization associated with individuals recognizing their responsibility and committing to becoming active agents of environmental protection. The aim of this study was to explore the types of KSEEs and the relationship between climate change anxiety, KSEEs, and the intention to act. The role of formal education was also examined. This exploratory, mixed-method cross-sectional study involved 501 high school students and 941 adults. Participants answered an online survey regarding climate change-related knowledge, attitudes, eco-emotions, KSEEs, and behavioural intentions. Results indicate that while climate anxiety is higher among those who have experienced a KSEE, their sense of individual responsibility and willingness to take action are also significantly stronger. Furthermore, global media events were more frequently reported as KSEE triggers by students, whereas adults more commonly cited local experiences. Theoretically, the research provides an empirical foundation for the KSEE concept. Practically, it highlights that formal education was rarely reported as a KSEE source in this sample.

Keywords: Keystone Environmental Experience (KSEE); climate change; health; anxiety; environmental education; generational differences

1. Introduction

The authors of the study are professionals working in the field of education and teacher training, all of whom consider it extremely important to care for the mental well-being of students in educational institutions, in addition to teaching the curriculum. This research was motivated by the high level of interest in environmental issues among high school students. These students

are frequently exposed to news about climate change-related disasters and their global impacts. As part of their daily work, teachers have to be able to answer questions such as, "What kind of world will my child have to live in?" This specific question, received during teaching practice, motivated the authors to conduct the present study. The data collection for the study took place at the end of 2019, capturing a pre-pandemic snapshot of environmental awareness. This period was marked by the emergence of Greta Thunberg and her mobilization for climate protests called Fridays for Future (Sabherwal et al., 2021). This timing is significant as it aligns with the publication of foundational definitions of eco-anxiety (Clayton, 2020; Pihkala, 2020), yet predates the compounding effects of the Covid-19 pandemic, the Russian-Ukrainian war, and the increasingly frequently mentioned global polycrisis (Lawrence et al., 2024). Since most subsequent empirical studies in this field remain cross-sectional, making direct historical comparisons difficult, we utilize recent literature, including research on the interplay between climate and COVID-19 anxieties (Stefkovics et al., 2024), to retrospectively frame and interpret our pre-crisis observations within today's more complex scientific landscape.

2. Background and literature review

Climate change is no longer a distant problem but a reality shaping everyday life (Hansen, 2007). It represents one of the most serious global challenges, driven by factors such as overpopulation, overconsumption, greenhouse gas emissions, and disruptive land-use changes. The rise in global average temperatures is leading to extreme weather patterns, sea level rise, pandemics, ecosystem disruption, and the resulting socio-economic problems (Cramer et al., 2018; Feulner, 2017; Kemp et al., 2022; Pörtner et al., 2023; Shiraiwa, 2023). There is scientific consensus that climate change and other global issues caused by human activity reinforce each other, threatening not only ecological balance but also social well-being, which is why the literature refers to this situation as a polycrisis (Fletcher et al., 2024; Lawrence, 2024; Søgaard Jørgensen et al., 2024). It is also evident that these events greatly increase social and economic inequalities, affect access to food and water, stimulate migration, and have a direct and indirect impact on mental and physical health (Asbrand et al., 2023; Falk et al., 2022; Favas et al., 2024; Khraishah et al., 2022).

Sudden and unexpected climatic events can cause mental disorders, including post-traumatic stress syndrome, depression, and anxiety (Cianconi et al., 2020; Clayton, 2021; Hrabok et al., 2020; Palinkas & Wong, 2020; Ramadan & Ataallah, 2021). At the same time, long-term and recurring negative environmental events, whether experienced personally or seen in various media, contribute to ongoing psychological stress, the development of mental disorders, and may also increase the risk of suicide (Chen et al., 2024; Evans, 2019; Obradovich et al., 2018).

This is why psychology specifies certain emotional reactions (i.e., eco-emotions), such as eco-anxiety—broadly defined as chronic fear or worry surrounding environmental doom—alongside grief, and guilt (Ágoston et al., 2022a; Ágoston et al., 2024a; Ágoston et al., 2022b; Clayton, 2020; Reyes et al., 2021). Studies also draw attention to the fact that certain vulnerable groups, such as young people, women, indigenous communities living close to nature, and those with pre-existing mental health problems, are particularly vulnerable to the psychological effects of climate change and environmental pollution (Amin, 2025; Aylward et al., 2024; Gunasiri et al., 2022; Ma et al., 2022). Moreover, the interconnected nature of the global polycrisis means that different sources of psychological stress can interact and reinforce one another over time. For example, recent large-scale evidence highlights a complex relationship between climate change worry and COVID-19 anxiety, demonstrating how environmental concerns prominent before 2019 have evolved and compounded alongside subsequent global health crises (Stefkovics et al., 2024).

However, eco-anxiety is not solely paralyzing; it is often positively associated with proactive behavior as an adaptive coping mechanism. As Ojala (2012) notes, combining problem-focused action with meaning-focused coping—such as finding hope in collective efforts—is vital to prevent burnout. Translating these eco-emotions into constructive action could be a part of formal environmental education, which aims to strengthen this proactive behavior. The authors believe it is particularly important for the formal education system to prepare students to contribute to mitigating the effects of climate change and environmental pollution while maintaining their mental well-being. In the following overview, we summarize how environmental education programs contribute to students' commitment to environmental protection and enable them to take active steps toward positive change. Large-scale studies and meta-analyses consistently show that environmental education programs improve young people's environmental knowledge and awareness and help them develop more environmentally conscious behaviors (Ardoin et al., 2020; Ardoin & Bowers, 2020; van de Wetering et al., 2022) Although participation in longer-term and repeated programs brings about more significant change, even short-term interventions can be effective (Maurer et al., 2020; Pacini et al., 2025). These programs can be implemented regardless of school type, in the classroom, or outside the classroom, but also in the field within the school setting (Hohenhaus et al., 2023; Papavasileiou et al., 2025; Seres & Nagy, 2025; Thor & Karlsudd, 2020).

This raises critical questions: What situations are linked to these eco-emotions and are associated with individuals' intentions to take action? Furthermore, to what extent are these decisive moments linked to formal educational experiences or spontaneous, everyday

encounters? In response to these questions, the authors examine in this article what types of experiences and encounters can shape Keystone Environmental Experience (KSEE). This concept was coined by the authors and can be defined as an experience or moment that awakens a personal obligation to protect the environment. A KSEE serves as the connecting link that frequently aligns with an individual's intention to act. It should be noted that this does not automatically trigger action, but it can be a cathartic, sometimes life-changing moment in an individual's life that is associated with greater commitment to environmental protection. Although the literature review above shows that environmental education is very important in shaping environmental awareness, it would be helpful to have a clearer understanding of the extent to which formal, informal, or other experiences can generate cathartic encounters. If these encounters occur in non-educational contexts, it is important to consider how they can be incorporated into environmental education practices.

Although the term "keystone environmental experience" was coined by the authors, similar concepts are already used in psychology, and KSEE is proposed to build upon these frameworks. Some researchers have identified the term “Significant Life Experiences” (SLE) (Chawla, 2001; Howell & Allen, 2019; Tanner, 1980), while others have described “Profound Experiences with Nature” (PEN) (Mathers & Brymer, 2022). Arguably all profound experiences with nature are significant life experiences, but not all significant life experiences involve nature.

The term Significant Life Experiences is widely used in psychology to describe personally significant, memorable events that shape beliefs, identity, or behavior over time. They can be positive (e.g., birth of a child, successful migration) or negative (e.g., war experiences, serious illness, loss), and these experiences influence mental health, problem solving, personality development, and long-term life choices (Deyessa et al., 2025; Klein et al., 2011; Nhamo et al., 2025). While SLE encompasses a wide range of general life events, it lacks the specific focus required to describe the awakening of environmental consciousness; therefore, KSEE can be understood as a specific, action-oriented subset within this framework. KSEE is explicitly tailored to the environmental domain and captures the realization of environmental responsibility, regardless of whether that realization is triggered by a specific, abrupt moment or emerges gradually over a longer period of reflection (e.g., observing the disappearance of snowy winters). While a KSEE can theoretically emerge gradually, the present empirical study captures primarily salient, remembered turning points (moments) as reported by the participants.

Profound Experiences with Nature are intense, memorable encounters with the natural world that evoke fear, connection, meaning, or transformation. They typically involve emotional depth, changes in worldview (e.g., feeling part of a larger living system), or lasting changes in values and behavior (e.g., environmental concern). Empirically, a PEN can often serve as a KSEE. However, while PEN focuses heavily on phenomenological experience (experiencing unity, discovering the "inner self") the defining element of the KSEE is the reported behavioral shift: the goal is not merely to experience a connection with nature, but to recognize responsibility. The essence of the KSEE is the realization that "I must also do something," not just experiencing a more intimate relationship with nature—although the latter is often an essential accompanying phenomenon of the process. Furthermore, while PEN is strictly rooted in direct encounters with the natural world, KSEE encompasses a broader spectrum of potential triggers. A KSEE can certainly originate from a PEN, but it can equally be catalyzed by indirect or negative experiences—such as observing environmental degradation, consuming media, or participating in social movements. In this theoretical alignment, KSEE serves as a highly specific, action-oriented subset of SLE, while simultaneously broadening the trigger-specific focus of PEN, acknowledging that the drive for environmental action stems from diverse sources. To clarify the theoretical distinctiveness of KSEE from established concepts, Table 1 summarizes the primary differences in triggers, focus, and action orientation.

Table 1. Theoretical comparison of SLE, PEN, and KSEE across triggers, focus, and action orientation

Concept	Typical Trigger	Primary Focus	Action Orientation
SLE (Significant Life Experiences)	Broad life events (positive or negative, e.g., birth, illness)	General identity, personality development, or worldview shift	Variable (not inherently pro-environmental)
PEN (Profound Experiences with Nature)	Direct, intense encounters with the natural world	Phenomenological experience (e.g., connection, spiritual unity, meaning)	Often increases environmental concern, but behavioral action is secondary
KSEE (Keystone Environmental Experiences)	Diverse (direct nature, indirect media, witnessing negative degradation)	Awakening of personal environmental responsibility	High (defined by the reported behavioral intent / "I must act")

A similar approach can be found in Hungarian literature in the work of Fodor (2024), who refers to KSEEs as “formative life events”. She defines these as “*an experience, impression, or influence of subjective significance to the individual, lasting for a longer or shorter period of time, which played a role in the development of a commitment to environmental protection and the manifestation of that commitment in actions, thus leading to the development of*

environmentally friendly behavior." This definition partly overlaps with the phenomenon we are examining; however, it is important to note that the specific concept of KSEEs was already described earlier by Nagy (2020).

3. Research questions

This exploratory study seeks answers to the following questions:

- What types of life events and information sources dominate among keystone experiences regarding adolescents and adults, and can a generational shift be observed in this regard?
- Does formal education fulfill its expected role in shaping attitudes: does school education appear as a powerful source among students' KSEE?
- Are there any significant demographic differences in the respondents' visions of the future with regard to the effects of climate change?
- Can it be proved that individuals with KSEE have a greater intention to act compared to those without KSEE?

4. Materials and methods

4.1. Measurement tools

An online, self-report, anonymous survey was conducted in two samples: high school students aged 14 and over and adults (Appendix A). The two questionnaires differ in only one question, and we wrote them in a formal tone for adults and an informal tone for students. This description only includes those parts of the questionnaire that were analyzed in the article. We used a novel questionnaire developed specifically for this study.

The questionnaire began with a survey of general demographic data (gender, place of residence—capital city, county seat, town, village—and year of birth). Respondents then indicated on a ten-point scale how much they believed human activity was responsible for the climate change taking place today (1 – I consider it a natural process, 10 – It is entirely attributable to human activity).

This was followed by three questions that assessed opinions on the perceived and presumed effects of climate change, i.e., what perceived effects it has on living organisms on Earth, on societies and people living on Earth, and on the respondent's life in three-time perspectives (short, medium, and long-term, i.e., 5 years, 25 years, and 50 years). There were two differences between the student and adult questionnaires: for adults, 15 years and 30 years, while for students, 25 years and 50 years indicated the medium and long-term time perspective relating to the respondent's life.

We also examined how often respondents think about the consequences of climate change on a scale of 1 to 7 (1 - several times a day; 2 - daily; 3 - several times a week; 4 - weekly; 5 - several times a month; 6 - monthly or less frequently; 7 - never).

Since validated questionnaires examining eco-emotions were not yet available at the time of the research (which since then have been published), the authors developed their own questionnaire based on data from the literature. It is worth noting that questionnaires published later (e.g., Ágoston et al., 2022b) contain similar questions to those included in the present questionnaire. Attitudes toward climate change, perceived threat, positive emotions and anxiety were measured using eight statements:

1. I am afraid that climate change will cause more extreme weather.
2. I feel that I should take action against climate change, but I don't know what I can do on my own.
3. I feel that climate change endangers my life.
4. I think our civilization will be able to solve the consequences of climate change.
5. I think climate change will have positive consequences for humanity (e.g., mineral resources in Antarctica will become accessible).
6. I feel that climate change endangers my future.
7. There have been times when I couldn't sleep because I was thinking about the consequences of climate change.
8. For students only: Climate change affects my further education or my future career choice.

Respondents rated on a five-point scale how relevant they felt the statements were to themselves: 1 - Not at all relevant; 2 - Not very relevant; 3 - Neither relevant nor irrelevant; 4 - Quite relevant; 5 - I feel it is completely true.

There was a question on how much respondents felt that they could individually do something about the negative effects of climate change (1 - I do not feel this at all; 2 - I rather do not feel this; 3 - I feel this to some extent, but not entirely; 4 - I rather feel this; 5 - I feel this completely).

Respondents could indicate with yes, no, or I don't remember whether they had had a KSEE, i.e., whether there had been a moment in their lives when they felt they absolutely had to take action to protect the environment. If the respondent answered yes, we asked them to describe this KSEE briefly. It is important to note that this single retrospective item serves only as an initial exploratory indicator of KSEE to map the phenomenon, rather than a comprehensive measurement instrument.

In order to increase the accuracy of the questionnaire, a validation question (attention check) was also used for students, in which they had to select a specific answer. In the case of incorrect answers, their responses were deleted during data curation.

4.2. *Sample*

We received 538 student questionnaires and 957 adult questionnaires. After processing the students' responses, 37 cases were excluded because they did not pass the attention check. In the case of 16 adult questionnaires, the completion was interrupted, or the respondent was under 18 years of age, so these cases were also deleted. Thus, the final sample size was 501 for the student sample and 941 for the adult sample. The proportion of female respondents was 65% for students and 72% for adults. The proportion of women in the total sample was 71%. The average age of students was 16.3 years (*SD* = 1.4, min.: 14, max.: 20), while that of adults was 34 years (*SD* = 12.27, min.: 18, max.: 85). The proportion of respondents from the capital city was 40% in the total sample, 37% in the student sample, and 42% in the adult sample. 45% of the total sample, 45% of students, and 45% of adults live in cities or county-level cities, while 15% of the total sample, 18% of students, and 13% of adults live in villages.

4.3. Procedure

Student respondents were recruited from four high schools in Budapest and four from the countryside, and the invitation to complete the questionnaire was also shared in social media groups for teachers. For adults, there was no targeted recruitment; the questionnaire was only shared on social media. The questionnaire was available for completion between October 17 and December 10, 2019.

Regarding students, the questionnaires were completed with the passive consent of their parents, and all potential respondents had to accept a consent form at the beginning of the questionnaire. The questionnaire has been approved by the Research Ethics Committee of ELTE PPK (license number 2019/355).

As the topic of the questionnaire may have been sensitive for certain respondents, the following text was included at the end of the questionnaire "If you feel you need help, call the toll-free crisis hotline at 116-123 or 06 80 820 111, which is a toll-free number for people in crisis situations!"

4.4. *Statistical analysis*

The data was processed and analyzed using Microsoft Excel (version: 16.106.1) and JASP (Version: 0.95.4) statistical software. When analyzing the differences between the groups, we selected the appropriate statistical test depending on the violation of the assumptions (e.g., distribution of the variables). During the decision-making process, we checked the normality of the distribution of the samples using the Shapiro-Wilk test and the equality of the standard deviations between the groups using the Levene test.

We used Student's two-sample t-test for variables where the data distribution was considered normal ($p > .05$) and the variances between groups were equal ($p > .05$). We performed a Welch t-test in cases where the normality assumption was met but the homogeneity of variances was violated ($p < .05$). We used the Mann-Whitney U test in all cases where the normality assumption was violated ($p < .05$), regardless of the equality of variances.

The level of statistical significance was set at 0.05. We used Cohen's d to describe the effect size in the case of Student's and Welch's t-tests, where we consider the effect size to be small between 0.2 and 0.5, medium between 0.5 and 0.8, and large above 0.8 (Field, 2013). We used rank-biserial correlation as the indicator of effect size for the Mann-Whitney U test, where values between -1 and +1 are considered small, values between 0.1 and 0.3 are considered medium, and values above 0.5 are considered large (Cohen, 1988).

We used exploratory factor analysis (EFA) with Maximum Likelihood estimation to explore the internal structure of the scale created to measure climate anxiety. Due to the possible correlations between factors, we used Promax rotation. We checked the prerequisites for performing factor analysis using the Kaiser-Meyer-Olkin (KMO) index and Bartlett's test. We considered KMO values above 0.6 to be acceptable. When determining the number of factors, we took into account the Kaiser criterion (eigenvalue > 1) and the model fit indices (RMSEA and its 90% confidence interval CFI, TLI). For the model fit indices, RMSEA values below 0.08, and CFI and TLI values above 0.90 were considered indicative of an acceptable fit (Hooper et al., 2008).

When screening the items, we examined the factor loadings: in accordance with the recommendations in the literature (Tabachnick & Fidell, 2014), we excluded items with a weight below 0.30 from the final model.

When interpreting the magnitude of the correlation coefficient, we considered ±0.1 to be a weak correlation, ±0.3 to be a moderate correlation, and ±0.5 to be a strong correlation.

To assess the internal consistency of the newly developed climate anxiety scale, we calculated Cronbach's α. In accordance with widely accepted psychometric guidelines, an alpha coefficient of 0.70 or higher was considered to indicate acceptable reliability (Hair et al., 2010).

Respondents who selected the 'I don't remember' option regarding whether they had experienced a KSEE were excluded from the comparative analyses (With KSEE vs. Without KSEE).

5. Results

5.1. The types of KSEEs

Participants' descriptions of their KSEEs were analyzed using an inductive qualitative content analysis approach (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). This method is particularly appropriate for exploratory research, as it allows analytical categories to emerge directly from the participants' own words rather than relying on preconceived theoretical frameworks. The analytical process followed standard qualitative principles: it began with an immersion phase, where the first and second authors independently read through the 923 valid text responses (received from 290 students and 633 adults) multiple times to achieve familiarization with the data. During the subsequent open coding phase, the authors independently generated initial codes by highlighting recurring meaning units. Following this independent phase, discrepancies were discussed and resolved through consensus. Through a process of abstraction, these initial codes were progressively merged into higher-order groups to establish the final categorization. No formal intercoder reliability coefficient (e.g., Cohen's kappa) was calculated; instead, consensus coding was used to resolve any discrepancies. Three main categories were created: 1. Natural, environmental, and social events and disasters; 2. Personal and everyday experiences; 3. Information communicated through the media or other means. Within these, further subcategories were established. Of course, there were several responses that, due to their complexity, could not be specifically classified into a category or subcategory, or did not contain sufficient information (e.g., "there were several of these"). Complex responses were not broken down into individual elements or assigned to multiple categories. To complement the human analysis, artificial intelligence tools (e.g., Google Gemini Pro) were explored as a supplementary check rather than a formal validation step. The model was instructed to assign the raw text responses into the human-established categories. The AI classification showed high convergence with the researchers' consensus coding, serving merely as an exploratory supportive tool that reinforced the clarity of the established coding scheme. The responses consisted of an average of 12 words and 89 characters, with no significant difference between adult and student respondents in this regard. The difference was that the adults' responses were more polarized, i.e., they more often gave very short or very long responses.

The content characteristics of each main category and subcategory are described below:

- Main category: Natural, environmental, and social events and disasters – respondents named a specific event, the primary focus of which was not whether they had experienced it or from what source they had learned about it, but rather the fact of the specific disaster.

- Subcategory: The answer focused on a specific meteorological phenomenon or event, e.g., heat, unpredictable weather, flooding, drought, lack of snow
  Example responses from adults: "The summer weather is slowly becoming unbearable." "My children have hardly ever seen snow." "30 °C in autumn."
  Example response from a student: "This year, autumn was so unnaturally warm that I think that's reason enough to do something about climate change."

- Subcategory: The answer focused on a real natural, environmental, or social disaster/crisis, e.g., forest fires, glacier melt, mudslides, migration
  Example response from an adult: "After the fires in the Amazon rainforest, after the floods in Venice."
  Example response from a student: "Amazon forest fires."

- Subcategory: The answer focuses on recognizing pollution caused by humans, e.g., water, air, or soil pollution, waste management concerns, and industrial pollution
  Example response from an adult: "Cyanide pollution in the Tisza River."
  Example response from a student: "We see environmental pollution and littering every day."

- Subcategory: The destruction and annihilation or significant change (even suffering) of the living environment is the focus of the answer, which may concern humans or other living beings.
  Example response from an adult: "Seeing the extinction of animals; seeing a sea of litter; witnessing the proliferation of invasive insect species."
  Example response from a student: "The extinction of polar bears."

- Subcategory: The destruction and annihilation or significant change of the inanimate environment is the focus of the answer, which may be about: habitats, places of residence, etc.
  Example response from an adult: "The concreting of Lake Balaton, the over-regulation of natural waters, the environmental damage caused by man-made structures."
  Example response from a student: "One of the videos showed the death throes of a very thin polar bear walking in the green. They said that the bear's death was probably caused by malnutrition, which is caused by habitat loss due to melting. This left such a deep impression on me that I threw my money for that day into the ocean cleaning foundation's donation box."

- Main category: Personal and everyday experiences, where the primary focus was on something the individual had experienced or gone through.
  - Subcategory: Precise, concrete experience of some natural or environmental event, e.g., seeing litter or experiencing pollution
    Example responses from adults: "Excessive littering at a festival." "On my first trip to Africa, I saw a field full of plastic bags. They had been blown there by the Moroccan wind..."
    Example response from a student: "When I noticed how much litter there was in the parks and on the riverbank."

  - Subcategory: Responses related to healthy living, illness, and having children
    Example response from an adult: "It wasn't instantaneous, but about two years ago I realized that things couldn't go on like this! At the time, I really wanted a

child, but I looked around and realized that I didn't want to bring a child into this world. I'm giving myself and the world five years, and if I see improvement, then maybe it won't be too late, but if not, then I will accept that I'll live my life without children."
Sample answer from a student: No answers were received in this subcategory

- Subcategory: Specifics related to shopping and product purchasing: e.g., wasteful use of single-use plastic bags, problems caused by online orders (packaging, shipping, etc.), specific purchasing of everyday foods, and food waste
  Example response from an adult: "I usually get the creeps when I see all the plastic packaging, especially for vegetables and fruit, therefore I don't buy them."
  Example responses from students: "When the lady put the pears in the fourth bag." "I didn't let my mom use plastic bags when shopping."

- Subcategory: Participation in some kind of social movement, e.g., climate strike or demonstration focused on environmental protection or animal welfare
  Example response from an adult: "Climate strike." "Promoting petitions."
  Example response from a student: "Mostly when I got to know the mother of the one-and-a-half-year-old girl I met every time I was out at a climate protest."

- Subcategory: The primary focus of the responses in this category was a sense of personal responsibility related to an activity or job, e.g., a sense of responsibility toward students through teaching, or voluntarily leaving a job because the respondent recognized that their work contributed to environmental problems, as well as a sense of responsibility towards children already born or yet to be born.
  Example response from an adult: "Since I have a 7-year-old son, I have to act for the sake of his future."
  Example response from a student: No answers were received in this subcategory

- Subcategory: Related to the respondent's actions, i.e., something they did or did not do to protect the environment and nature
  Example responses from adults: "After a sleepless night filled with guilt, I decided to become a vegetarian. I always take a big step towards an environmentally conscious lifestyle when I receive too much depressing information in a short period of time, as a way of dealing with my overwhelming anxiety and depression." "I gave up meat and started paying attention to what I buy. I try to buy products that contain minimal or no plastic."
  Example response from a student: "Recycling, riding a bike, not smoking." "I sewed bread bags from old, holey sheets so that I no longer have to bring groceries home from the store in single-use plastic bags."

- Main category: Information communicated through the media or other means - In this case, the emphasis in the responses was primarily on where the experience came from. Here, the KSEE was caused by the influence of some kind of media product or information provider.
  - Subcategory: Specifically named films, series, famous people
    Example responses from adults: "The first Jane Goodall lecture I attended," "When I watched the movie Before the Flood."

Example responses from students: "When I watched BBC World on TV, specifically David Attenborough's program. I was home alone and cried for hours afterwards. That's when I decided to dedicate my life to this. I have to dedicate myself to this." "It took me a while to really understand why things are the way they are, but when I first met Greta Thunberg and delved a little deeper into her 'work', I thought to myself that if this girl my age can do so much for the cause, then I too am capable of taking it to heart and paying attention. I think she is definitely a great inspiration to young people."

- Subcategory: Books, news portals, blogs, articles, reports
  Example responses from adults: "At the age of 8, in 1982, when I first heard and read about how humans are endangering the environment." "In the summer of 2019, I read an article about environmental protection, alone in the dark, after putting my children to bed. I was overcome by a terrible, anxious feeling, panic, fear of death, and helplessness."
  Sample response from a student: "When I read the first article about how little time we have to change, that we cannot reverse the effects of our harmful actions."

- Subcategory: Participation in a class or educational lecture or discussion
  Example response from an adult: "In the early 2000s, after a lecture by a guest speaker (at school). He said 2008 would be the point of no return for climate change."
  Example responses from students: "When I held a presentation on water pollution," "At a lecture on the extinction of wildlife."

The answers were often very complex and identified multiple problems. Therefore, examining the frequency of response types was not the primary objective of our analysis; instead, we want to put a stronger emphasis on a qualitative analysis of the responses.

Nevertheless, it can be noted that two-thirds of the responses received contained some reference to pollution, littering, or plastics. A quarter of the responses referred to some form of media product, with students tending to highlight specific news items or articles, while adults tended to refer to films and books. A higher proportion of adults than students gave answers based on personal experience. The majority of students mentioned global events and disasters, while adults tended to mention local and everyday problems. This is supported by the fact that shopping-related problems were mostly mentioned by adults, who face such dilemmas on a daily basis. Only a small proportion of both groups indicated that they had had a KSEE during their education, which means that such experiences rarely occur during formal and presumably lecture-based education. Among students, there was a higher incidence of overly complex responses that could not be assigned to a single category. This indicates that for them, the KSEE tends to be a more multifaceted experience comprising multiple elements, rather than a single, easily identifiable external event, which is more typical for adults. It is worth noting that adults more often associated the KSEE with a specific change in behavior, while students tended to

describe the triggering experience without a change in behavior. In both groups, expressions carrying strong emotional markers (shocking, dramatic, frightening, etc.) were found in almost equal measure.

5.2. The exploratory factor analysis of the scale related climate anxiety

We originally used eight statements to measure attitudes, threat perception, and anxiety related to climate change. Three of these items were excluded prior to analysis: two items were reverse scored (Item 4-5), but during the content review, we concluded that they measured different constructs (i.e., optimism, positive spin) and therefore could not be included in a single scale. The last item was used only in the questionnaire for students, so it was not possible to compare the adult and student samples, and it was therefore excluded, too. At the end, we performed exploratory factor analysis (EFA) on the five-item measure created to measure climate anxiety[(KMO=0.756), Bartlett's test (χ^2 = 2242.01, p < .001)]. Based on the results of the analysis, Item 2 was excluded due to low factor loading because it did not reach the required threshold of 0.30.

The analysis revealed a single main factor with an eigenvalue of 2.179, explaining 43.6% of the variance in the items. The EFA resulted in a four-item anxiety scale, which showed excellent fit (RMSEA=0.051 {CI: 0.032 - 0.072}, TLI=0.983, CFI=0.991). The items of the final climate anxiety scale are:

- I am afraid that climate change will cause more extreme weather.
- I feel that climate change endangers my life.
- I feel that climate change endangers my future.
- I have had trouble sleeping because I was thinking about the consequences of climate change.

We calculated a total score for the climate anxiety scale based on the sum of the scores for the four questions, with a minimum score of 4 and a maximum score of 20. The final four-item scale demonstrated acceptable internal consistency (Cronbach's α = .735).

5.3. General analyses of the data

Based on the entire sample, 31.7% of respondents said they think about climate change every day, and another 42.2% said they think about it weekly or several times a week.

There is a moderate negative correlation between the age of the respondents and the degree of climate anxiety (r = -0.429, p < .001), and a weak positive correlation between the degree of climate anxiety and perceived individual responsibility (r = 0.152, p < .001) as well as the belief that climate change is due to human activity (r = 0.121, p < .001). A moderate positive

correlation was observed between the degree of climate anxiety and how often individuals reported thinking about climate change (r= 0.418, p < .001).

5.4. Differences between the student and adult sample as well as between male and female respondents in the perceived consequences of climate change, the human caused nature of climate change and climate anxiety.

Regarding the perceived consequences of climate change, there are significant differences between the responses of students and adults regarding the “long-term" questions:

- Students (M = 1.22, SD = 0.61) perceived the impact on living organisms on Earth as more negative than adults (M = 1.28, SD = 0.63) [t(1098.40)= -2.117, p = .034, effect size: 0.049].
- The impact on society and humans living on Earth was perceived as more negative by adults (M = 1.24, SD = 0.59) than by students (M = 1.32, SD = 0.69) [t(960,93)= 2.148, p = .032, effect size: 0.063].
- Students (M = 1.51, SD = 0.74) perceived it as more negative than adults (M = 1.42, SD = 0.67) [t(1002.44)= 2.359, p = .019, effect size: 0.060].

The average score given by students on a 10-point scale for the question of how much of today's climate change is due to human activity was 8.27 (*SD* = 1.58), while the average score given by adults was the same, 8.27 (*SD* = 1.57). It can also be stated that there is no significant difference between students and adults in this regard [t(1067.54)= -.053, p = .957]. However, when examining this question in terms of male and female respondents, the average score for men was 7.91 points (*SD* = 1.84), while the average for female participants was 8.42 points (*SD* = 1.43), and the difference is clearly significant [t(548.43)= -4.666, p < .001, effect size: 0.332]. Female respondents reported significantly higher climate anxiety than male respondents, both in the total sample [U = 180389.5, p < .001, effect size: 0.206], among students [U = 19867.5, p< . 001, effect size: 0.353], and among adults [U = 69682.5, p < .001, effect size: 0.201]. Projected onto the entire sample, the average score for women was 11.1 (*SD* = 3.6), while for men it was 9.8 (*SD* = 3.5). The average score for adult women was 9.6 (*SD* = 2.9), while for men it was 8.6 (*SD* = 2.7). For students, the average score for girls was 14 (*SD* = 3.2), while for boys it was 11.7 (*SD* = 3.7). If we group the data by students (M = 13.2, *SD* = 3.5) and adults (M = 9.3, *SD* = 2.9), there was a significant difference [U = 406,776, p < .001] between the two groups, with an effect size of -0.606.

5.5. Keystone Environmental Experience (KSEE), Climate Anxiety and Pro-Environmental Attitudes

The following section presents the results related to KSEE, i.e., whether the respondent had ever felt that they absolutely had to take action to protect the environment. Based on the entire sample, 64% of respondents reported having had a KSEE, 11% reported not having had one,

while 25% were unable to recall such an experience. 45% of men and 69% of women, 58% of students and 67% of adults reported having had a KSEE. As detailed in the accompanying table (Table 2) for the student sample, the results show that those with and without KSEE showed significant differences across nearly all measured variables. Specifically, the only non-significant difference was found among students regarding the perceived long-term effects of climate change on living organisms.

Table 2. Values of the measured variables depending on the presence or absence of KSEE, for students, *$p < .05$ ** $p < .01$

		With KSEE. *M* (*SD*)	Without KSEE. *M* (*SD*)	*U*	Effect size
The climate change taking place today is due to human activity		8.49 (1.39)	7.48 (2.26)	10765.00**	0.28
How will climate change affect living organisms on Earth?	In the short term	1.86 (0.66)	2.35 (0.95)	5953.00**	0.29
	Medium term	1.29 (0.51)	1.67 (0.94)	6352.00**	0.25
	Long term	1.19 (0.62)	1.33 (0.83)	7666.00	0.09
How will climate change affect society and people living on Earth?	In the short term	2.06 (0.81)	2.59 (0.96)	5906.50**	0.30
	Medium term	1.45 (0.62)	2.02 (1.03)	5605.00**	0.33
	Long term	1.27 (0.70)	1.60 (0.99)	6550.50**	0.22
How will climate change affect the respondent's life?	In the short term	2.20 (0.80)	2.85 (0.95)	5277.50**	0.37
	Medium term	1.63 (0.72)	2.24 (1.00)	5344.00**	0.37
How often do you think about the consequences of climate change?		2.93 (1.47)	4.52 (1.63)	3978.00**	0.53
Climate anxiety		14.41 (3.27)	10.45 (3.41)	13443.00**	0.60
Can you work with your family and friends to combat the negative effects of climate change at the local level?		3.48 (1.11)	2.34 (1.16)	12698.00**	0.51
Can you do anything individually to combat the negative effects of climate change?		3.17 (1.25)	1.74 (0.98)	13521.50**	0.61

The scores on the climate anxiety scale were significantly higher among adults and students who had a KSEE (Figure 1). At the same time, adults and students with KSEE also showed significantly higher levels of personal responsibility.

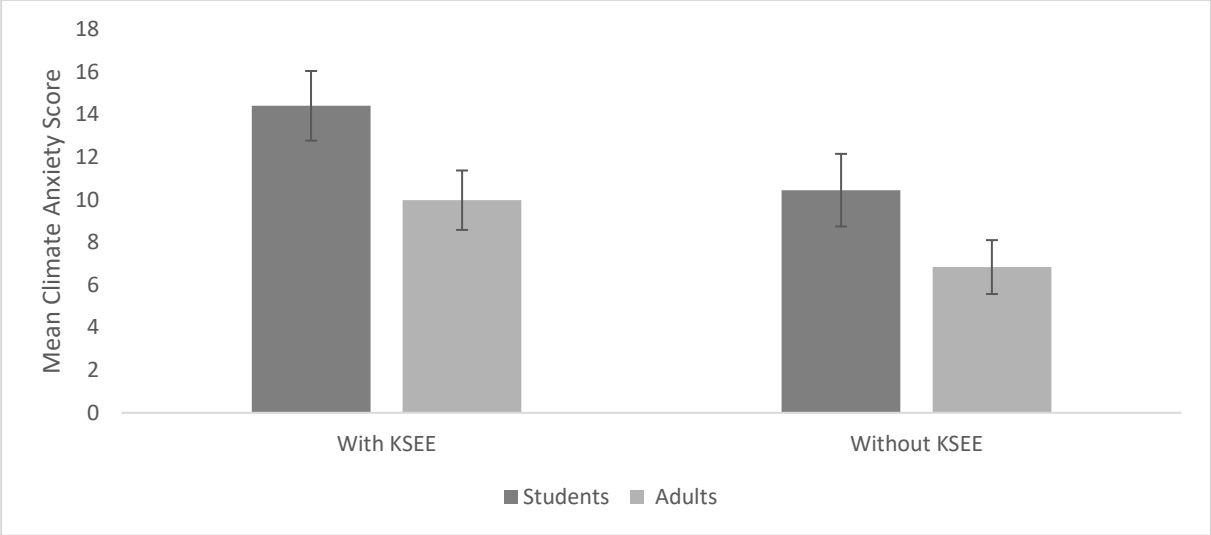

Fig. 1. Mean Climate Anxiety Scores Among Students and Adults With and Without Keystone Environmental Experience (KSEE), *Note.* Error bars represent standard deviations.

It can also be seen that both students and adults with KSEE feel significantly more strongly that they can take action at the national, family/friend (local), and individual levels to combat the negative effects of climate change, i.e., they feel more involved and empowered (Figure 2).

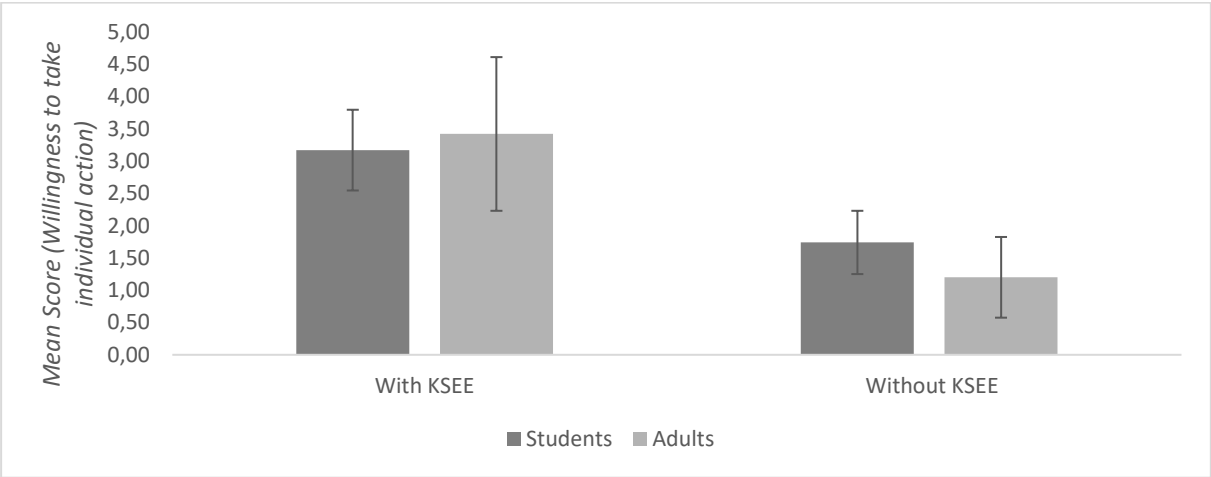

Fig. 2. Mean Scores of Willingness to Take Individual Action Among Students and Adults With and Without Keystone Environmental Experience (KSEE), *Note.* Error bars represent standard deviations.

Notably, the effect sizes regarding individual action are among the largest for both demographics.

Furthermore, both student and adult respondents with KSEE think about the consequences of climate change significantly more often, i.e., several times a week, while those without KSEE think about it several times a month.

The KSEE is also significantly associated with the extent to which respondents believe that climate change is caused by human activity (measured on a ten-point scale). Finally, those with KSEE perceive that climate change has a significantly more negative impact on living organisms on Earth, on society and people living on Earth, and on the lives of respondents in the short, medium, and long term.

6. Discussion

We can view this study as an analysis—in light of our current knowledge—of an archive of data compiled in the last year that was not yet distorted by subsequent crises. It thus provides a more nuanced picture of the relationship between climate anxiety and the intention to act, as reflected in KSEE.

The results show that climate anxiety should not be thought of as a negative and paralyzing emotion, but rather as something that can be positively associated with the intention to act, alongside KSEE. This is consistent with the fact known from the literature that anxiety can be not only paralyzing but also motivating in relation to solving a problem (Cheng & McCarthy, 2018; Wilmer et al., 2021). More specifically, eco-emotions—especially eco-anxiety—are related to people's intent to change their behavior in a pro-environmental direction (Ágoston et al., 2024b; Pavani et al., 2023).

The results support the findings of international literature that climate anxiety is significantly higher among young people and women. The higher anxiety levels among students compared to adults may stem from the fact that they feel their future is more directly threatened, while their options for action are more limited than those of adults. The higher values observed among women are consistent with the findings of Clayton (2020) and Ágoston et al. (2022b), and have also been recently confirmed on a nationally representative Hungarian sample, which found that women report significantly higher levels of negative eco-emotions and pro-environmental behaviors (Varga et al., 2026). This may be due, among other things, to factors related to caregiving roles and a sense of responsibility towards future generations.

The results show that adults have a more negative view of the impact on their own lives, on society and people living on Earth than students do. At the same time, students had a more negative view of the impact on living creatures on Earth. In light of the data, it can also be said that, regardless of age and group (student or adult), respondents believed that human activity

was largely responsible for global climate change. However, it also pointed out that a larger proportion of female respondents believed that human activity was responsible for climate change.

Based on the entire sample, two-thirds of respondents reported having some kind of KSEE. This group also had higher anxiety levels, but at the same time felt that they had greater individual responsibility and opportunities. Qualitative text analysis is not suitable for revealing significant differences, but at the same time, a textual analysis of KSEE revealed interesting discrepancy between the generations: while students' KSEE are often linked to global events (e.g., Amazon forest fires) and media content, adults' experiences are more local and related to everyday life (e.g., shopping, weather changes). It was an important finding that KSEEs do not (only) include cognitive levels (e.g., I see a lot of trash and realize that this is not good, so I need to change), but numerous examples show that such experiences generally induce strong negative emotions in individuals, which ultimately relate to a higher willingness to take action. The sense of personal responsibility came predominantly from adults, while students only expressed it implicitly, referring to it indirectly. A particularly important finding is that formal education was rarely reported as a KSEE source in this sample by either demographic group. This suggests that traditional, lecture-based environmental education, although it imparts knowledge, does not achieve the emotional depth that would be necessary for evoking a cathartic moment and is potentially associated with behavioral change. It is therefore essential to strengthen the role of climate change education and environmental protection, and also action-oriented education in formal education. The results suggest that knowledge transfer alone is not necessarily sufficient; the emotional and action-oriented elements of attitude formation can play a key role. The findings imply that future educational curricula could benefit from integrating empathy and action-oriented approaches alongside traditional science subjects. Without addressing the emotional and action-oriented aspects of climate change, the transformative potential of environmental education may remain limited.

Although the study was conducted on a different sample, our results appear to contradict Fodor’s (2024) findings. She analyzed the formative experiences of adult environmental education professionals—people who are actively involved in protecting their environment. She found that direct experiences in nature and interactions with other people shaped a strong connection to nature and a desire to take action in almost equal measure. The role of education and training followed with slightly less weight, whereas in our case, its presence was negligible. This discrepancy can likely be explained by the specific characteristics of the samples. While we conducted our study on the general population (including a large proportion of high school

students), Fodor examined highly committed environmental professionals. For such a specialized group, higher education and targeted professional training naturally serve as defining, formative experiences in their career paths, which is fundamentally different from the general impact of formal public education on average adolescents or lay adults.

This study has several limitations that should be considered. First, the cross-sectional design restricts the ability to establish causal relationships. Therefore, our findings support only associations between climate anxiety, KSEEs, and pro-environmental intentions, rather than directional effects. Second, the use of convenience sampling may introduce selection bias and limit the generalizability of the results. Third, the reliance on self-reported data and the use of a newly developed climate anxiety scale represent further limitations. Although the four-item scale demonstrated acceptable internal consistency in our sample, it lacked prior extensive validation. However, it is crucial to note that at the time of data collection (2019), validated eco-emotion questionnaires were not yet available in the literature. Since then, valid and reliable questionnaires for measuring eco-emotions have been developed in Hungarian (Ágoston et al., 2022b). Finally, since the current study was exploratory in nature, we assessed KSEEs using a single open-ended question to better understand the characteristics of this phenomenon. Although this may limit the possibilities for measuring this concept, it was necessary as a first step to explore the potential content characteristics of KSEEs and to determine whether they are indeed distinct from similar concepts already defined in the literature. However, an important direction for future research could be the development of a more structured measurement tool related to KSEEs based on the identified content categories. By using a more sophisticated measurement tool in longitudinal studies, it would also be possible to determine which types of KSEEs are associated with greater perceived responsibility, and which of them evoke actual pro-environmental behavior. It should be noted that while several differences between groups reached statistical significance, some of the measured effect sizes were small in magnitude (e.g., regarding the perceived long-term impacts of climate change); thus, these specific results should be interpreted cautiously.

7. Conclusion

The study highlights that, in the relationship between climate anxiety and action, KSEE may be associated with individuals becoming active agents and feeling responsible for their environment.

Further research directions could explore why formal education does not provide KSEE and whether environmental education methods in and/or outside the classroom help to shape KSEE.

The findings suggest that the key issue is not whether climate anxiety exists, but how it is socially and educationally framed. Rather than being inherently paralyzing, it appears to hold mobilizing potential when accompanied by meaningful experiences and perceived agency. Climate anxiety thus emerges not simply as an individual psychological burden, but as a context-dependent phenomenon shaped by opportunities for action.

The generational differences observed indicate that engagement with climate change develops through distinct experiential pathways, raising the need for differentiated approaches. Furthermore, the marginal role of formal education as a source of KSEEs in this sample suggests a need to re-evaluate strictly knowledge-centered models of climate education. If awareness is not paired with emotional depth and action competence, its transformative capacity may remain limited. Finally, it must be acknowledged that this study is exploratory in nature, and all findings are intentionally limited to associations rather than causal claims.

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Ethics statement

The research was conducted in accordance with the ethical standards of the Declaration of Helsinki. The study has been approved by the Research Ethics Committee of ELTE PPK (license number 2019/355).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

Questionnaire items “Climate anxiety", does it really exist?

Dear Respondent!

By completing the questionnaire, you are participating in a scientific research study aimed at investigating climate anxiety and environmental awareness; the completion time is a maximum of five to eight minutes. The originator of the research is Bence Nagy, a teacher training student at ELTE TTK, who will use the received data for his TDK (Scientific Students' Associations) paper and to prepare scientific publications. His science supervisor is Dr. Béla Munkácsy, lecturer at the Institute of Geography and Earth Sciences, ELTE TTK, and the psychology supervisor of the research is Dr. Csilla Ágoston, lecturer at the Institute of Psychology, ELTE.

If you would like to complete the questionnaire, please inform your parent/guardian that you intend to participate in the research and only start the questionnaire with their permission.

Participation in the research is completely voluntary. During the completion of the questionnaire, it is possible to interrupt it so that it does not become tiring. You can interrupt the study permanently at any time without justification or refuse to answer the questions. There is no financial compensation for participating in the study.

Data in the research is collected anonymously, and none of your personal data will be recorded. We handle all information collected within the framework of the research strictly confidentially. The data obtained during the research is kept on a secure computer. We perform statistical analyses on the data obtained during the research, from which the identity of any single participant cannot be determined.

By proceeding, you consent to the use of data collected during the study, which is not suitable for identifying you, for research purposes, and to make it accessible to other researchers as well. You retain the right to withdraw from continuing the study at any time; in such cases, the data collected about you up to that point will be deleted.

1. I have read the information and by proceeding I consent to participate. I further declare that if my age is between 14 and 18, my parent/guardian is aware of and has consented to me completing the survey. * *(Mark only one oval per row.)*

☐ Yes

☐ No

2. Please state your gender! *(Mark only one oval per row.)*

☐ Female

☐ Male

3. Please select your type of residence! *(Mark only one oval per row.)*

☐ Capital city

☐ County seat

☐ Town

☐ Village

4. Please enter your birth year! * *(Short text answer)*

5. To what extent do you think the current climate change is due to human activity? * *(Scale 1 to 10)*

1 - Entirely due to natural processes

10 - Completely due to human activity

6. Based on your intuition, what impact will climate change have on LIVING BEINGS ON EARTH? *

	Definitely negative	Rather negative	Will have no impact	Rather positive	Definitely positive
In 5 years	☐	☐	☐	☐	☐
In 25 years	☐	☐	☐	☐	☐

	Definitely negative	Rather negative	Will have no impact	Rather positive	Definitely positive
In 50 years	☐	☐	☐	☐	☐

7. Based on your intuition, what impact will climate change have on SOCIETY AND PEOPLE ON EARTH? *

	Definitely negative	Rather negative	Will have no impact	Rather positive	Definitely positive
In 5 years	☐	☐	☐	☐	☐
In 25 years	☐	☐	☐	☐	☐
In 50 years	☐	☐	☐	☐	☐

8. Based on your intuition, what impact will climate change have on YOUR LIFE? *

	Definitely negative	Rather negative	Will have no impact	Rather positive	Definitely positive
In 5 years	☐	☐	☐	☐	☐
In 25 years	☐	☐	☐	☐	☐
In 50 years	☐	☐	☐	☐	☐

9. How regularly do you think about the consequences of climate change? * *(1- multiple times a day, 2- daily, 3- multiple times a week, 4- weekly, 5- multiple times a month, 6- monthly or less frequently, 7- never)*

☐ 1 - Multiple times a day

☐ 2

☐ 3

☐ 4

☐ 5

☐ 6

☐ 7 - Never

10. To what extent do you feel the following statements are TRUE / APPLICABLE to you?

	Do not feel it applies at all	Rather do not feel it applies	Feel it applies and doesn't apply	Rather feel it applies	Feel it completely applies
I feel that I should take action against climate change, but I don't know what I can do on my own.	☐	☐	☐	☐	☐
Attention check, please select the 'Feel it completely applies' option.	☐	☐	☐	☐	☐
I think our civilization will be able to solve the consequences of climate change.	☐	☐	☐	☐	☐
I think climate change will have positive consequences for	☐	☐	☐	☐	☐

	Do not feel it applies at all	Rather do not feel it applies	Feel it applies and doesn't apply	Rather feel it applies	Feel it completely applies
humanity (e.g., mineral resources in Antarctica will become accessible).					
I am afraid that climate change will cause more extreme weather.					
I feel that climate change endangers my life.	☐	☐	☐	☐	☐
There have been times when I couldn't sleep because I was thinking about the consequences of climate change.	☐	☐	☐	☐	☐
For students only: Climate change affects my further education or my future career choice.	☐	☐	☐	☐	☐

Answer the questions with the following options: (1- I don't feel that way at all, 2- I rather don't feel that way, 3- I feel that way and don't feel that way, 4- I rather feel that way, 5- I completely feel that way)

11. To what extent do you feel that we can act against the negative effects of climate change at the NATIONAL level (with laws, rules, programs)?

☐ 1 - I don't feel that way at all

☐ 2

☐ 3

☐ 4

☐ 5 - I completely feel that way

12. To what extent do you feel that you can act against the negative effects of climate change at the local level, joining forces with your FAMILY and FRIENDS? *

☐ 1 - I don't feel that way at all

☐ 2

☐ 3

☐ 4

☐ 5 - I completely feel that way

13. To what extent do you feel that YOU INDIVIDUALLY can act against the negative effects of climate change? *

☐ 1 - I don't feel that way at all

☐ 2

☐ 3

☐ 4

☐ 5 - I completely feel that way

14. Has there ever been a moment in your life when you felt you absolutely had to act to protect the environment? (Some shocking data, or picture, or personal experience) *

☐ Yes

☐ No

☐ I don't remember

15. If yes, what was this moment? *(Short text answer)*

_____

_____

Thank you very much for filling it out! Your answers and opinions are important to us and greatly help our work!

If you feel you need help, call the toll-free number 116-123 or 06 80 820 111, dedicated to people in crisis!