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Measuring Environmental Worldviews: Investigating the Dimensionality of the New Environmental Paradigm Scale for Children in a Large Central European Sample

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Abstract: A complex research program linked to the national Sustainability Thematic Week (STW) educational program was launched in 2020 to examine Hungarian primary and secondary school students' environmental attitudes, behaviors, and awareness. The Hungarian newly developed version of the New Ecological Paradigm Scale for Children was used in a large sample ($N = 9396$). The results of a set of factor analyses suggested that the NEP Scale for Children cannot be considered unidimensional. We found three distinct and valid factors (Questioning of Human Intervention, Rights of Nature, and Eco-Crisis) with significant associations, having partially different directions, with gender, age, pro-environmental behavior, and economic-technical aspects of environmental worldviews, providing thus new evidence for the highly complex structural characteristics of pro-environmental attitudes and worldviews. Our results might contribute to solving the issues, misunderstandings, and challenges that are related to the dimensionality of the NEP Scale and, even after decades of use, make the comparison of international research difficult.

Keywords: environmental attitudes; environmental worldviews; New Ecological Paradigm Scale for Children; pro-environmental behavior; factor analysis



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1. Introduction

Social scientists have long been investigating the background of motivations to engage in pro-environmental behavior. Detailed knowledge of why individuals behave (or do not behave) pro-environmentally is important for researchers and policymakers alike [1]. Environmental sociological, social, and environmental psychological theories and models—as opposed to, for example, some economic theories—argue that pro-environmental behavior is derived from internal values, beliefs, environmental knowledge, and pro-environmental attitudes (c.f. [2]). In the American society of the 1970s, a new worldview, i.e., a set of beliefs and values regarding the relationship between people and the physical environment, emerged after witnessing certain consequences of the prevailing treatment of nature in the era. The anthropocentric Dominant Social Paradigm (DSP) included beliefs in endless progress, the supremacy of growth over environmental protection, an abundance of resources, the appropriateness of using nature for human purposes, the ability of nature to recover, and the problem-solving capacity of scientific and technological progress [3,4]. In the 1980s, Van Liere and Dunlap [5] (p. 194) emphasized that “the most powerful analyses of the social bases of environmental concern will likely be those which consider both its demographic and cognitive determinants”. Psychological processes, such as environmental

values and attitudes, play key roles in determining how global conditions impinge on individuals' everyday behavior [6]. The emerging new ecocentric paradigm emphasized the high valuation of nature, the limits to growth, the necessity of achieving a "steady-state" economy, the importance of human harmony with nature, and human responsibility in the protection of nature [4,7].

This new worldview was termed the "New Environmental Paradigm" or NEP by Dunlap and Van Liere [7], who constructed a scale for measuring the aspects of this new paradigm, i.e., the shift in people's worldview related to people-environment interaction. The New Environmental Paradigm Scale contained 12 items and was intended to assess the three primary hypothesized facets of NEP: balance of nature, limits to growth, and human dominance over nature (anti-NEP, after the revising of scoring anti-anthropocentrism) with four items for each. Each item could be answered on a 4-point Likert scale. Based on the results of the psychometrical analysis, i.e., the high corrected item-total correlations, the high Cronbach's alphas (0.81 and 0.76), and the accounting of the first unrotated principal factor for high percentages of the variance, Dunlap and Van Liere [7] argued that the NEP Scale is internally consistent and unidimensional.

After approximately 20 years of use of the NEP Scale, Dunlap and colleagues decided to revise the scale [8]. They implemented several changes: in the points of the Likert scale (5 instead of 4), the number of items (15 instead of 12, with the aim of broadening the scale content with two more aspects of the new paradigm and balancing the number of pro-NEP versus anti-NEP items), the wording of the items (to reduce the gender-specific and outdated expressions, e.g., "humans" instead of "humankind" and "mankind"), and the title of the scale. The renamed "New Ecological Paradigm Scale" (abbreviated as the revised NEP Scale) thus was intended to assess five hypothesized facets of the NEP (limits to economic growth, anti-anthropocentrism, fragility of nature's balance, human exemptionalism, and possibility of eco-crises affecting people, with three items for each), and contained a balanced number of pro-NEP (i.e., ecocentric) and anti-NEP (i.e., anthropocentric or pro-DSP) items (the eight odd-numbered items for pro-NEP, and the seven even-numbered items for anti-NEP orientation). Dunlap and colleagues [8] conducted item and factor analysis, and they found a high internal consistency (the value of Cronbach's alpha was 0.83) and four factors containing different items than the hypothesized facets did. Despite the resulting factor structure, Dunlap and colleagues suggested using the revised scale as unidimensional since all 15 items load heavily on the first unrotated factor because all items showed strong item-total correlations and because the first three factors contained items from several facets with heavy factor loadings.

There are several inter-related issues that are important to consider regarding the applicability of the NEP scales. The internal consistency of the scale is the first point to discuss. After reviewing more than 300 articles using any version of the NEP Scale, Hawcroft and Milfont [9] found that the value of Cronbach's alpha is reported as lower than is considered acceptable (i.e., 0.69 according to Nunnally cited by them) in half of the studies that report internal reliability.

The second point is the dimensionality of the scale, which is related to the first point since unidimensionality is one of the assumptions of using and interpreting Cronbach's alpha as an indicator of internal consistency [10]. Hawcroft and Milfont [9] pointed out that a large number of the reviewed studies treat the items as measuring one construct even if unidimensionality is not examined or justified. Among the studies published after 2010 we reviewed, more studies were found that used overall NEP score after factor analysis resulted in more than one factor and without analyzing one-factor solutions (e.g., ref. [11,12]). The conclusions about unidimensionality were reached by some researchers based on only exploratory factor analysis (e.g., ref. [13,14]), by others, after conducting confirmatory factor analysis (e.g., ref. [15–17])—all these researchers revealed second-order models). Similar to Dunlap and colleagues [8], many researchers (e.g., ref. [12,13,18–20]) chose principal component analysis with varimax rotation as the method of exploratory factor analysis (EFA). Regarding the factor structure of the revised NEP Scale, the researchers reported

different results: models with one factor (e.g., in a U.S. sample [14]), two factors (e.g., in a Brazilian sample [21]), three factors (e.g., in Australian samples [13]), four factors (e.g., in New Zealand samples [22]), and five factors (e.g., in a Greek sample [12]).

The issue of dimensionality relates to the cross-cultural applicability of the NEP Scale, i.e., our third point. Dunlap and colleagues [8] argued that, since the dimensionality of the NEP Scale is sample-specific due to the differences in the coherence and consistency of belief systems between populations, the treatment of the scale as uni- or multidimensional should be based on the results of the particular research. Many researchers argue that the cross-cultural validity and thus the dimensionality of the NEP Scale depend on the sociocultural context in which the environmental beliefs and experiences are embedded, and which is different from the North American context where the NEP originally emerged (see [20,23], and for children's version detailed below: [24,25]). In their summary, Rosa and colleagues [21] discussed that the psychometric properties of the NEP Scale (e.g., internal consistency) are poorer when used in a non-WEIRD (Western, Educated, Industrialized, Rich, and Democratic) country.

The last issue focused on what the NEP Scale actually measures. According to Brennan and colleagues [13], the NEP assesses a loose set of concerns for the environment on a societal basis instead of measuring a worldview or a paradigm, or environmental attitudes in the personal domain. Harraway and colleagues [22] cite Shephard, who argued that NEP is an instrument of behavioral tendencies. In his summary, Harrison [26] discussed whether NEP measures environmental attitude, ecological worldview, environmental values, or a system of environmental beliefs, and he connects this question to the issue of dimensionality: a unidimensional instrument is more suitable for measuring attitudes, whereas assessing beliefs requires a multidimensional measurement tool. Hawcroft and Milfont [9] advise researchers to continue applying the NEP Scale as a standardized instrument of environmental attitudes until the adoption of a new "gold-standard" measurement tool.

Since it is children who will be responsible for the treatment of nature in the future and thus there was a need to measure children's environmental worldview dimensions included in NEP and the development of children's worldview related to the environmental education programs, the revised NEP scale was developed for children aged 10 to 12 by Manoli and colleagues in several steps [27,28]. The points of the Likert scale were unmodified, i.e., five, during the developmental process. In the first phase [27], they replaced the words not understandable to or convenient for children with easier and more familiar synonyms (e.g., "greatly mistreating the environment" instead of "severely abusing"). Van Petegem and Blicck [24] used this version in their research. In the next phase, Manoli and colleagues [28] reformulated several items containing problematic words for students (e.g., "treating nature badly" instead of "greatly mistreating the environment"). Based on the exploratory factor analysis (principal components analysis with varimax rotation) of data collected in a student sample with this 15-item version, they deleted 4 items from the scale. As the last step, they removed one more item because of the high number of "Do not understand" responses and conducted a confirmatory factor analysis in another student sample with this 10-item version in order to examine how these data fit the model derived from the previous steps and a unidimensional model which the original NEP authors suggested as the best model in an adult sample. They reported a good fit in both cases and suggested that the NEP Scale for Children can be treated as both three-dimensional and unidimensional. To examine the robustness of the final results, it is worth mentioning the following. First, the final model encompasses four items with low parameter estimates (between 0.09 and 0.25). Second, all the three items in the Human Exemptionalism factor have low parameter estimates, and despite reverse scoring of these items, item 6 loads in the factor with the opposite sign. Third, the reported values of CFI (comparative fit index) are above the expected value (0.90) for good fit [29] regarding both the three-dimensional and the unidimensional model.

Although Manoli and colleagues developed this 10-item version of the NEP Scale for children aged 10 to 12, many researchers applied it or one of its preliminary variants

for assessing the environmental beliefs or attitudes of younger or older children (e.g., for children aged 8–13 [30]; for children aged 13–15 [24]; for adolescents aged 14–16 [31]). Even though a version developed for children is available, many researchers decided to use the adult version of NEP in samples of participants aged below 18 (e.g., ref. [32,33]).

The issues detailed above related to NEP scales for adults can be drawn up with similar conclusions in terms of the NEP Scale for Children after reviewing some studies using one of the versions of this scale (with 15, 11, or 10 items: [27,28]). Regarding internal consistency, the reported value of Cronbach's alpha was below 0.69, i.e., the cited value by Hawcroft and Milfont [9], in several cases (e.g., 0.23 [25]; 0.67 [34]; 0.64 [35]). Regarding the assumption of applicability of Cronbach's alpha only for unidimensional scales, some researchers estimated omega instead of alpha in the frame of a CFA. For example, in Harrison's [26] research, the value of omega was found to be 0.78 for the whole scale (which is an acceptable value of internal consistency of a multidimensional scale), and 0.57, 0.70, 0.58 for the resulting subscales (the value of omega is considered low, below 0.60; however, it can be argued as acceptable in the case of diverse constructs [36]).

Some researchers applied the scale as unidimensional without examining its dimensionality (e.g., ref. [35,37]; however, the latter researchers applied the adult version of Dunlap and colleagues [8] for children) or computed and analyzed the overall score too after concluding multidimensionality (e.g., ref. [24]). Similar to Dunlap and colleagues [8] and Manoli and colleagues [28], many researchers chose principal component analysis with varimax rotation when they conducted exploratory factor analysis (e.g., ref. [24,38,39]; Ref. [25]: do not report the rotation method—and among researchers using the adult version of Dunlap and colleagues [8] for children: [23,32,33]). In contrast to the adult version, three factors were revealed as the result of EFA in most cases (e.g., in Zimbabwean and Belgian samples [24]; in a Senegal sample [25]; in Zimbabwean, Vietnamese and Belgian samples [38]), however, with factor contents different from those of the three-dimensional model of Manoli and colleagues [28]. Though researchers using one of the versions of the NEP Scale for Children rarely found a different number of factors than three (e.g., one factor [30]; two factors [39]), the researchers using the adult version of Dunlap and colleagues [8] for children revealed factor structure with fewer or more than three factors in most cases (two factors [32]; four factors [33]; five factors [23]). Moreover, some researchers conducted (a set of) confirmatory factor analyses to justify the fit of their data to the uni- or three-dimensional models of Manoli and colleagues [28]. Regarding the unidimensional solution, a good fit for the one-dimensional model was found in none of the papers reviewed ([26,31,40,41], though Adams and colleagues [40] used stricter threshold values). A good fit for the three-dimensional model was only found by Harrison [26]; other researchers did not have the same result ([25,31,41]). Corraliza and colleagues [30] identified a second-order model with one second-order factor and three first-order factors, encompassing 9 items of the 11 initial items of Manoli and colleagues.

Regarding the cross-cultural applicability of the NEP Scale for Children, the sample-specificity of the dimensionality of the scale is supported by two facts mentioned above. First, studies that resulted in three factors (e.g., ref. [24,25,38]) with factor content different from that of the initial three factors of Manoli and colleagues [28] were not conducted in US samples. Second, the data which did not show a good fit to the three-dimensional model of Manoli and colleagues were also collected outside the US. The low Cronbach's alpha value reported by Grúňová and colleagues [25] fits the argumentation of Rosa and colleagues [21] about the poorer psychometric properties of the NEP Scale when investigating non-WEIRD samples.

The aim of our research is, among others, to explore the environmental awareness associations of the participation in a Hungarian program related to education for sustainable development (see below). This necessitates the use of a validated measurement tool for assessing the environmental attitudes or worldviews of the primary and secondary school students participating and not participating in this program. For this purpose, we intended to use the New Ecological Paradigm Scale for Children. Although the scale, with different

translations, had already been used in Hungary [42], its psychometric properties were not analyzed in detail in Hungarian samples. This was meticulously performed in the presented study.

Considering this research step to be exploratory, the research questions discussed in this paper are focused on the psychometric properties and the dimensionality of the Hungarian version of the NEP Scale for Children. Our research questions were the following: (1) whether, based on the psychometric properties, the scale or the emerging factors derived from the factor analyses could be reliably used for comparing students' environmental worldviews in future studies, especially concerning our research program within the framework of the STW; (2) whether it can be justified to use the scale as a unidimensional or multidimensional measurement tool; (3) whether the scale or the emerging factors derived from the factor analyses have adequate construct validity based on their associations with factors that are related to the environmental attitudes or worldviews of children according to previous literature: gender (e.g., ref. [43,44]), age (e.g., ref. [45]), pro-environmental behavior (e.g., ref. [46,47]), and economic and technical aspects of environmental worldview (e.g., ref. [48,49]).

2. Materials and Methods

2.1. Sample

The data collection of the NEP Scale for Children was conducted in a research program called "Students and teachers about sustainability" within the framework of the Sustainability Thematic Week (STW). The STW is an annually organized program launched in 2016 and considered one of the main initiatives that try to support the implementation of education for sustainable development (ESD) in the Hungarian national educational system in line with the Sustainable Development Goals (SDG) of the United Nations [50]. The main aim of the STW is to draw the attention of primary and secondary school students to the local and global environmental issues and the importance of sustainability.

The research program aiming to provide empirical data for examining the effect and the development of STW was launched by the organizer PontVelem Nonprofit Ltd. and was implemented in co-operation with four Hungarian universities: Eötvös Loránd University, University of Nyíregyháza, Széchenyi István University, and John von Neumann University. The professional support of the research program was provided by the Hungarian National Committee for UNESCO Commission on Education, and Pixrating Ltd. (Budapest, Hungary) was responsible for the technical background.

The online student questionnaire in Hungarian, which was one of the three methodological parts of the research and included the NEP Scale for Children, could be completed on a computer or mobile devices by primary and secondary school students in the Central European region: in Hungary (98.4%) and the surrounding countries (1.6%). The link of the questionnaire was distributed in two distinct ways: the students could reach the link either in Facebook posts messaged by the organizer of the STW or via invitation of teachers after the approval of the class teacher or school principal. The completion of the questionnaire was anonymous, and it could be started after reading the research ethics information and consenting to the participation, and lasted about 8–10 min. The questionnaire was also available for Hungarian-speaking students from neighboring countries and contained the option "parent or teacher" in the question for age in order to provide the opportunity for parents or teachers to look over the questionnaire. The data collection via the student questionnaire occurred between 5 October and 10 November 2020.

The initial dataset contained the answers of 11,687 respondents. During the cleaning process conducted by the first two authors, all cases were deleted (1) if the student did not consent to the completion (in those cases, the application led them to the end of the questionnaire), (2) if the completion time was equal to or under 60 s, (3) if the respondent marked the option "parent or teacher" in the question for age, and finally (4) if the first and second questions following the sociodemographic ones were not answered. Although the completion lasted a minimum of 5–6 min, we decided to clear only those responses which

were completed in less than 1 min, as we thought that even incomplete questionnaires could provide interpretable and valuable data from the responded questions. Altogether 2291 rows were deleted; thus, the answers of 9396 students were included in the analytic procedure. The characteristics of the study sample are shown in Table 1.

Table 1. The characteristics of the sample ($N = 9396$).

	N	%	Min	Max
age (whole sample)	9360		10	“more than 19”
10–18-year-old	9117	97.4		
more than 19	243	2.6		
age recoded “19 or more” to “19”: M = 14.17, SD = 2.241			10	19
gender	9395		0	1
boys	4215	44.9		
girls	5180	55.1		
grade	9268		5	13
5. grade	907	9.8		
6. grade	1043	11.3		
7. grade	1535	16.3		
8. grade	1340	14.5		
9. grade	1690	18.2		
10. grade	1364	14.7		
11. grade	674	7.3		
12. grade	601	6.5		
13. grade	114	1.2		
country	9393			
Hungary	9244	98.4		
surrounding countries	149	1.6		
socioeconomic status (in the household)				
number of rooms of residence	8442		1	8
1	211	2.5		
2	1492	17.7		
3	3155	37.4		
4	1864	22.1		
5	804	9.5		
6	361	4.3		
7	208	2.5		
more	347	4.1		
number of mobile phones	8457		0	4
0	52	0.6		
1	84	1.0		
2	401	4.7		
3	1736	20.5		
more	6184	73.1		
number of computer devices	8452		0	4
0	239	2.8		
1	1001	11.8		
2	1813	21.5		
3	1951	23.1		
more	3448	40.8		
number of cars	8449		0	4
0	874	10.3		
1	2669	31.6		
2	3093	36.6		
3	1012	12.0		
more	801	9.5		

2.2. Ethics Statement

The research program was conducted based on the ethical permission (number: 2020/162., date: 5 April 2020) obtained from the Research Ethics Committee of Eötvös Loránd University Faculty of Education and Psychology.

2.3. Measurement Tool

The online student questionnaire contained 38 questions. The questions targeted sociodemographic data (5 items: age, grade, gender, country, and residential postcode), the ID number of the school (1 item, according to Hungarian educational administration), pro-environmental behavior (6 items), general local environmental awareness (4 items), environmental attitudes and worldviews (10 + 3 items), participation in and evaluation of the Thematic Week (5 items), and socioeconomic status (4 items). In this paper, we used the following for analysis: gender, age, and the variables created based on the questions on pro-environmental behavior, environmental attitudes, and worldviews.

Regarding age, since the last value was “19 or more”, the data of respondents with this age value could not have been included in the analysis. However, we intended not to ignore these data; thus we added value 19 to all these respondents in the age variable used in the analysis (we recoded this categorical value to a continuous one). This recoding was based on the assumption that most respondents with the age value of “19 or more” were supposed to be aged 19 because the questionnaire could be completed by 12th or 13th graders at most.

Pro-environmental behavior was measured via 6 items developed in this research and answered on a 5-point Likert scale (ranging from “strongly typical for me” to “strongly not typical for me”, later coded as 5 to 1). Two examples of the items: “I collect waste separately.”, and “I save energy.” Based on the PCA described below, during the analytic procedure, a total score of “Pro-environmental behavior” was calculated, which ranged from 6 to 30.

To assess environmental attitudes and worldviews, we used the translated version of the NEP Scale for Children ([28]; 10 items) and 3 additional items created for this research (see below). The Hungarian translation of the NEP Scale for Children (the items are presented in Appendix B) was prepared by the first two authors within the framework of this research, considering the appropriate questionnaire translation assumptions (translation into Hungarian, re-translation into English, professional consultation with the third author). Respondents answered these items on a 5-point Likert scale (ranging from “strongly agree” to “strongly disagree”, later coded as 5 to 1). Items 3, 6, 7, and 9 (anti-environmental) were reverse scored. Higher scores on subscales of Manoli and colleagues [28], i.e., on Rights of Nature, Eco-Crisis, and Human Exemptionalism, and on the overall scale indicate stronger environmental attitude. The additional items focusing on economic and technical aspects were formulated as follows: “To solve environmental problems, people need to buy less and live more modestly”, “Economic growth is necessary for people to live well,” and “Technological progress can solve all environmental problems.” Respondents were asked to answer these additional questions on the same 5-point Likert scale as used in the case of the NEP items.

2.4. Data Analysis

Factor analysis with principal component extraction method, i.e., principal component analysis: PCA) and reliability analysis were conducted using the pro-environmental behavior items to reveal whether the calculation of a summed score of them is justifiable.

In the next stage, we randomly halved our sample of 9396 students. In one half of our sample ($N = 4698$), another principal component analysis (PCA) with varimax rotation (according to the NEP dimensionality’s literature detailed above and to facilitate comparison between our results and those found by discussed authors) and reliability analysis were run using our translated items to explore the dimensionality of the NEP Scale for Children. To support the interpretability of the scale’s dimensionality, we performed

another factor analysis applying principal axis factoring extraction method with varimax rotation. A series of confirmatory factor analyses (CFA) based on Structural Equation Modeling (SEM), using MLR estimates, was performed encompassing the 10 NEP items to examine the fit of the data in the other half of our sample ($N = 4698$) to the factor structure resulting from the first step PCA and to the factor structure of Manoli and colleagues [28]. Since these authors argued for the applicability of the NEP Scale for Children as unidimensional, we intended to test a one-factor, a bifactor, and a second-order factor model. The bifactor model allows all items to load directly on a general factor (e.g., environmental worldview) as well as on domain-specific factors, while in a second-order factor model, the first-order factors, necessarily with a high correlation between them, load on a second-order general factor (see [51]). However, after studying the values of coefficients of the relationship between our factors, only the one-factor and the bifactor models were tested.

In order to estimate the construct validity of our NEP Scale for Children factors, a CFA with covariates, using MLR estimates, was performed. With this technique, we could estimate the association between our factors and the indicators that are important in environmental attitudes according to the literature (in this analysis, gender and age) and that measure other aspects of environmental thinking and behavior (in this analysis, the pro-environmental behavior and our 3 additional items following NEP Scale for Children). This analysis provided the opportunity to estimate each association in one model while controlling for other predictor variables included in the model. This analysis thus helped us to demonstrate that our factors assess relevant and distinct aspects of environmental attitudes. SPSS version 26.0 [52] was used for PCAs, and Mplus version 8 [53] was applied for CFAs.

3. Results

The descriptive statistics of the variables used in the analysis are presented in Table 2 for both the whole sample and the second half of our sample.

Table 2. The descriptive statistics of the variables used in the analysis.

	Whole Sample ($N = 9396$)				The Second Half of the Sample ($N = 4698$)				Both	
	N	%	M	SD	N	%	M	SD	Min	Max
Gender	9395				4698					
boys	4215	44.9			2138	45.5				
girls	5180	55.1			2560	54.5				
Age (recoded "19 or more" to "19")	9360		14.17	2.241	4677		14.17	2.220	10	19
Pro-environmental behavior	9200		21.17	4.041	4585		21.19	4.004	6	30
Environmental attitudes										
Questioning of Human Intervention	8559		12.12	3.554	4274		12.08	3.561	4	20
Rights of Nature	8635		13.19	1.908	4315		13.18	1.940	3	15
Eco-Crisis	8553		12.57	2.042	4273		12.56	2.073	3	15
To solve environmental problems, people need to buy less and live more modestly.	8552		3.92	1.012	4276		3.93	1.004	1	5
Economic growth is necessary for people to live well.	8536		3.67	1.036	4269		3.68	1.035	1	5
Technological progress can solve all environmental problems.	8523		2.82	1.186	4265		2.85	1.189	1	5

The principal component analysis (PCA) of pro-environmental behavior items in the whole sample (Kaiser–Meyer–Olkin measure of sampling adequacy: $KMO = 0.766$; Bartlett test: $p < 0.001$) revealed one component with an Eigenvalue greater than 1, i.e., the items were included in a single component, explaining 36.56% of the variance. Factor loadings on this component ranged from 0.45 to 0.68 and are presented in Table 3. Regarding the exploratory nature of this analysis, the internal consistency of the items (Cronbach's

alpha = 0.649) can be considered acceptable [54]. In the results of the item-total analysis, there is no item whose deletion would increase the value of Cronbach's alpha. All these results support that, although the variance explained by this component is low, the six pro-environmental behavior items in this study can be interpreted as being arranged in a unidimensional structure, and hence a total summed score can be calculated in order to measure pro-environmental behavior.

Table 3. The result of the principal component analysis of pro-environmental behavior items.

	Component
	1
5. I am willing to pay more for a product whose production as I know causes less pollution.	0.683
4. I save energy.	0.658
6. I would like to live less comfortably if it makes our environment cleaner and healthier.	0.632
3. I eat healthy food and drinks.	0.596
2. I collect waste separately.	0.581
1. I keep order around me.	0.449

Regarding the exploratory analysis of the NEP Scale for Children items in the first half of our sample, the reliability of these items was lower (Cronbach's alpha = 0.575) than the accepted value for psychological scales, but this is a common result regarding this scale according to the literature (see above, and [9]). The item analysis found no item whose omission would significantly improve the reliability of the scale (only the deletion of item three would increase the value of Cronbach's alpha by 0.007). The PCA of NEP items (KMO = 0.713, Bartlett test: $p < 0.001$) resulted in three factors with an Eigenvalue greater than 1, explaining 52.36% of the variance. The factor structure and factor loadings ranging from 0.51 to 0.77 are presented in Table 4. It indicates a slight uncertainty of the factor structure that items 3 and 5 loaded relatively high on two factors. The common exploratory factor analysis (applying the principal axis factoring extraction method with varimax rotation) resulted in the same number and content of factors; however, the variance explained by the three factors was, in this case, remarkably lower (32.49%). Table 4 shows the results of this analysis too. The three factors were named Questioning of Human Intervention, Rights of Nature, and Eco-Crisis, inspired by the study of Manoli and colleagues [28]; however, we did not obtain the same factor structure they reported (see Table 4). Higher scores on Questioning of Human Intervention indicate lower agreement with the manageability of harmful effects of human activity and with the need for human rule and control over nature. Higher values on the Rights of Nature denote more respect for the laws and rules of nature, whereas higher scores on Eco-Crisis indicate higher awareness of the negative consequences of harmful treatment of nature by humans, i.e., stronger belief in eco-crisis. The correlation between Questioning of Human Intervention and Rights of Nature was 0.032, between Questioning of Human Intervention and Eco-Crisis 0.115, and between Rights of Nature and Eco-Crisis 0.335.

The results of the confirmatory factor analysis (CFA) of NEP items in the second half of our sample, based on the fit indices (see Appendix A), show an adequate fit of our data in this sample half to the factor structure of PCA presented above ($\chi^2(32) = 394.57$, $p < 0.001$, RMSEA = 0.051 [90% CI: 0.047–0.056], CFI = 0.923, TLI = 0.892, SRMR = 0.036). The results of the detailed analysis (standardized factor loadings, factor determinacies, and correlations between factors) are shown in Table 5.

Table 4. The result of the principal component analysis and the common factor analysis of NEP items in the first half of our sample with wording published in Manoli and colleagues [28] after reversal of the scoring of anti-environmental items (3, 6, 7, and 9).

	PCA: Components			PAF: Factors			In Which Factor by Manoli and Colleagues [28]
	1	2	3	1	2	3	
7. People are supposed to rule over the rest of nature.	0.765			0.670			Rights of Nature (1.)
6. Nature is strong enough to handle the bad effects of our modern lifestyle.	0.745			0.625			Human Exempt. (3.)
9. People will someday know enough about how nature works to be able to control it.	0.728			0.567			Human Exempt. (3.)
3. People are clever enough to keep from ruining the earth.	0.508	−0.448		0.403			Human Exempt. (3.)
1. Plants and animals have as much right as people to live.		0.732				0.513	Rights of Nature (1.)
4. People must still obey the laws of nature.		0.709				0.559	Rights of Nature (1.)
5. When people mess with nature it has bad results.		0.572	0.321			0.433	Eco-Crisis (2.)
10. If things don't change, we will have a big disaster in the environment soon.			0.709		0.638		Eco-Crisis (2.)
2. There are too many (or almost too many) people on earth.			0.670		0.359		Eco-Crisis (2.)
8. People are treating nature badly.			0.658		0.509		Eco-Crisis (2.)

Table 5. Standardized factor loadings, factor determinacies, and correlations between factors resulted in the CFA of the second half of our sample.

	Factors		
	Questioning of Human Intervention	Rights of Nature	Eco-Crisis
7. People are supposed to rule over the rest of nature.		0.639 ***	
6. Nature is strong enough to handle the bad effects of our modern lifestyle.		0.632 ***	
9. People will someday know enough about how nature works to be able to control it.		0.548 ***	
3. People are clever enough to keep from ruining the earth.		0.411 ***	
4. People must still obey the laws of nature.			0.645 ***
5. When people mess with nature it has bad results.			0.579 ***
1. Plants and animals have as much right as people to live.			0.523 ***
10. If things don't change, we will have a big disaster in the environment soon.			0.653 ***
8. People are treating nature badly.			0.578 ***
2. There are too many (or almost too many) people on earth.			0.421 ***
Factor determinacies	Questioning of Human Intervention	Rights of Nature	Eco-Crisis
		0.816	0.824
			0.818
Correlations	Questioning of Human Intervention	Rights of Nature	Eco-Crisis
	Rights of Nature		0.025
	Eco-Crisis		0.066 *
		Rights of Nature	0.762 ***

* $p < 0.05$; *** $p < 0.001$.

Furthermore, the results of CFA, regarding the factor structure presented by Manoli and colleagues [28] as proposed models, showed that our data did not fit their factor structure ($\chi^2(32) = 1364.59$, $p < 0.001$, RMSEA = 0.098 [90% CI: 0.093–0.102], CFI < 0.001, CFI = 0.718, TLI = 0.603, SRMR = 0.081).

The correlation coefficients suggested non-unidimensionality of NEP Scale for Children in our sample, however, additional CFAs showed that the unidimensional model had an inadequate fit ($\chi^2(35) = 2282.09$, $p < 0.001$, RMSEA = 0.121 [90% CI: 0.117–0.126], CFI < 0.001, CFI = 0.524, TLI = 0.388, SRMR = 0.102), and that the bifactor model was not identified, even if the number of iterations was increased to 100,000. The low correlation coefficients did not justify testing a second-order model.

To estimate the reliability of the scale and our three factors regarding the non-unidimensionality of the NEP Scale for Children as a violation of one of Cronbach's alpha's assumptions [10], we calculated omega for each of them in the frame of the first CFA. According to the results, the value of omega was 0.816 for the whole scale, 0.647 for Questioning of Human Intervention, 0.600 for Rights of Nature, and 0.560 for Eco-Crisis.

Despite its moderate value, the third factor's coefficient can be argued as acceptable because of the diversity of the construct being measured [36].

In the CFA with covariate model, the measurement model part contained our three factors of NEP, whereas the structure model part included the covariates: gender, age, pro-environmental behavior, and our three additional environmental attitudes items. The model showed adequate fit ($\chi^2(74) = 748.62, p < 0.001, RMSEA = 0.046$ [90% CI: 0.043–0.050], CFit = 0.971, CFI = 0.914, TLI = 0.878, SRMR = 0.035). The standardized regression coefficients are presented in Table 6. Rights of Nature and Eco-Crisis were predicted by all the covariates, whereas Questioning of Human Intervention was predicted by five of the six covariates (the exception was the environmental attitude aspect measured by the first additional item) while each other predictor covariate variable included in the model was controlled for.

Table 6. Confirmatory Factor Analysis with covariates model: predictors of our 3 NEP Scale for Children factors.

NEP Scale for Children factors	Gender	Age	Pro-Environmental Behavior	To Solve Environmental Problems, People Need to Buy Less and Live More Modestly	Economic Growth Is Necessary for People to Live Well	Technological Progress Can Solve All Environmental Problems	R ²
Q of Human Intervention	0.069 *** [0.038, 0.100]	0.131 *** [0.099, 0.163]	−0.166 *** [−0.202, −0.131]	−0.014 [−0.048, 0.020]	−0.228 *** [−0.262, −0.194]	−0.541 *** [−0.574, −0.507]	52.3%
Rights of Nature	0.138 *** [0.102, 0.174]	−0.040 * [−0.076, −0.003]	0.290 *** [0.250, 0.329]	0.350 *** [0.309, 0.392]	0.106 *** [0.065, 0.148]	−0.147 *** [−0.187, −0.108]	33.8%
Eco-Crisis	0.077 *** [0.040, 0.113]	0.081 *** [0.045, 0.117]	0.109 *** [0.069, 0.148]	0.493 *** [0.452, 0.533]	0.127 *** [0.085, 0.168]	−0.125 *** [−0.166, −0.084]	33.1%

This table contains partial regression coefficients. * $p < 0.05$; *** $p < 0.001$; in square brackets: 95% confidence interval (CI) for coefficient.

4. Discussion

Regarding the internal consistency (see research question 1), the lower than accepted value of Cronbach's alpha for the whole NEP scale is not an uncommon result based on the literature [9], and it might be associated with the socioeconomic development of Hungary which differs from that of the traditional western states. However, considering that we used the version with the least number of items and the fact that, based on the results of our exploratory factor analysis, the assumption of unidimensionality for Cronbach's alpha was violated in our research, we should interpret the value of omega as the indicator of internal consistency. The value of omega was found to be 0.816 for the whole scale, which is an acceptable value; however, the omega values for our subscales were lower, similar to the results of Harrison [26].

We identified three factors named Questioning of Human Intervention, Rights of Nature, and Eco-Crisis (see research question 2). Neither the correlation coefficients between our factors nor the result of a CFA testing the one-factor and the bifactor models justify the treatment of the NEP Scale for Children as unidimensional in our Hungarian sample. Therefore, our results provide no opportunity to use an overall score to measure the environmental attitudes in our analysis which will be published later. The number of our factors can be considered as a typical result, although the content of them is different from that presented by Manoli and colleagues [28] as justified by the results of our CFA, and they also differ from the contents of other three-factor models reported in the literature (see Table 7). All the anthropocentric items of the NEP Scale for Children (items 3, 6, 7, and 9) loaded on a single factor, unlike in the factor structures of Manoli and colleagues and the other researchers discussed. (The third factor of Van Petegem and Blicck [24] and Boeve-de Pauw and Van Petegem [38], and the second factor of Atav and colleagues [32] included these four items, but did not encompass all seven anthropocentric items of the 15-item version they used.) Item 5 ("When people mess with nature it has bad results.") loaded on Eco-Crisis factor in the factor structure of Manoli and colleagues, but the Hungarian students interpreted it in the meaning of "nature over man", i.e., in the meaning of consequences after violating the rights of nature, and therefore, in our results, this item loaded

primary on the Rights of Nature factor, although it secondarily loaded on the Eco-Crisis factor. The difficulty of translating “mess with” into Hungarian might have contributed to this result. Based on the results of the factor analysis discussed above, we can argue that the factor structure presented in this study fits more the environmental worldview’s hypothetical facets described by the initial authors of the NEP Scale than the factor structure of Manoli and colleagues [28].

Table 7. Comparison of the subscales based on principal component analysis of the NEP Scale for Children, and NEP Scale applied in samples of children.

	Components				
	I	II	III	IV	V
	using one of the versions of the NEP Scale for Children (15 items: [27], 10 items: [28])				
Manoli and colleagues [28], 10 items	1, 4, 7 (Rights of Nature)	2, 5, 8, 10 (Eco-Crisis)	3, 6, 9 (Human Exempt.)	–	–
Van Petegem and Blicck [24], 15 items *	2, 4 (Limits to growth)	1, 5, 8, 10 (Balance of nature)	3, 6, 7, 9 (Humans over nature)	–	–
Boeve-de Pauw and Van Petegem [28], 15 items *	2, 4 (Limits to growth)	1, 5, 8, 10 (Balance of nature)	3, 6, 7, 9 (Man above nature)	–	–
Grúňová and colleagues [25], 10 items	2, 4, 5, 10	8, 9	3, 6, 9	–	–
The current research	3, 6, 7, 9 (Q of Human Intervention)	1, 4, 5 (Rights of Nature)	2, 8, 10 (Eco-Crisis)	–	–
	using adult version (15 items *: [8]) in samples of children				
Wu [23]	5, 8, 10 (“eco-crisis”)	6	1, 4, 7, 9 (“human innature”)	3 (“pro-techno-centrism”)	∅
Atav and colleagues [32]	1, 2, 4, 5, 8, 10 (NEP)	3, 6, 7, 9 (DSP)	–	–	–
Srbinovski and Stanišić [33]	1, 4, 5, 10 (Balance of nature)	3, 6, 9 (Humans over nature)	2, 8 (Limits to growth)	7 (Environmental philosophy)	–

* reported only (appropriate) items encompassed in 10-item NEP Scale for Children [28], marked them with appropriate item numbers of this scale.

In a recent study in which these 10 NEP items were administered to young Hungarians ages 14 to 30 years, a similar factor structure emerged [42]. However, the wording of the items in that study was somewhat different (the translation was based on the version of Manoli and colleagues [28] but partially relied on the version of Dunlap and colleagues [8] and was adapted to be interpretable by children of 14 years of age and older), and the categorization of one item was obviously different. Item 5 (“When people mess with nature it has bad results”) was classified as the “Eco-crisis” subscale instead of the “Rights of Nature” subscale. Furthermore, items 1 and 4 (categorized in this study as part of the “Rights of Nature” subscale) were not separated so strictly from the “Eco-crisis” subscale as in this study. Although in the research of Mónus [42] three factors also emerged (named as “preservation”, “utilization”, and “eco-crisis”), its factor analysis was based on the mentioned 10 NEP items combined with other items from the 2-MEV Scale of Johnson and Manoli [55] (25 items in total).

Subsequently, with the aim of examining the construct validity of the emerged factors (see research question 3), we tested the association of the subscales of the NEP Scale for Children with gender, age, pro-environmental behavior, and economic-technical aspects of environmental worldview. A CFA with covariates model was applied for the analysis. The aspects considered to be associated with environmental attitudes and behavior had a significant association with all three factors (with one exception in the Questioning of Human Intervention factor). Moreover, the analysis resulted in different directions of these associations between the three factors. In accordance with the literature (e.g., ref. [43,44]), girls reached higher scores on all three factors, i.e., they were proved to have a more ecocentric worldview based on all three aspects than boys. Regarding age, older students reported lower agreement with the manageability of harmful effects of human activity

and with the need for human rule and control over nature, and a stronger belief in eco-crisis; however, they showed less respect for the laws of nature than younger ones. These results are basically in accordance with the literature (e.g., ref. [45]), but they also add new elements by highlighting that older students are not simply less eco-centered, but they have stronger beliefs in eco-crisis and, to a lower extent, agree with the manageability of harmful effects of human activity, which result can be considered as an explanation of the growing appearance of eco-grief and other similar phenomena among teenagers (e.g., ref. [56]). Students with a higher score on pro-environmental behavior believe in eco-crisis more strongly and respect the rules of nature more; however, they reached lower scores on Questioning of Human Intervention. Regarding this latter result, it can be argued that the original interpretations of the NEP scales' items about the rule and control over nature and about people's cleverness to keep from ruining the earth have become changed over the past decades as a result of the emerging emphasis on environmental protection and environmental issues: the human intervention thus might be beneficial, and the human control over their own activities is inseparably associated with the rule and control over nature. If we interpret this latter result as they believe more that harmful effects of human activity can be managed, it raises the question of whether the items of this factor before reversal actually grab an anthropocentric value orientation, and, as former research also pointed out, we could not decide if pro-environmental behavior causes pro-environmental attitudes or vice versa (e.g., ref. [46,47]). Former research has also revealed that there is a highly complex correlation system (e.g., ref. [48,49]) between pro-environmental attitudes and peoples' worldviews about economic and technological development. In our sample, the higher agreement with the need for buying less and living more modestly to solve environmental problems was significantly associated with higher scores on Rights of Nature and on Eco-Crisis, whereas higher agreement with the role of technological progress in solving environmental problems was significantly associated with lower scores of all three factors. Another interesting result is that those who agree more with the need for economic growth showed higher agreement with the manageability of harmful effects of human activity and with the need for human control over nature, whereas they show more respect for the laws of nature and have a stronger belief in eco-crisis.

Our research has several strengths and limitations. The main strength of our study is the sample size: reviewing the literature, we did not find another research project applying the NEP Scale (for Children) and performing factor analysis which was conducted in a sample of nearly 10,000 respondents. However, using internet-based sampling might have had inherent selection biases toward students with higher socioeconomic status. Therefore, the factor structure and the associations could not be tested in students with lower socioeconomic status. Another limitation of this study is that due to voluntary participation prescribed by the ethical permission and emphasized in the description of research on the first page of the application, the questionnaire might have been completed by students who are open to and interested in environmental issues. In addition, our sample was not balanced regarding gender and school grade.

The "Students and teachers about sustainability" research program will be organized in Hungary in the following years and will provide an opportunity to compare the results of analyses deriving from data collected in different years. This could justify the robustness and generality of the above-detailed results regarding the factor structure and associations of the factors. Future analysis might be supplemented with the investigation of how different groups of students understand and interpret the items of the NEP Scale for Children.

5. Conclusions

The results showed that the Hungarian version of the NEP Scale for Children could not be applied as unidimensional considering either the first- or second-order factor modeling; thus, an overall NEP score cannot be used in analyses regarding environmental awareness of children. The multidimensionality of the scale and the different directions of the three

interpretable and distinct factors' examined associations suggest that the scale measures environmental beliefs or complex worldviews rather than attitudes (see [26]) with adequate internal consistency. In addition, supplemented by the later investigation of the associations of the three newly emerged factors with environmental awareness variables (e.g., PEB), our results might contribute to explaining the issues, misunderstandings, and challenges that (1) are related to the dimensionality of NEP scales, (2) might weaken the ability of the scale to explore attitudinal differences and to help in identifying opportunities to change attitudes, and (3) even after decades of use make the comparison of international research difficult.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Research Ethics Committee of Eötvös Loránd University Faculty of Education and Psychology (ethical permission's number: 2020/162., date: 5 April 2020).

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

Data Availability Statement: The database resulting after the cleaning process is available from the correspondent author upon reasonable request.

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Appendix A

In the case of RMSEA (root mean square error of approximation), a value below 0.05 indicates excellent fit and a value between 0.05 and 0.08 shows a good fit, the significant deviation of the RMSEA from 0.05 is indicated by the value of Cfit: not significant ($p > 0, 05$) probability values indicate acceptable model fit [57]. For CFI (comparative fit index) and TLI (Tucker–Lewis index), a value above 0.9 is expected [29], while an SRMR (standardized root mean square residual) value below 0.08 indicates a good fit [58].

Appendix B

The Hungarian items of the NEP Scale for Children translated in the current research are the following:

1. A növényeknek és az állatoknak ugyanannyi joguk van élni, mint az embereknek.
2. Túl sok (vagy majdnem túl sok) ember él már a Földön.

3. Az emberiség elég értelmes ahhoz, hogy ne hagyja tönkretenni a Földet.
4. Az embereknek még mindig tiszteletben kell tartaniuk a természet törvényeit.
5. Nem vezet jóra, ha az emberek beleavatkoznak a természet dolgaiba.
6. A természet elég erős ahhoz, hogy kezelni tudja modern életünk káros hatásait.
7. Az embereknek uralkodniuk kellene a természet többi része felett.
8. Az emberiség rosszul bánik a természettel.
9. Az emberiség egy nap eleget fog tudni a természet működéséről ahhoz, hogy képes legyen irányítani.
10. Ha nem változnak a dolgok, hamarosan nagy környezeti katasztrófát fogunk megélni.

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