Psychology Research and Behavior Management

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Development and Validation of the Curiosity of Climate Changes Scale

Piotr Próchniak*, Adam Ossowski*

Institute of Psychology, University of Szczecin, Szczecin, 70-453, Poland

*These authors contributed equally to this work

Correspondence: Piotr Próchniak, Email piotr.prochniak@usz.edu.pl

Introduction: As it is stated by researchers from multiple scientific fields, climate change has real consequences both for the natural environment but also for the human beings, but not everyone is interested in fighting the global warming and its implications. Yet, there are people who are curious about climate change and became invested in the cause of fighting it. Taking this into account, the aim of this study was to create a questionnaire that would enable to measure curiosity about climate change and as such be an useful tool in research regarding this matter.

Methods: After examination of existing literature and the evaluation of competent judges, we created a questionnaire which structure and reliability was determined in conducted studies. We also investigated possible correlations between introduced in this paper the Curiosity of Climate Changes Scale (CCCS) and other diagnostic tools: The Curiosity and Exploration Inventory II, The Need for Cognitive Closure Scale, The Elements of Nature Curiosity Scale, The Climate Anxiety Scale, The Environmental Identity Scale and The Generational Time Perspective Scale.

Results: The results of the factor analyses verified a one-factor structure. The CCCS showed satisfactory internal consistency (Cronbach's $\alpha = 0.95$). The validity of the CCCS was indicated by correlations with different scales. The CCCS correlates with general curiosity, curiosity of elements of nature, need for cognitive closure, environmental identity, climate anxiety and generational time perspective.

Conclusion: The results indicate that the Curiosity of Climate Changes Scale is a valid and reliable tool. The Curiosity of Climate Changes Scale can be used in future research but also has its practical use – for teachers and environmental educators who thanks to the CCCS can obtain information regarding one's interest in climate change, which can be used in educational programs.

Keywords: curiosity, climate change, measurement

Introduction

Climate change is a result of natural factors, such as increased energy from the sun, but also of man-made greenhouse gases.[1] The sources of these gases are fossil fuels burned in power stations, transport, industry and households, agriculture and land-use changes such as deforestation, waste disposal in landfills and the use of industrial fluorinated gases.[2] The effects of climate change can be seen in the increasing frequency of heat waves, droughts, floods, heavy rainfall and hurricanes and a significant portion of those consequences are interrelated, causing each other to amplify.[3–5] These highly adverse weather events cause a range of damage and destruction in various sectors such as agriculture, fisheries, forestry and tourism.[6–9] They also have a negative impact on human health, both physical and mental.[10,11]

Despite the clearly visible consequences of planetary warming and pollution, these signals are sometimes ignored because fighting climate warming would mean reducing profits and increasing the costs of reorganising the economy and production. Many people therefore deny climate change, considering it to be a whim and an invention of ecologists. However, we can also observe a significant group of people who care about stopping climate change. They are interested in the causes, consequences and coping mechanisms associated with climate change and want to explore the impact of

Received: 1 July 2023
Accepted: 11 November 2023
Published: 28 November 2023

these changes on our planet. In other words, they are curious about climate change. It seems that curiosity of these people has a crucial contribution to make to the efforts being made to combat climate change.

Generally speaking, curiosity can be defined as a need to seek knowledge, to explore and reach satisfaction as a result of obtaining new information,[12] however curiosity tends to be defined and understood in different ways depending on the scientific discipline. From philosophical perspective every human being has a desire for knowledge but when it comes to philosophy itself it's not curiosity that matters, but something called thauma which was translated as "wonder".[13] In turn, contemporary research from the field of social sciences proposes that curiosity should be viewed as a mostly social phenomenon. It views it as a drive – due to its motivational function – and as such curiosity organizes the production of knowledge which depends on both historical and cultural circumstances.[14] Which means that instead of perceiving curiosity on an individual level as a personal characteristic, it should also be viewed as a force that organizes knowledge in a social world. To comprehensively understand and tackle climate change, it is imperative to analyse the collective actions of significant segments of society, instead of solely emphasizing individual initiatives. From more of an evolutionary approach, according to McDougall, curiosity is one of the instincts, defined as an impulse or a strong need to approach an object that differs from other objects and its surrounding, an object that excites its perceiver.[15] From this point of view, curiosity about climate change, especially when it is very intense, can be seen as a motive that is biologically determined.

Also from a psychological perspective curiosity is an intriguing phenomenon because individuals are intrinsically interested in issues which are very important not only for them but also for future generations.[16,17] Curiosity is an intrinsic need to seek out new information and sensory experiences. It motivates exploratory behaviour.[18–20] During an explosion of research into exploratory behaviour in the 1950s, the first theories of curiosity emerged. The forerunner of curiosity research, Berlyne, explicitly distinguished between epistemic and perceptual curiosity.[21] Epistemic curiosity was aroused by scientific theories, which motivated the testing of hypotheses in order to solve an unknown task using abstractive representation. In this context, epistemic curiosity about climate change can include the search for information about the causes, the consequences or the ways of coping with a change in climate. In turn, perceptual curiosity was aroused by sensory stimulation (e.g. sights, sounds, tastes, smells). Exposure to heavy rain, strong winds or very hot or cold temperatures can trigger perceptual curiosity about climate change.

The current psychological literature on curiosity conceptualises curiosity in a variety of ways. For example, it has been studied as an aspect-level personality construct with a broad trait of openness to experience. The Openness to Experience dimension measures an individual's "receptiveness to new ideas, approaches, and experiences".[22] It describes a mix of characteristics related to intellectual curiosity, aesthetic interest, perceived intelligence, imagination, fantasy, creativity, or unconventionality.[23–25] This characteristic tends to remain relatively constant. It means that some people are not and will not be interested in climate change, but others can develop and strengthen their own curiosity about planetary warming and pollution.

Spielberger and Reheiser also offer an interesting approach to the phenomenon of curiosity.[26] They describe an experience of curiosity as a positive emotional state that significantly differs depending on the individual, but that is also a relatively stable personality trait. It motivates exploration and investigation of perceived stimuli and, as such, it is viewed as an asset to one's environmental adaptation and adjustment. From this perspective, the study of climate change can foster positive attitudes towards various weather-related issues. As a result, it can encourage further investigation: climate change curiosity is a persistent trait that resonates across settings.

The literature on curiosity conceptualises curiosity not only as a facet-level personality construct under the broad trait of openness to experience, as some researchers treat curiosity as a multidimensional construct. For example, Kashdan et al propose the Five-Dimensional Model of Curiosity.[19] There are following dimensions: Joyous Exploration (seeking out new knowledge and information and enjoying learning), deprivation sensitivity (this involves reducing undesirable states of information deprivation), social curiosity (an interest in other people's behaviours, thoughts or feelings and the way in which details about other people are discovered – in indirect, surreptitious and clandestine ways), Stress tolerance (the dispositional tendency to cope with the anxiety) and sensation seeking (an inclination to pursue new and intense sensory).

Although these forms of curiosity differ from each other, it seems that the common denominator is the idea of being curious, linked to wanting to experience and learn something new.[27] Curious people probably reject simplistic or

superficial explanations including explanations for climate change and instead prioritise a deeper comprehension and explanation of its causes. They are more likely to tackle issues regularly, devoting more time and effort to their resolution. This enables them to identify more potential solutions to different problems including climate change.[28,29] What`s more, their curiosity probably compels them to formulate issues related to global warming that need to be solved, to inquire about them, and to pursue answers persistently.

Several constructs have been proposed sharing key aspects with curiosity.[27] Researchers have used a variety of questionnaires to measure curiosity but two kinds are dominant: questionnaires that diagnose general curiosity[19,21,28,30–32] and questionnaires concerning curiosity in relation to specific areas: interpersonal relations (e.g. Interpersonal Curiosity Scale), curiosity at work (e.g., Work-related Curiosity Scale), smoking curiosity (e.g. Brief Adolescent Smoking Curiosity Scale), specific curiosity in sport (e.g. Fans' Specific Curiosity) or curiosity about elements of nature (e.g. Elements of Nature Curiosity Scale).[18,33–35]

Even though curiosity about climate changes should be normal and understandable, there is no scale for diagnosing people's curiosity about climate changes in the literature, therefore the main purpose of this study is to present a tool for diagnosing people's curiosity about climate changes.

Development and Validation of the Scale

Construction of the Scale

The inspiration for the construction of the CCCS scale came from a number of sources: our personal experiences and conversations, and publications on climate changes. Using these sources, we attempted to craft statements about the curiosity of different aspects of climate changes: sources, consequences and coping with climate changes.

We tried to formulate the questions for the CCCS in a way that the average recipient could understand and assigned the initial pool of statements to: a) curiosity of climate changes b) curiosity of consequences of climate changes, and c) ways of coping with climate changes.

We tried to craft statements for each factor in such a way that a person with a particular attitude could disagree or agree with each given statement.

We started the construction of the questionnaire with a pool of 47 items on the phenomenon of curiosity of climate changes. In the next steps, we excluded 9 items that were formulated in a very similar way, were a paraphrase of content already expressed in other items or contained technical vocabulary.

To assess the quality of the construct, five experienced environmental psychologists were asked to use a five-point Likert-type scale (very poor, poor, fair, good, very good) to independently determine the extent to which the initial pool of 38 items reflected: (a) the definition of curiosity of climate change (relevancy) and (b) were clearly and simply written (clarity). Only items with an average score of 4.0 or above were retained.

A total of 30 items were accepted for further analysis. The number of questions in each subscale then proved to be balanced: the sources of climate changes contained 10 items, the consequences of climate changes contained 10 items, and curiosity of ways of coping with climate changes also included 10 items. The next stages of the work on the Curiosity of Climate Changes Scale are presented below.

Study 1. Exploratory Factor Analysis

The first aim of this study was to determine the factor structure of the Curiosity of Climate Changes Scale, and the second aim was to determine its reliability.

Method

Participants

In order to verify questionnaire's structure, we conducted a first study with 306 participants – 220 women (71.90%), 79 men (25.82%) and 7 people identifying with a gender other than male or female (2.29%). The age of the subjects ranged from 18 years old to 83 years old (M = 25.75; SD = 8.35). Most of the participants were residents of cities (83%), while 17% of participants lived in villages. When it comes to the education level of the subjects, the majority of the

respondents had secondary education (55.88%), followed by university education (42.16%). Participants with vocational (1.31%), lower secondary (0.33%) and primary (0.33%) education were a minority. The vast majority of the participants identified as heterosexual (77.78%).

Procedure

We collected data for the research via the Internet (Google Sheets and a computer application). Google Sheets is an interactive form whose layout corresponds to the graphical design of the paper equivalent. The subjects filled in the questionnaire directly on the Internet.

The current project (Studies 1–3) was approved by the Bioethics Committee of the Institute of Psychology at the University of Szczecin (14/2019; date of approval: 6 December 2019).

The study was conducted in accordance with the ethical principles of the 2013 Helsinki declaration and its subsequent amendments. All participants provided fully informed, written consent.

Results

Before proceeding with the factor analysis, we analysed the sampling adequacy (Kaiser-Meyer-Olkin test, KMO) and performed the Bartlett test of sphericity. The KMO measure of sampling adequacy was 0.965, which is a very good result.[36] The Bartlett's sphericity test: χ^2 (435) = 6553.188; $p < 0.001$, indicated that the correlations between the items were high enough to conduct a reliable analysis.

Initial analyses using a parallel analysis suggested the possibility of a one-factor solution (actual $\lambda 1 = 15.55$, $\lambda 2 = 1.46$, $\lambda 3 = 1.16$ vs $\lambda 1 = 1.63$, $\lambda 2 = 1.54$, $\lambda 3 = 1.47$ from the parallel analysis).

Thus, a possible one-factor solution was investigated, taking into account the loading of their theoretical interpretation. Two- and three-factor solutions were also tested. Exploratory factor analysis (EFA) was used to determine the factor structure of the CCCS. Factor solutions were tested using principal axis factoring (PAF) (as it does not depend on multivariate normality assumptions) with Oblimin rotation, as factors may be correlated.[37,38] The individual factor solutions were then assessed for their theoretical and structural interpretation, model coefficients (>.40) and eigenvalues (>.20).[39]

The exploratory factor analysis using the principal axis factoring principal-factors method of estimation showed a strong single-factor. Thus, only those items loading on the first factor were retained.

The quality of the items that composed the one-factor solution was also analysed. Comrey and Lee classified items with loadings higher than or equal to 0.71 as excellent, higher than or equal to 0.63 as very good, higher than or equal to 0.55 as good, higher than or equal to 0.43 as reasonable, and higher than or equal to 0.32 as poor.[40] Thus, as to the items' quality, statements loaded above 0.70 were retained. Thus, the final version of the Curiosity of Climate Changes Scale consisted of 15 items.

The 15-item version of the Curiosity of Climate Changes Scale was again subjected to exploratory factor analysis using the method of factoring the principal axis. Bartlett's sphericity test: χ^2 (105) = 3358.821; $p < 0.001$. The KMO measure of sampling adequacy was 0.958. The final version of the Curiosity Climate Change Scale contains 15 items (Table 1).

A one-factor structure explains about 60% of the variance. The factor has satisfactory reliability as measured by Cronbach's alpha. The reliability of the factor is Cronbach's alpha = 0.95.

Study 2. Confirmatory Factor Analysis

The next stage of the research was to conduct a confirmatory factor analysis. Two models were tested: the M1 model assumed a one-factor solution and included all statements about curiosity of climate changes, whereas the M2 model assumed a three-factor solution (Factor 1: "Curiosity of sources of climate changes", items 4, 6, 7, 9, 14; Factor 2: "Curiosity of consequences of climate changes", items 2, 3, 5, 11, 13, 15; Factor 3: "Curiosity of ways of coping with climate changes", items 1, 8, 10, 12).

We used several indices to evaluate the model on the empirical data: χ^2 (df), comparative fit index (CFI), TLI index, and root mean squared error of approximation (RMSEA). The following criteria indicated a good fit of the model to the empirical data: >0.90 CFI, TLI and <0.09 RMSEA.[41]

Table 1 Medium, Standard Deviation, Communalities, Factor, and Item-Total Correlations of the Curiosity of Climate Changes Scale (N = 306)

No.	Items:	*M*	*SD*	*C*	*F*	*I-T*
1	I wonder what can be done to stop the rise of our planet's temperature.	3.22	1.24	0.63	0.79	0.77
2	I am interested in how the degradation of the natural environment may change the life on Earth in the future.	3.53	1.26	0.61	0.78	0.76
3	I think about the consequences of the greenhouse effect on me.	3.52	1.31	0.54	0.74	0.72
4	I wonder where the excess carbon dioxide in the atmosphere comes from.	3.02	1.25	0.59	0.77	0.75
5	I often think about the effects of climate change on people.	3.46	1.23	0.59	0.77	0.75
6	I look for connections between coal mining and the changing weather conditions on Earth.	2.74	1.28	0.54	0.74	0.72
7	I am interested in why the glaciers are melting so fast.	3.10	1.33	0.66	0.81	0.79
8	I wonder what I can do to reduce the negative consequences of climate change.	3.59	1.25	0.57	0.75	0.73
9	I look for the causes of frequent tornadoes, floods, and droughts in many regions of the world.	2.80	1.34	0.46	0.71	0.66
10	I am interested in ideas / proposals on how to replace coal mining in order to reduce the air pollution.	3.17	1.30	0.54	0.73	0.71
11	I wonder about the effects of melting glaciers on the future of life on Earth.	3.45	1.31	0.59	0.76	0.74
12	I pay attention to any information that offers a way to stop the degradation of the natural environment.	3.02	1.29	0.60	0.77	0.75
13	I am interested in the consequences of the greenhouse effect in different parts of the world.	3.13	1.33	0.67	0.82	0.80
14	I analyse how deforestation will increase the level of carbon dioxide in the atmosphere.	2.83	1.25	0.53	0.73	0.80
15	I think about how life on Earth will change as a result of excessive human interference in the natural environment.	3.75	1.23	0.56	0.75	0.73
Variance [%]					60.00	
Reliability (Cronbach's alpha)					0.95	

Method

Participants

In the second study, we collected data from a sample consisting of 234 participants, including 174 women (74.35%) and 60 men (25.65%). The age of the respondents ranged from 18 years old up to 82 years old (M = 26.60; SD = 8.17). Among the collected sample, 188 participants lived in cities (82%) and 46 participants lived in villages (18%).

Most of the respondents had university education (58%), followed by secondary education (39.25%). A small part of the sample consisted of respondents with either vocational education (1.25%), primary education (1.00%) or lower secondary education (0.50%). Similarly to the previous study, the vast majority of the respondents identified themselves as heterosexual (83%).

Procedure

As with the exploratory factor analysis data collection, the confirmatory factor analysis data were collected electronically. The study was conducted in accordance with the ethical principles of the 2013 Helsinki declaration and its subsequent amendments. All participants provided fully informed, written consent.

Results

The results of the confirmatory factor analysis are shown in Table 2. The one-factor model proved to be a better fit to the empirical data.

Study 3. Curiosity of Climate Changer Scale and Other Diagnostic Tools

In Study 3, we looked for possible relationships between the Curiosity of Climate Changes Scale and other instruments for diagnosing curiosity and attitude towards the natural environment.

Table 2 Indices for Each Model

Model	χ^2	*p*	*Df*	CFI	TLI	RMSEA
Model 1	280.14	0.01	90	0.919	0.926	0.044
Model 2	900.978	0.01	90	0.653	0.684	0.443

Method

Participants

In the third study, we collected data from a sample consisting of 259 participants, including 175 women (67.58%) and 84 men (32.43%). The age of the respondents ranged from 18 years old up to 84 years old (M = 26.41; SD = 7.93). Among the collected sample, the largest number of participants were residents of cities (83%), and the other respondents lived in villages (17%). Most of the respondents had university education (54.05%), followed by secondary education (42.86%). A small part of the sample consisted of respondents with either vocational education (2.54%), primary education (1.16%) or lower secondary education (0.39%). Similarly to the previous studies, the vast majority of the respondents identified themselves as heterosexual (80.69%).

Procedure

The participants filled in the questionnaire directly on the Internet. The people who took part in the study were also asked to fill in all questionnaires carefully. The study was conducted in accordance with the ethical principles of the 2013 Helsinki declaration and its subsequent amendments. All participants provided fully informed, written consent.

Instruments

The Curiosity of Climate Changes Scale

Curiosity and Exploration Inventory II[28]

The CEI II was developed by Kashdan et al and translated into Polish by Kaczmarek et al.[28,42] The CEI II consists of two subscales: stretching and embracing. The scale has a satisfactory internal consistency of Cronbach's α = 0.86.

Need for Cognitive Closure Scale[43]

To measure NFC, we used the Need for Cognitive Closure Scale in the Polish adaptation by Kossowska.[44] The scale consists of five subscales: (1) preference for order and structure in the environment, (2) predictability of future contexts, (3) affective discomfort caused by ambiguity, (4) closed-mindedness, and (5) decisiveness of judgements and choices.

Elements of Nature Curiosity Scale (ENCS).[45]

The Elements of Nature Curiosity Scale (ENCS) diagnoses people's curiosity about hazardous events caused by elements of nature: such as volcanic eruptions, thunderstorms, avalanches, and floods. The scale has an internal consistency of Cronbach's α = 0.86.

Climate Anxiety Scale (CAS).[46]

The CAS was developed by Clayton and Karazsia and was translated into Polish by Larionow et al.[46,47] The Climate Anxiety Scale (CAS) is a 13-item questionnaire for assessing climate anxiety (CA) as a psychological response to climate change. The CAS consists of two subscales, namely, cognitive impairment (Cronbach's α = 0.87) and functional impairment (Cronbach's α = 0.87).

Environmental Identity Scale (EID)[48]

The environmental identity (EID) scale was developed to measure individual differences in a stable sense of inter-dependence and connectedness with nature. The results support the internal consistency (Cronbach's α = 0.91) of the scale. Polish adaptation: Larionow.[49]

Generational Time Perspective[50]

The Generational Time Perspective Scale was developed to measure one's concentration on life in future generations. The first factor includes items about the cognitive representation of the distant future (Cronbach's α = 0.83). The second factor describes negative emotions towards the problems that humanity may face in future generations (Cronbach's α = 0.85).

Results

Statistical analyses show that the Curiosity Climate Change Scale (CCCS) correlates with all the tools used in the validation process, but the vast majority of the dependencies found are rather weak. The weakest correlations found were between the

Table 3 Curiosity of Climate Changes and Other Instruments

	CCCS
CEI-II – Stretching	0.34*
CEI-II – Embracing	0.15*
PPD – Order Preference	0.20*
PPD – Predictability Preference	0.21*
PPD – Ambiguity Intolerance	0.21*
PPD – Closed-mindedness	−0.37*
PPD – Decisiveness	−0.13*
ENCS	0.22*
CAS – Cognitive Difficulties	0.28*
CAS – Functional Difficulties	0.16*
EID	0.62*
GPC	0.64*

Note: *$p < 0.05$.

CCCS and PPD – Decisive Scale ($r = -0.13$), CEI-II – Embracing Scale ($r = 0.15$) and CAS – Functional Difficulty Scale ($r = 0.16$). Then, slightly higher correlations, although still weak, ranging from $r = 0.20$ up to $r = 0.28$, was discovered between the CCCS and the following tools: PPD – Order Preference Scale ($r = 0.20$), PPD – Predictability Preference Scale and Ambiguity Intolerance Scale ($r = 0.21$), ENCS ($r = 0.22$), CAS – total score ($r = 0.24$), CEI-II – total score ($r = 0.26$) and CAS – Cognitive Difficulties Scale ($r = 0.28$). Stronger correlations, but again still somewhat weak, were observed in the relationships between the CCCS and CEI-II – Stretching Scale ($r = 0.34$) and PPD – Closed-mindedness Scale ($r = .-37$). The strongest relationships were found between the CCCS and GPC ($r = 0.64$), followed by EID ($r = 0.62$). All of the correlations between the CCCS and the other instruments are presented in Table 3.

Discussion

The CCCS is a useful tool for assessing individuals' curiosity about climate change. The results of the present study indicate that the Curiosity of Climate Change Scale is a reliable and valid instrument. The exploratory factor analysis and confirmatory factor analysis verified the one-factor structure. The results suggest that the CCCS also has strong internal consistency.

The CCCS correlates positively with other assessment tools. In particular, the CCCS correlates highly with the Generational Time Perspective Scale, which may indicate that curious people are aware of the consequences of climate change for future generations, and they are concerned about the next generations.[50]

Environmental Identity also correlates with the Curiosity of Climate Changes Scale. Environmental Identity (EID) diagnoses attachment to nature.[51] This result may mean that people who are curious about climate change have a strong relationship with the natural environment. Nature is very important to them, and they want to protect it.

Curiosity about climate change correlates with general curiosity and exploration, but the correlation between the variables is rather low. Therefore, these correlational results must be interpreted very cautiously. The results may suggest that the Curiosity of Climate Changes Scale measures separate phenomena from those diagnosed by other human curiosity scales.

The CCCS is moderately correlated with the Climate Anxiety Scale. There was a stronger correlation between the CCCS and cognitive impairment than functional impairment, suggesting that high scores on the CCCS indicate that the respondents have more problems with cognitive functioning than social functioning. We could speculate that due to the increased curiosity about climate changes, followed by gathering information regarding it, the concept of climate change and its negative consequences is more likely to be activated within one's internal structures, causing difficulties with cognitive functioning. The opposite could also be true – due to climate anxiety, one could become more curious about

climate changes. Either way, we assume a stronger tendency to activation of climate change concepts within the population that is curious about said topic.

The CCCS correlates poorly with the Elements of Nature Scale. This result means that people interested in climate change have a moderate interest in elements of nature, which may be somewhat surprising, but also reassuring as it shows that one does not have to be interested in nature itself or be close to it to show interest in the phenomenon of climate change.

Limitations and Future Directions

The validation work on the construction of the questionnaire also has some limitations. One of them is undoubtedly the selection of the research sample. Mostly young people participated in the study, so it is very difficult to generalise the results obtained. In future research, people from different age groups should be invited to participate.

Although the gender of the respondents was controlled for in the construction of the questionnaire, this variable was not analysed. Previous research, eg on the protection of the natural environment, indicates that the gender of a person determines their involvement in pro-environmental activities (women are more likely to undertake such activities). It therefore seems necessary to take gender into account in future studies.

The CCCS is a reliable tool, as shown by the Cronbach's results, but the validation process of the CCCS did not include an analysis of the stability of the questionnaire over time, which should be considered a limitation. Future research should measure the stability of the CCCS questionnaire.

The method of data collection was Google Sheets. However, it's important to note that collecting data online can sometimes lead to low-quality responses. Therefore, the results of this study should be interpreted with caution.

Curiosity of climate change does not strongly relate to other measures of curiosity. Further research is needed to explore these tenuous links in more detail. For example, perhaps studying the link between interest in climate change and the Five-Dimensional Curiosity Scale (5DC), which includes the following components: Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Social Curiosity, and Thrill Seeking, could provide fresh insight into the connection between these factors. Which aspects of five dimensional curiosity model correlate with the CCCS?[19]

Future research could also examine the relationship between curiosity about climate change and various variables of psychological functioning. Do personality traits correlate with climate change curiosity? In future research, it would be also interesting to analyze the relationship between the CCCS and personal resources such as: self-efficacy, coping, self-esteem or positive orientation. Does the availability of personal resources have an impact on people's interest in climate change?

It would also be very interesting to examine the relationship of the CCCS with scales of well-being, to see if it is possible that inducing curiosity about climate change could be beneficial in the personal lives of individuals. In general, we believe it would be of value to examine potential factors indicating one's curiosity regarding climate changes, especially knowing that one's relation to nature is not one of them. Knowing such factors could be beneficial when discussing raising awareness of climate changes but also actual individual mitigation actions. This raises another question worth answering in future research: Is there any relationship between the CCCS and actual pro-environmental behaviour?

Conclusion

The Curiosity of Climate Change Scale can be a source of scientific reflection on environmental challenges and threats in the XXI century. Moreover, measuring dispositional construct that can diagnose psychological aspects of climate change is becoming increasingly important not only in theory but also in practice: this scale can help teachers and environmental educators effectively deliver diagnoses when they start to work with students or clients. Moreover, this scale may be used to measure the effects of education about climate changes. Finally, the design and development of a reliable and valid measure of this type can further advance environmental psychology research and practice.

Data Sharing Statement

The data sets used during the current study are available from the corresponding author.

Acknowledgment

The authors thank the study participants who completed the questionnaires.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Disclosure

The authors declare that they don't have any competing financial interests or personal relationships that have an impact on this research.

References

1. Stern DI, Kaufmann RK. Anthropogenic and natural causes of climate change. *Clim. Change*. 2014;122:257–269.
2. Siddiqui AH, Hasnain MD, Alam M, Fatima S. Climate change: causes, impacts and solutions. *Int Res J Eng Technol*. 2022;9(11):928–934.
3. Altaf L, Bhat AA, Bhat BP, Bhat SA, Wani SA. Climate Change: causes, consequences and mitigation strategies. *Indian J Agric Sci*. 2022;8(4):23–26.
4. Marsz AA, Sobkowiak L, Styszyńska A, Wrzesiński D. Causes and course of climate change and its hydrological consequences in the Greater Poland region in 1951–2020. *Quaest Geogr*. 2022;41(3):183–206. doi:10.14746/quageo-2022-0033
5. Holme P, Rocha JC. Networks of climate change: connecting causes and consequences. *Appl Netw Sci*. 2003;8(10):1–20.
6. Mozaffari GA. Climate change and its consequences in agriculture. *IntechOpen*. 2022;2022:1–19.
7. Ommer R, Perry I, Cochrane KL, Cury P. *World Fisheries: A Social-Ecological Analysis*. Chichester: Wiley-Blackwell; 2011.
8. Szegleti Z, Czóbel S, Zimmermann Z, Horváth F. How do Central European forest stands respond to climate change – review. *J Agric Environ Sci*. 2020;7(1):35–46. doi:10.18380/SZIE.COLUM.2020.7.1.35
9. Odimegwu F. *Tourism & Climate Change: An Assessment of Relationships Between Tourism and Climate Change*. Beau Bassin: LAP LAMBERT Academic Publishing; 2020.
10. Filho WL, Vidal DG, Dinis MA. *Climate Change and Health Hazards. Addressing Hazards to Human and Environmental Health from a Changing Climate*. Cham: Springer; 2023.
11. Thoma MV, Rohleder N, Rohner SL. Clinical ecopsychology: the mental health impacts and underlying pathways of the climate and environmental crisis. *Frontiers in Psychiatry*. 2021;12:1–20. doi:10.3389/fpsyt.2021.675936
12. Dyche L, Epstein RM. Curiosity and medical education. *Med Educ*. 2011;45:663–668. doi:10.1111/j.1365-2923.2011.03944.x
13. Inan I. *The Philosophy of Curiosity*. New York: Routledge; 2012.
14. Bineth A. Towards a sociology of curiosity: theoretical and empirical consideration of the epistemic drive notion. *Theory Soc*. 2023;52:119–144. doi:10.1007/s11186-021-09464-y
15. McDougal W. *An Introduction to Social Psychology*. London: Batoche Books; 2001.
16. Aschieri F, Durosini I, Smith JD. Self-curiosity: definition and measurement. *Self Identity*. 2020;19(1):105–115. doi:10.1080/15298868.2018.1543728
17. Yow YJ, Ramsay JE, Lin PKF, Marsh NV. Dimensions, measures, and contexts in psychological investigations of curiosity: a scoping review. *Behav Sci*. 2022;12(12):493. doi:10.3390/bs12120493
18. Kashdan TB, Goodman FR, Disabato DJ, McKnight PE, Kelso K, Naughton C. Curiosity has comprehensive benefits in the workplace: developing and validating a multidimensional workplace curiosity scale in United States and German employees. *Pers Individ Differ*. 2020;155:1–13. doi:10.1016/j.paid.2019.109717
19. Kashdan TB, Stiksma MC, Disabato DJ, et al. The five-dimensional curiosity scale: capturing the bandwidth of curiosity and identifying four unique subgroups of curious people. *J Res Pers*. 2018;73:130–149. doi:10.1016/j.jrp.2017.11.011
20. Litman JA. Relationships between measures of I- and D type curiosity, ambiguity tolerance, and need for closure: an initial test of the wanting-liking model of information-seeking. *Pers Individ Differ*. 2010;48(4):397–402. doi:10.1016/j.paid.2009.11.005
21. Berlyne DE. A theory of human curiosity. *Br J Psychol*. 1954;45:180–191. doi:10.1111/j.2044-8295.1954.tb01243.x
22. McCrae RR, Costa PT. *Personality in Adulthood*. New York: Guilford Press; 1990.
23. Hirsh JB, DeYoung CG, Peterson JB. Metatraits of the big five differentially predict engagement and restraint of behavior. *J Pers*. 2009;77(4):1085–1102. doi:10.1111/j.1467-6494.2009.00575.x
24. Nusbaum EC, Silvia PJ. Are intelligence and creativity really so different? Fluid intelligence, executive processes, and strategy use in divergent thinking. *Intelligence*. 2011;39(1):36–45. doi:10.1016/j.intell.2010.11.002
25. Zhang W, Sun SL, Jiang Y, Zhang W. Openness to experience and team creativity: effects of knowledge sharing and transformational leadership. *Creat Res J*. 2019;31(1):62–73. doi:10.1080/10400419.2019.1577649
26. Spielberger CD, Reheiser EC. Assessment of emotions: anxiety, anger, depression, and curiosity. *Appl Psychol*. 2009;1(3):271–302.

27. Wagstaff MF, Flores GL, Ahmed R, Villanueva S. Measures of curiosity: a literature review. *Hum Resour Dev Q*. 2021;32(6):363–389. doi:10.1002/hrdq.21417
28. Kashdan TB, Gallagher MW, Silvia PJ, et al. The Curiosity and Exploration Inventory-II. Development, factor structure, and psychometrics. *J Res Pers*. 2009;43(6):987–998. doi:10.1016/j.jrp.2009.04.011
29. Litman JA. Interest and deprivation dimensions of epistemic curiosity. *Pers Individ Differ*. 2008;44(7):1585–1595. doi:10.1016/j.paid.2008.01.014
30. Litman JA, Jimerson TL. The measurement of curiosity as a feeling of deprivation. *J Pers Assess*. 2004;82(2):147–157. doi:10.1207/s15327752jpa8202_3
31. Litman JA, Spielberger CD. Measuring epistemic curiosity and its diversive and specific components. *J Pers Assess*. 2003;80:75–86. doi:10.1207/S15327752JPA8001_16
32. Collins RP, Litman JA, Spielberger CD. The measurement of perceptual curiosity. *Pers Individ Differ*. 2004;36(5):1127–1141. doi:10.1016/S0191-8869(03)00205-8
33. Litman JA, Pezzo MV. Dimensionality of interpersonal curiosity. *Pers Individ Differ*. 2007;43(6):1448–1459. doi:10.1016/j.paid.2007.04.021
34. Khalil GE, Calabro KS, Prokhorov AV. Development and initial testing of the brief adolescent smoking curiosity scale (ASCOS). *Addict. Behav.* 2018;78:67–73. doi:10.1016/j.addbeh.2017.11.008
35. Park SH, Ha JP, Mahony D. Development and validation of a measure of sport fans' specific curiosity. *J Sport Manag*. 2014;28(6):621–632. doi:10.1123/jsm.2013-0198
36. Field A. *Discovering Statistics Using SPSS*. 3rd ed. Los Angeles: Sage Publications; 2009.
37. Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Pract Assess Res Eval*. 2005;10(7):1–9.
38. O'Connor BP. SPSS and SAS programs for determining the number of components using parallel analysis and velicer's map test. *BehavRes Methods Instrum Comput*. 2000;32:396–402. doi:10.3758/BF03200807
39. Tabachnick BG, Fidell LS. *Using Multivariate Statistics*. 5th ed. Boston: Allyn and Bacon; 2007.
40. Comrey AL, Lee HB. *A First Course in Factor Analysis*. 2nd ed. Hillsdale: Lawrence Erlbaum Associates, Inc; 1992.
41. Marsh HW, Wen Z, Hau KT. Structural equation models of latent interactions: evaluation of alternative estimation strategies and indicator construction. *Psychological Methods*. 2004;9(3):275–300. doi:10.1037/1082-989X.9.3.275
42. Kaczmarek LD, Bączkowski B, Baran B The Curiosity and Exploration Inventory – II – validation of the Polish version. 5-th European Conference on Positive Psychology; 2010; Copenhagen.
43. Webster DM, Kruglanski AW. Individual differences in need for cognitive closure. *J Pers Soc Psychol*. 1994;67(6):1049–1062. doi:10.1037/0022-3514.67.6.1049
44. Kossowska M. Różnice indywidualne w potrzebie poznawczego domknięcia. [Individual differences in the need for cognitive closure]. *Przegl Psych*. 2003;46(4):355–374. Polish.
45. Próchniak P. Development and testing of the elements of nature curiosity scale. *Soc Behav Pers*. 2017;45(8):1245–1254. doi:10.2224/sbp.6130
46. Clayton S, Karazsia BT. Development and validation of a measure of climate change anxiety. *J Environ Psychol*. 2020;69:1–11. doi:10.1016/j.jenvp.2020.101434
47. Larionow P, Sołtys M, Izdebski P, et al. Climate change anxiety assessment: the psychometric properties of the polish version of the climate anxiety scale. *Front Psychol*. 2022;13:1–9. doi:10.3389/fpsyg.2022.870392
48. Clayton S. Environmental Identity: a Conceptual and an Operational Definition. In: Clayton S, Opotow S, editors. *Identity and the Natural Environment: The Psychological Significance of Nature*. Cambridge: MIT Press; 2003:45–65.
49. Larionow P. W stronę psychologii środowiskowej: właściwości psychometryczne polskiej wersji Skali Tożsamości Środowiskowej.[Towards environmental psychology: psychometric properties of the Polish version of the Environmental Identity Scale]. *Kwartalnik Naukowy Fides Et Ratio*. 2020;44(4):190–208. Polish.
50. Timoszyk-Tomczak C, Próchniak P. Generational Time Perspective: development and validation of a new diagnostic tool. In: *Scientific Reports*. In press; 2023.
51. Clayton S, Czellar S, Nartova-Bochaver S. Cross-cultural validation of a revised environmental identity scale. *Sustainability*. 2021;13(4):2387. doi:10.3390/su13042387