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Measuring Environmental Perceptions Grounded on Different Theoretical Models: The 2-Major Environmental Values (2-MEV) Model in Comparison with the New Ecological Paradigm (NEP) Scale

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Received: 10 January 2019; Accepted: 25 February 2019; Published: 1 March 2019

Abstract: Our study examined the two-dimensional nature of the Two Major Environmental Values model (2-MEV) in comparison with the New Ecological Paradigm (NEP) scale's unidimensional construct. The latter places respondents on a continuum from a bio-centric to anthropocentric worldview, where an individual can either have a pro-environmental (bio-centric) or an anti-environmental (anthropocentric) perspective, but not both. On the other hand, the 2-MEV treats biocentrism (Preservation, PRE) and anthropocentrism (Utilization, UTL) as two separate and not necessarily related components. The model allows us to place individuals into one of four quadrants, rather than on either end of a continuum, allowing an individual to have a bio-centric and an anthropocentric worldview at the same time. Students' environmental perceptions were measured using the NEP and 2-MEV questionnaires. As predicted, high preservation/low utilization scorers preferred a biocentric worldview on the NEP; similarly, low preservation/high utilization scorers preferred an anthropocentric worldview on the NEP. However, the NEP failed to differentiate between the high preservation/high utilization and low preservation/low utilizations scorers. Both of these groups of students, while on different quadrants on the 2-MEV, cluster together in the middle of the unidimensional NEP. Evidence suggests that the NEP may not fully explore all dimensions of environmental perceptions.

Keywords: environmental perceptions; worldviews; 2-MEV; NEP; earth education

1. Introduction

The long history of attempts since the 1970s to measure environmental perceptions produced a plethora of instruments. Relevant discussions thus started early to get insights into theoretical frames, which very often derived from conceptual definitions with some degree of favor or disfavor preferences [1]. Grass root researchers laid (philosophical) foundations going back to Dewey [2,3], Muir [4], Leopold [5], and Carson [6], to name some major pioneers. Later, researchers formulated paradigm messages, for instance, the New Environmental Paradigm [7], the New Ecological Paradigm [8], or the Ecological World View. While the latter covered conservational preferences, the Dominant Social Paradigm (DSP) coined anthropocentric views in highlighting our planet as an unlimited resource for human consumption [9]. The New Environmental Paradigm (NEP) scale was

the first to reach a wide usage in adult populations [7,10]. That approach was designed to measure public acceptance in adult populations by using a unidimensional construct.

Since then, the NEP scale has been treated as a measure of environmental concern, environmental values, environmental attitudes, and more appropriately environmental beliefs [11]. In general, the NEP has been endorsed across various samples with known-group validity and reliability (criterion validity). Earlier studies have also provided evidence of the scale's content and construct validity [8,11]. For example, the NEP has been used in sophisticated social-psychological models of environmental concern and behavior [12–16], in studies of risk perception e.g., [17,18] and as a predictor of willingness to pay in contingent valuation studies e.g., [19,20]. Finally, the NEP Scale has been revised and used with children [21,22]. More impressively, and after its use in several national and international studies, it still demonstrated a reasonably strong internal consistency [23]. During its development and extensive use, the NEP "has been used most often with samples of the general public, ... specific sectors such as farmers and members of interest groups e.g., [24,25]. In addition, it was used to examine the environmental orientations of ethnic minorities in the United States e.g., [26,27]... " and "...to compare the environmental orientations of college students in several Latin American nations and Spain with those of American students [13,28]". The NEP was also used with residents of several countries [24,29–32].

However, the NEP faced some contradicting analyses regarding dimensionality. Its dimensionality was in dispute for decades after the initial study had proposed a single dimension [7], while others postulated even up to four dimensions. This confused dimensionality of the NEP scale has also received some criticism [23], as this unidimensional structure of the NEP scale was built upon a model which assumed people's ecological worldview can be either biocentric (pro-environmental) or anthropocentric (anti-environmental) [8]. In that view, respondents can score high on biocentrism or on anthropocentrism but not on both. In addition, the theoretical foundation of the NEP scale was criticized as it may only partly reflect the contemporary environmental ethics debate by missing some ecocentric orientations, which may come up with difficulties to distinguish ecocentric values from anthropocentric ones [33]. In summary, a number of studies [34–36] suggested "that the NEP is composed of three distinct dimensions—balance of nature, limits to growth, and human domination of nature . . . "; a total of three other studies [24,36,37] "found all items to load on a single factor and several studies have found only two dimensions in one or more of their samples [27,28,30,38,39]."; a few others "have found as many as four dimensions [29,40]" [8], p. 430. In view of that dimensionality discussion and of the nature of terminology, Dunlap and his colleagues [8] revised and expanded the original item set as well as renamed it the New Ecological Paradigm (still NEP). The revised version contains 15 items designed to tap five key facets of the NEP. These facets did not form distinct dimensions in this study and thus were treated as one primary dimension reflecting endorsement of an ecological worldview.

After the 1980s, an increasing demand for valid information about the efficacies of educational programs was highlighted [41,42]. While most of the early instruments, such as the NEP, were developed for adult populations, the development of the 2-MEV scale (Two Major Environmental Values) focused on monitoring of adolescents [43–46]. On the basis of a theoretical foundation, this battery was designed to measure two higher order factors (values): Preservation (PRE) and utilization (UTL), based on primary factors (attitudes). After a series of pilot studies, a 20-item model was shown to sufficiently measure both constructs, with 10 items measuring the PRE-factor incorporating primary factor-analyzed subscales such as 'Intent of Support', 'Care with resources', and 'Enjoyment of nature' and 10 items measuring UTL with subscales such as 'Human Dominance' and 'Altering Nature'. The term 'values' was derived from Rokeach [47] referring to item-sets based first-order factors as 'attitudes' and higher-order factors as 'values'. The term 'environmental values', therefore, described the higher order factor PRE as 'a bio-centric dimension that reflects conservation and protection of the environment' and UTL as 'an anthropocentric dimension that reflects the utilization of natural resources' [48], p. 787. The developers of 2-MEV [45,49] used the general

term perception when labelling how individuals may perceive an identical environmental situation differently: Perceptions are regarded to envelope attitudes and values, which indicate one's feeling either favorably or unfavorably toward nature.

Despite the development of the 2-MEV, many other measures of environmental perceptions were constructed, a situation that also occurred in other fields. For instance, to measure personality in the 1960's, there were as many scales available as there were researchers in the field [50]. The majority, however, had little empirical testing and validation. To avoid this problem with the 2-MEV, additional support was provided for by applying cross-validation studies. (1) Personality variables reflecting risk-taking behavior strongly supported two orthogonal dimensions: High scorers on preservation turned out to be controlled and cautious gamblers, while utilizers failed to control risk-taking behavior [51]. (2) Eysenck and Eysenck's [50] scale measuring personality variables 'Psychoticism' (P), 'Extraversion' (E) and 'Neuroticism' (N) as well as a measure of social desirability (L), it provided further support [48]: Utilizers preferred immediate self-orientated gratification, while an individual preferring preservation accepted a delayed, otherwise-oriented gratification. (3) The relationship between preservation, utilization, and authoritarianism revealed a negative correlation of authoritarianism with PRE and a positive one with UTL [52]. (4) Bilateral applications within the cultural diversity of Europe (with its many languages) confirmed the 2-MEV model e.g., [45,53,54]. (5) Finally, application of the 2-MEV to European teacher communities expanded the validity to adults [55,56].

Independent confirmation finally supported the 2-MEV model in a new dimension:

(1). Milfont and Duckitt [57] coming from a psychometric background confirmed the two-factor second-order structure in spite of including a larger number of items.
(2). Some years later, evaluation efforts for earth education programs in the US provided the second independent confirmation [58], again confirming the secondary higher-order structure of PRE and UTL.
(3). A Flemish study applied the 2-MEV model within an eco-school initiative [59].
(4). A West African sample extracted the two-dimensional structure within the context of evaluating an outreach education program [14]. Thus, the 2-MEV finds itself in the exceptional situation of repeated independent confirmations from a variety of backgrounds and enjoys worldwide usage and close to 30 language versions. Thus, the 2-MEV provides the benefit of allowing inter-study comparisons by simultaneously fitting well with the current psychology of sustainable development [59].

An essential characteristic of the 2-MEV is that it does not imply a conflict between assigning importance to preserving the environment and the need to utilize resources. The 2-MEV allows for individuals to be placed in one of four quadrants rather than on either end of a continuum. A high score on preservation (mean score >3) and a low score on utilization (mean score <3) might be expected of a strong environmentalist (PRE+/UTL-), someone with deep concern about conservation. A low score on preservation but a high score on utilization (PRE-/UTL+) might be expected of someone with apathy toward conservation issues and a view of nature as a source of natural resources to be used for the benefit of human development. These two quadrants are the two ends of the NEP scale, (see Figure 1 below). However, it certainly is conceivable that someone could have a high score on preservation, indicating a strong desire to protect the environment, but at the same time believe that the primary purpose of nature is to benefit humans, resulting in a high score on utilization as well (PRE+/UTL+). Our hypothesis is that individuals in this quadrant would likely be placed in the center of the NEP scale, leading to a misinterpretation of their perceptions as noncommittal when in reality their views might be quite strong. A low score in both dimensions (PRE-/UTL-) is most likely indicative of someone with a lack of interest in the topic. Such individuals would most likely also, but more appropriately, be on the middle of the NEP scale.

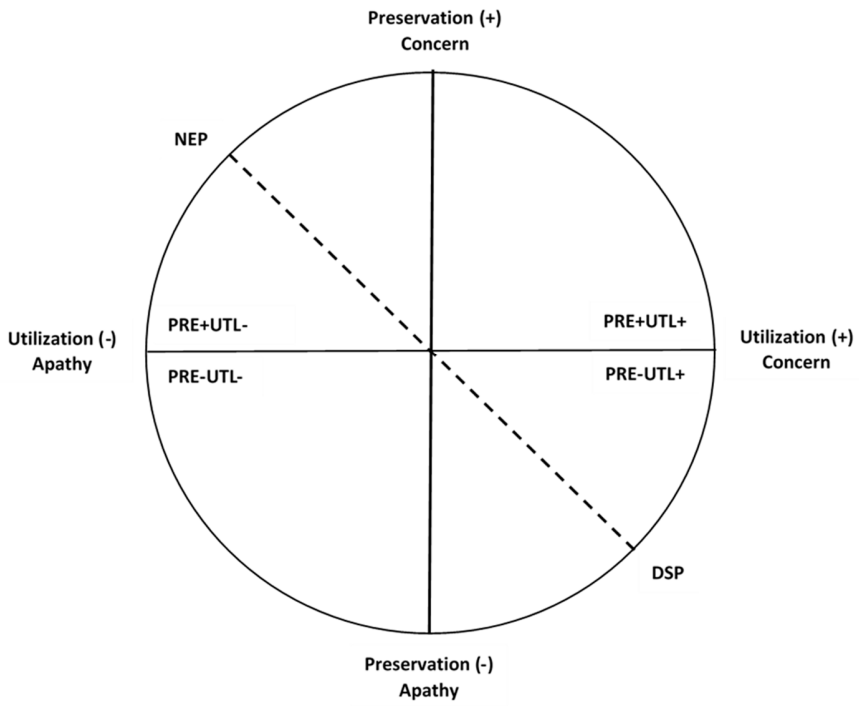

Figure 1. Graphic representation of the two major environmental values model (2-MEV) and new ecological paradigm (NEP) scales.

The purpose of the present study was to examine the two-dimensional nature of the 2-MEV scale [44,48] in contrast with the new ecological Paradigm (NEP) scale's [8] unidimensional construct. Therefore, the objectives of our study were threefold: First, to extract both 2-MEV factor scores (preservation and utilization), based on the participants' responses. Second, on the basis of the achieved factor scores, to assign all respondents to quadrants (PRE+/UTL-, PRE+/UTL+, PRE-/UTL+, PRE-/UTL-). Finally, to examine how the four 2-MEV quadrants relate to the NEP scores.

2. Materials and Methods

2.1. Participants

Participants were 1425 4th and 5th grade students from 31 schools in the southwestern United States. Gender distribution was similar between boys (49%) and girls (51%). Since the purpose of the study did not address demographic differences among the participants, no additional information was collected from individual students. However, school information was available from the district's office. The participating schools ranged mostly from low to middle socioeconomic status (SES), and the students were primarily White and Hispanic. All students completed the 2-MEV and NEP scales before and after participating in the earth education program Earthkeepers [60], at an informal education center away from school.

2.2. Earthkeepers Program

Students participated in the Earthkeepers program [60]. This program was selected for the study because it targets the attitudes and values identified in the 2-MEV model. The program included an initial three-day/two-night experience at a residential outdoor, environmental center on the outskirts of a city in the southwestern US and follow-through activities back at school and at home to complete the program. The time at the residential center focused on building ecological understandings and developing positive values and attitudes through participatory outdoor activities. Back at school and home, participants worked on self-identified tasks to reduce their impact on the environment and

increase their contact with nature and to share their knowledge and experiences with others in order to complete the program.

2.3. Instruments

Perceptions were measured using modified, but validated and reliable versions of the 2-MEV Scale [61] and the NEP Scale for children [22] in the US. The items on both scales were modified to US standards, and the language was simplified for children of a younger age (10–12 years old) without changing the meaning from the original items. The revised 2-MEV scale has 16 items whereas the Children's NEP has 10 items. Both scales were adapted for upper elementary students in the US. The items on both scales are statements about the environment with a five-point Likert-style response set of 'strongly agree' (5 points) to 'strongly disagree' (1 point). For the NEP scale, a total mean score was calculated. Mean scores above 3.0 imply a bio-centric perspective (NEP) and lower than 3.0, an anthropocentric (DSP) view. For preservation, mean scores above 3.0 are considered to be PRE+ and scores below 3.0 are PRE-. For utilization, the opposite is true; scores above 3.0 are UTL- and those below 3.0 are UTL+.

2.4. Procedure and Data Analyses

Students completed the instrument both as a pre-test and again as a post-test, before and after involvement in the Earthkeepers program. The pre-test was completed two weeks before the students arrived at the center for their Earthkeepers training. The post-test was completed one month after their visit to the center in order to measure the long-term impact of the program. All data were entered and analyzed using the IBM SPSS Statistical Package 21. The 2-MEV pre-test scores were subjected to a Confirmatory Factor Analysis (CFA) to determine if the previously found two-factor structure was consistent with the current data. The 2-MEV post-data scores were subjected to a Principal Component Analysis (PCA), in order to extract the two factor scores. For the same reason, the NEP post-test scores were also subjected to a PCA. Using post-data mean scores, students were placed into one of the four 2-MEV quadrants, and then their mean NEP scores were calculated. An Independent Samples t-test analysis between the mean NEP score quadrants (PRE+/UTL- vs PRE-/UTL+, PRE-/UTL- and PRE+/UTL+) examined their relationship. Finally, a correlation analysis examined the relationship between PRE and NEP items and UTL and NEP.

3. Results

A Confirmatory Factor Analysis of the 2-MEV pre-test scores confirmed the two-factor structure of PRE and UTL. Fit indices indicated that the model fit the data well. Chi2/df ratio was 59.20, CFI (0.95), TLI (0.94), and RMSEA (0.088). The 2-MEV post-test scores were subjected to a PCA including a subsequent oblique rotation. The solution was then rotated to maximum conformity using the method of least squares. This analysis was done to determine if items belonged to distinct factors (were truly different) or if they overlapped. The factor solution is displayed in Figure 2. Two clear separate factors emerge: Utilization (UTL) items cluster together and preservation (PRE) items cluster together. A similar analysis using the NEP scores was also performed in order to determine the dimensionality of the scale. The results confirmed that all ten items load on a single factor, accounting for 60.9% of the variance.

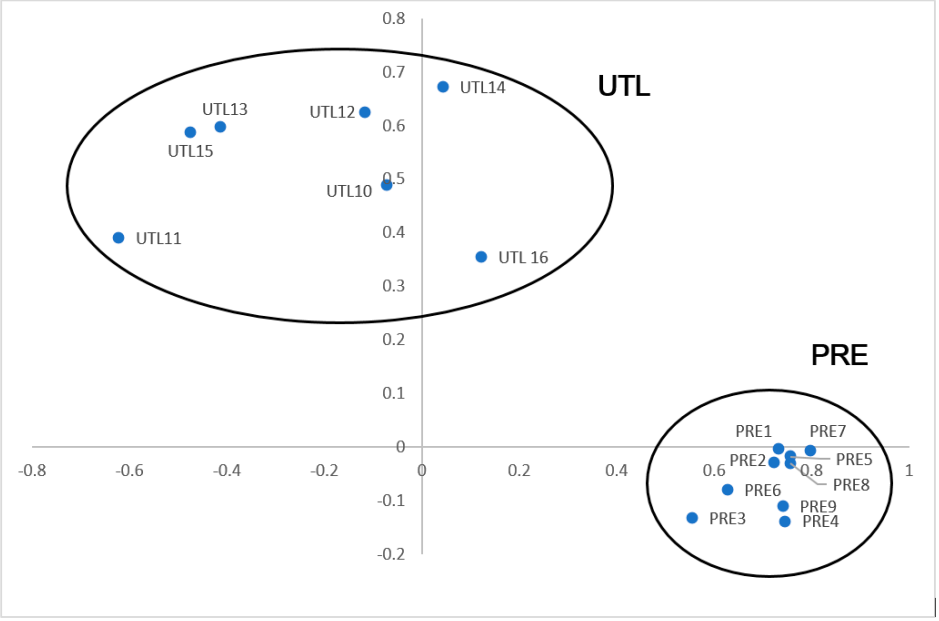

Figure 2. The two-dimensional representation shows the distinct location of both factors. One circle represents the preservation (PRE)-factor, the other the utilization (UTL)-factor.

The frequencies of the 2-MEV factor scores are displayed in Figure 3, showing a clear positive tendency for PRE and negative tendency for UTL. Figure 4 shows the distribution of factor scores among the four quadrants. The factor scores show the composite scores for each students' relative scores for each factor based on how strongly each item loads onto each factor. As can be seen below, students' scores fall into all four quadrants based on their preservation and utilization score.

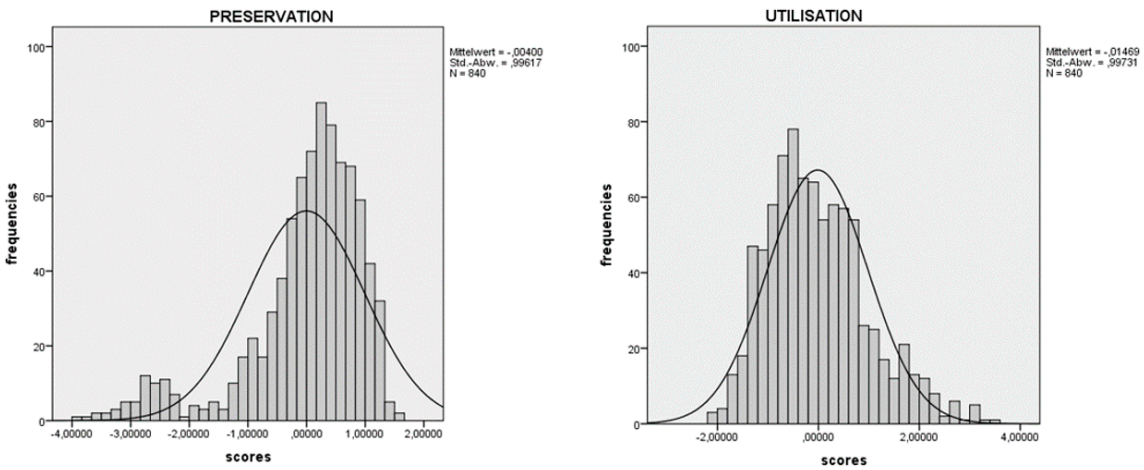

Figure 3. Frequency distribution of 2-MEV domains: PRESERVATION and UTILIZATION.

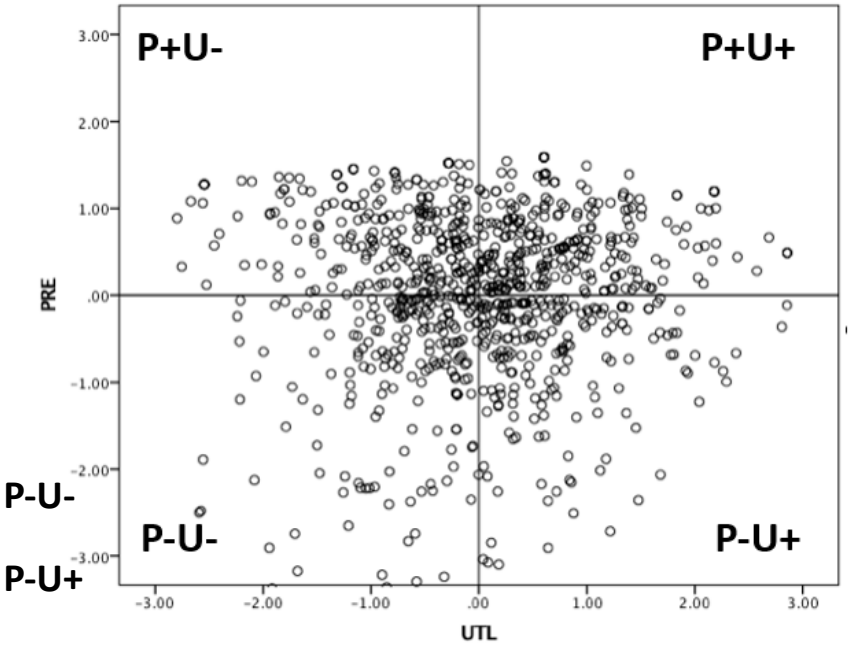

Figure 4. Quadrant score distribution of participants regarding PRE and UTL.

As expected, students in the PRE+/UTIL- quadrant had the highest NEP scores, indicating a bio-centric orientation (see Table 1). Students in the PRE-/UTL+ quadrant had the lowest NEP scores, as we predicted, showing an anthropocentric orientation (DSP). However, students in the PRE-/UTL- and PRE+/UTL+ quadrants had similar NEP scores, very close to the middle of the NEP scale, as hypothesized.

Table 1. Mean NEP cores of each 2-MEV quadrant.

Quadrant	Mean	N	Std. Dev
PRE+/UTL-	3.86	304	0.40
PRE+/UTL+	3.44	196	0.38
PRE-/UTL-	3.43	169	0.55
PRE-/UTL+	2.95	156	0.43

An independent samples t-test between the mean NEP scores of the PRE+/UTL- and the PRE-/UTL+ quadrants (Table 2), revealed a statistically significant difference ($t = 10.63$, $p < 0.001$) with a large effect size ($d = 2.24$). In contrast, the comparison of the mean NEP scores of the PRE-/UTL- and PRE+/UTL + quadrants revealed no statistically significant difference ($t = 0.84$, $p > 0.05$).

Table 2. Independent samples t-test between the NEP scores of the four quadrants.

	Mean Scores		Std. Deviation				
Quadrant	PRE+UTL-	PRE-UTL+	PRE+UTL-	PRE-UTL+	*t*	*p*	Effect size
1-4	3.86	2.95	0.04	0.43	10.63	<0.001	2.24
Quadrant	PRE+UTL+	PRE-UTL-	PRE+UTL+	PRE-UTL-	*T*	*p*	Effect size
2-3	3.44	3.43	0.38	0.55	0.84	>0.05	na

The correlation analysis confirmed that preservation (items 1, 2, 3, 4, 5, 6, 7, 8, and 9) was highly correlated ($n = 744$, $r = 0.64$, $p < 0.001$) to NEP (items 17, 18, 19, 20, 21, 22, 23, 24, 25, and 26; see Table 3). In contrast, utilization (items 10, 11, 12, 13, 14, 15, and 16) was negatively correlated ($n = 726$, $r = -0.47$, $p < 0.001$) to the NEP.

Table 3. NEP and 2-MEV Scale items.

Preservation Items
PRE1. If I ever have extra money, I will give some to help protect nature. PRE2. To save energy in the winter, I make sure the heat in my room is not on too high. PRE3. I would like to sit by a pond and watch dragonflies. PRE4. I would help raise money to protect nature. PRE5. I always turn off the light when I do not need it any more. PRE6. I like to go on trips to places like forests away from cities. PRE7. I try to tell others that nature is important. PRE8. I try to save water by taking shorter showers or by turning off the water when I brush my teeth. PRE9. I like the quiet of nature.
Utilization Items
UTL10. People have the right to change the environment (nature). UTL11. Building new roads is so important that trees should be cut down. UTL12. I like a grass lawn more than a place where flowers grow on their own. UTL13. Because mosquitoes live in swamps, we should drain the swamps, and use them for farming. UTL14. To feed people, nature must be cleared to grow food. UTL15. People are supposed to rule over the rest of nature. * UTL16. Weeds should be destroyed because they inhibit the full development of useful and ornamental plants.
New Ecological Paradigm Items
NEP17. Plants and animals have as much right as people to live. NEP18. People are supposed to rule over the rest of nature. * NEP19. There are too many (or almost too many) people on Earth. NEP20. Human cleverness and skill will make sure that we do NOT ruin the earth. NEP21. People must still obey the laws of nature. NEP22. Nature is strong enough to handle the bad effects of modern developed countries. NEP23. When people mess with nature it has bad results. NEP24. Humans will someday learn enough about how nature works to be able to control it. NEP25. Humans are greatly mistreating the environment. NEP26. If things continue on their present course, we will soon experience a major ecological catastrophe.

* note: Item UTL15 and NEP18 are the same item. This item is shared between the two scales.

4. Discussion

4.1. NEP or 2-MEV?

From the analysis, it is evident that the 2-MEV factors of preservation and utilization cluster separately in two distinct factors. The frequencies of the two factor scores clearly show a positive tendency for PRE and a negative tendency for UTL and students' scores fall into all four quadrants. As predicted, students with bio-centric orientations (NEP) were placed in the PRE+/UTIL- quadrant and had statistically significant higher scores than students with an anthropocentric orientation (DSP) in the PRE-/UTL+ quadrant. However, students' NEP scores in the PRE-/UTL- and PRE+/UTL+ quadrants were not significantly different and clustered close to the middle of the NEP scale. The relation between the three factors was further confirmed with preservation highly correlated to NEP and negatively correlated to utilization.

It is clear that both the NEP scale and the 2-MEV scale have substantial validation evidence from a broad range of contexts. Evidence in the present study suggests that the NEP scale may not fully explore the dimensions of individuals' environmental perceptions. The 2 Major Environmental Values model (2-MEV) provides a better framework for doing so using a theoretical model recognizing that people can have different views on the values of preservation and utilization. The NEP scale, which groups individuals on a unidimensional construct, was designed to examine where individuals lie on the

anthropocentric to biocentric continuum). While these findings suggested that the NEP Scale has known-group validity, there are limitations to what we can learn from a unidimensional scale [8], p. 430.

In responding to criticism of the NEP scale [43–45], they had defined biocentrism (preservation) and anthropocentrism (utilization) as two separate and not necessarily associated environmental values (each of them comprised of some specific attitude-sets). Instead of placing respondents on either end of a continuum, 2-MEV allows for individuals to be placed in four quadrants: A strong environmentalist with deep concern about conservation might score high on preservation and low on utilization (PRE+, UTL-); on the other hand, an individual who does not realize the urgency to protect the environment and who regards natural resources as mere source for humans might score low on preservation and high on utilization (PRE-, UTL+). Although these two quadrants are the ends of the NEP continuum [58], in reality, environmental values may not lie in only those two quadrants. However, as some people may favor both preferences, as they realize the importance of environmental protection, but at the same time regard human beings as the masters of the environment (PRE+, UTL+), individuals in that quadrant would likely be placed in the center of the NEP continuum, leading to a misinterpretation as noncommittal, while in reality their views might be quite strong. For the last quadrant, where individuals score low in both (PRE-, UTL-), they may lack interest in environment issues, they may find themselves appropriately placed in the middle of the NEP continuum, too [58].

Consequently, the 2-MEV, with its two-dimensional scale, has become a popular measure of environmental orientation of adolescents. Bi-national applications additionally had confirmed the scale's dimensionality repeatedly across different languages and cultural contexts e.g., [49,53], as well as with rural–urban populations [53]. Its suitability has also been tested with adult age groups [55,62]. Taken together, all the validation studies (including several from independent groups) provide suitable evidence of the applicability of the 2-MEV scale for use with a variety of population groups. To avoid misunderstanding, we do not argue that the NEP scale should be discarded altogether. That scale is popular all over the world and the accumulated work based on it is very large, though issues with dimensionality make it difficult to compare those studies' results.

4.2. Recommendations for Education

Environmental perceptions are of great interest to those involved in environmental learning in formal and informal settings. Environmental learning centers commonly attempt to address at least some aspect of environmental perceptions within their programs. Having the ability to measure and analyze these perceptions is important for a variety of evaluation and research purposes, both for educators and for researchers. The ability to examine both preservation and utilization values using the 2-MEV scale provides researchers with an important tool. Quadrant scores can be analyzed in relation to behavior changes, looking at how the combination of values held by individuals influences their environmental actions. For instance, are the behaviors of students with high preservation values different depending on whether they have high or low utilization values? It is also important to look at how amenable both preservation and utilization values are to education interventions. Can they be equally influenced by education, or is one of them based on more deeply held beliefs that are resistant to change?

There are several ways the 2-MEV can assist those implementing educational programs. Comparisons of pre- and post-program value and attitude scores can be used, of course, to assess the impact of programs. The ability to measure both preservation and utilization values allows for analyses of changes in both values independently; participants' movements between quadrants from pre- to post-program can be tracked. This allows program leaders or evaluators to determine, for example, whether program elements are only successful in changing only values of preservation, while leaving views of utilization intact; that would have implications for program activities and emphasis.

5. Conclusions

The present study addresses an important issue of assessment for those in the environmental learning research community who are particularly interested in how students' environmental

perceptions change due to educational experiences. If the goal of environmental learning programs is to produce environmentally literate citizens, assessing the impact of educational interventions is of great importance for those who offer such experiences (e.g., environmental centers) as well as the research community. Therefore, the development and availability of valid and reliable instruments have been of great concern in this field, and the affective domain in environmental learning has been hampered both by the lack of good theoretical models and instruments to measure aspects of that domain.

In general, we agree that the NEP has proven to be a valid construct of environmental perceptions, differentiating individuals at the two ends of the scale, NEP–DSP. The results of the study provided evidence that a high NEP score correlates with the 2-MEV scale's preservation dimension and low NEP scores with the utilization dimension. However, in our study, we also provided evidence that the NEP scale actually fails to differentiate between two very distinct environmental perceptions (PRE-/UTL- and PRE+/UTL+ of the 2-MEV quadrants) that cluster in the middle of the NEP continuum. While the NEP scale can be useful in some studies, particularly those looking at groups with extreme environmental perceptions, the 2-MEV scale's ability to provide a more complete picture of people's environmental perceptions calls for its broader use.

Despite the efforts to carry out a well-designed empirical study, limitations will always be present. In this study, we examined students' perceptions using a sample of individuals from the southwestern United States. The participating students were predominantly White and Hispanic, thus limiting our ability to generalize the results across different cultures. In addition, all students originate from schools of low to mid socioeconomic background. This also limits our ability to generalize the results to students of high socioeconomic background. However, our study is adding another valuable piece to the huge mosaic of attitude studies within the field.

Author Contributions: Conceptualization, C.C.M., B.J., and F.B.; data curation, C.C.M.; formal analysis, C.C.M., B.J., S.B., and F.B.; funding acquisition, B.J.; investigation, C.C.M. and B.J.; methodology, C.C.M., B.J., S.B., and F.B.; project administration, C.C.M.; resources, B.J.; software, C.C.M. and S.B.; supervision, C.C.M.; validation, S.B.; visualization, C.C.M., B.J., S.B., and F.B.; writing—original draft, C.C.M.; writing—review and editing, C.C.M., B.J., S.B., and F.B.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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