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The 2-MEV model: Constancy of adolescent environmental values within an 8-year time frame

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The 2-MEV model is a widely used tool to monitor children's environmental perception by scoring individual values. Although the scale's validity has been confirmed repeatedly and independently as well as the scale is in usage within more than two dozen language units all over the world, longitudinal properties still need clarification. The purpose of the present study therefore was to validate the 2-MEV scale based on a large data basis of 10,676 children collected over an eight-year period. Cohorts of three different US states contributed to the sample by responding to a paper-and-pencil questionnaire within their pre-test initiatives in the context of field center programs. Since we used only the pre-program 2-MEV scale results (which is before participation in education programs), the data were clearly unspoiled by any follow-up interventions. The purpose of analysis was fourfold: First, to test and confirm the hypothesized factorized structure for the large data set and for the subsample of each of the three states. Second, to analyze the scoring pattern across the eight years' time range for both preservation and utilitarian preferences. Third, to investigate any age effects in the extracted factors. Finally, to extract suitable recommendations for educational implementation efforts.

Keywords: *2-MEV; Preservation; Utilization; Adolescent green attitudes; Values*

Introduction

Measuring adolescent and pre-adolescent environmental values (viewed as sets of attitudes; Wiseman & Bogner, 2003) is a complex and multifaceted task. It requires both a commonly agreed theoretical basis thoroughly founded in the literature body as well as the construction of a psychometrically sound measurement instrument, for instance,

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by employing as minimum requirement factor-analytic techniques, cross-sample testing and/or cross-validation by other studies (Leeming, Dwyer, Porter, & Cobern, 1993). Studies measuring environmental values or the related sets of attitudes or worldviews in general use self-report methods producing series of paper-and-pencil questionnaires for application to adult populations. For many years, scale development for the age group of adolescents and pre-adolescents was a neglected area (Hines, Hungerford, & Tomera, 1987). In spite of the importance and need for appropriate measures for numerous educational initiatives since the 1970s, confirmatory research for a long time failed to produce valid tools appropriate for adolescent and pre-adolescent samples (which represents the most promising age group for educational initiatives). Very often, program-specific instruments were used to monitor children's environmental values without regard for any scales' psychometric properties. Earlier meta-analyses (Gray, Borden, & Weigel, 1985; Leeming, Dwyer, & Bracken, 1995; Leeming et al., 1993) drew a disappointing picture of the field by dismissing all available measurement approaches and identifying not even one single valid and reliable instrument for adolescents or pre-adolescents, and hence stressed the need for developing appropriate evaluation techniques.

While instruments to measure environmental attitude sets (values) of adults were better developed, the factor-analytic dimensionality of instruments remained heavily disputed: Consequently, one-dimensional scales, for example, the New Environmental (Ecological) Paradigm scale (Blaikie, 1992; Dunlap & Van Liere, 1978), were proposed besides two-dimensional scales (an anthropocentric and an ecocentric view, Gagnon Thompson, & Barton, 1994), or three or even more dimensional scales (e.g. Stern, Dietz, & Guagnano, 1995). Within this research environment, Bogner and Wilhelm (1996) started an initiative to formulate a measurement basis to monitor adolescent and pre-adolescent attitudes and values (targeting 10–16 years olds). Subsequently, an age-adjusted item battery employing rigorous psychometric techniques by including factor analyses was developed and in a series of follow-up studies revised via application to six different (European) student populations across five language barriers (e.g. Bogner, 1998a, 2000; all studies cited in Bogner & Wiseman, 2002a). Subsequently, a measurement scale, labeled 2-MEV, appropriate to the entire European sample was available (Bogner & Wiseman, 1999, 2002a, 2006), its acronym meaning '2 Major Environmental Values'. This battery was envisioned to quantify aspects of ecological attitudes initially via first-order factorized item sets; it built upon a theory encapsulating ecological/environmental attitude sets within two orthogonal higher order factors (values): Utilization (UTL) and Preservation (PRE) (Wiseman & Bogner, 2003). This dichotomous two-factor construction described ecological values as determined by one's position on two orthogonal dimensions: a biocentric one (reflecting conservation and protection of the environment: Preservation) and an anthropocentric one (reflecting the utilization/exploitation of natural resources: Utilization). Within this model, the orthogonality permits an individual position on one dimension independently of that on the other. Consequently, assigning a high individual importance on both the protection of the environment as well as the need to make use of natural resources is possible (Bogner & Wiseman, 2002a).

This vertical structure of attitudes allows a distinction between those two higher order factors. Thus, the two-dimensional construct organized within a hierarchical fashion made the 2-MEV model increasingly popular.

Bogner and Wiseman provided some additional support to the proposed 2-MEV model by applying three cross-validation studies with related scales as a measure of validity. (i) The first study included personality variables reflecting risk-taking behavior (Bogner, Brengelmann, & Wiseman, 2000) and strongly supported the two opposing profiles: High scorers on Preservation were shown to portray controlled and cautious gamblers; Utilizers tended to avoid unpredictable risks, reacted with anger when risks fail, and failed to control risk-taking behavior. (ii) A second study (Wiseman & Bogner, 2003) included Eysenck's personality battery covering 'Psychoticism' (P), 'Extraversion' (E) and 'Neuroticism' (N) as well as a social desirability response set (L) (Eysenck & Eysenck, 1968, 1972). Again, principal component analysis supported an orthogonal, two-dimensional representation of ecological values: A high scorer in Utilization tend to make an effort to receive immediate self-orientated gratification, while a preservationist is supposed to be quite pleased with a delayed, otherwise-oriented gratification. (iii) Finally, a third study examined relationships between the environmental values (Preservation and Utilization) and Authoritarianism, measured as a factor extracted from a shortened set of items adapted from the Wilson–Patterson Conservatism scale (Wilson & Patterson, 1968). The negative correlation between Authoritarianism and Preservation and the positive one between Authoritarianism and Utilization were interpreted in terms of the 'aggressive, self-serving nature of those scoring high on the tough-minded brand of conservatism assessed by the Authoritarianism factor' (Wiseman, Wilson, & Bogner, 2012). In addition to those three cross-validation studies, a European initiative focusing on 'green' education issues in monitoring 16 European and Northern African countries showed that the MEV structure existing even in diverse adult (teacher) populations with 12 different languages involved and even with populations outside of Europe such as the Northern African countries (Munoz, Bogner, Clement, & Carvalho, 2009).

The MEV model itself might have been considered as just another approach within many, but subsequent, independent cross-validation initiatives introduced further confirmation of the structure. (i) An empirical study applied in New Zealand, based on 455 subjects, originally undertaken to challenge the two-factor second-order structure, brought the first independent approval (Milfont & Duckitt, 2004). On the basis of an extended 99-item battery (including the Bogner & Wiseman item set), this specific study extracted a higher order structure identical to the 2-MEV model. In spite of some limitations of the study, for instance, the study was based on the responses of undergraduate students of just one single institution, the two-factor model yielded the best fit for the data. (ii) While the New Zealand initiative originated in a psychometric project, four years later, an American study applied the 2-MEV model to fifth and sixth graders in order to compare their value scores before and after participation in an earth education program (Johnson & Manoli, 2008). Within this context, the secondary higher order structure of PRE and UTL was again confirmed. (iii) Likewise, another research group in Belgium studying

Flemish secondary school students within a statewide eco-school initiative yielded a similar result by confirming the two-factor structure even with an extended version (Boeve-de Pauw & van Petegem, 2011). (iv) Finally, Borchers et al. (2013) replicated the model in a West-African sample by applying confirmatory factor analysis when monitoring the consequences of students' participation in a local extra-curricular environmental education program. With a data basis of more than 1,200 participants, the dichotomous structure was again well confirmed. Consequently, the 2-MEV up to now finds itself in the exceptional situation of repeated independent confirmation; by this reason, up to now, it is already well distributed (we currently know from 26 language versions).

Besides the above-described cross-validation initiatives and confirmation approvals, the stability of the 2-MEV structure, especially in multiple field course evaluation studies, has been repeatedly verified (e.g. Bogner, 2000; Bogner & Wiseman, 2006; Činčera & Johnson, 2013; Johnson & Manoli, 2011; Liefländer & Bogner, 2014; Manoli et al., 2013; Schneller, Johnson, & Bogner, 2015). Nevertheless, the scale's stability over time still was an open issue, cross-sectional longitudinal studies are still missing (cf. Milfont & Duckitt, 2004). Consequently, the objectives of our study were fourfold: (i) To extract the scale's structure from a large sample which originated from different field center initiatives in the USA. (ii) To analyze the scores over an eight-year time span. (iii) To monitor a potential age dependency within three grade levels regarding PRE- and UTL-scores, and finally. (iv) To extract suitable recommendations for educational implementation efforts when monitoring soft variables such as attitudes and values.

Methods

As part of a larger evaluation of earth educations programs at field centers, the 2-MEV was used to measure the environmental attitudes and values of 10,676 children over an eight-year period. In the larger study, children completed the 2-MEV as both a pre-program and post-program measure of environmental values. Prior to the use of the 2-MEV, the scale was tested and revised for use in the USA (Johnson & Manoli, 2011). Items were first revised from European English to American English, and some words that might be considered difficult to 10–12-year-olds were replaced. The revised scale was pilot tested with children and interviews were conducted with some of the children to check for understanding. In addition, ecological knowledge, environmental behavior, program satisfaction and program completion were measured in the larger study. Because the purpose of the present paper was to examine the environmental attitudes and values of children across an 8-year time span, only the pre-program 2-MEV scale results were used, providing a picture of the environmental attitudes and values of children before they participated in education programs.

Children from three different program sites were included in the study. Each program site was a field center that offered multi-day earth education programs to local schools. The program sites were located in three different states in the USA,

Pennsylvania, Louisiana and Arizona. Two of the sites (Arizona and Louisiana) were located on the outskirts of cities, while the site in Pennsylvania was in a rural area, but still attracted schools from a major city in that state. Participants in Pennsylvania were from 26 elementary and middle schools from a mix of urban, suburban and rural schools with predominantly white students. Louisiana included children from 40 schools, mostly urban schools with a majority of African-American students and a few suburban schools with a majority of white students. In Arizona, children from 38 schools participated; most attended urban schools with a mix of Hispanic and non-Hispanic white children, while some were from suburban schools with a majority of white students. It is also important to note that the program sites in Arizona and Louisiana participated in all 8 years of the study. The program site in Pennsylvania, however, participated in only the first four years. The data from the last four years, then, only have Arizona and Louisiana schools.

Because this study was part of an evaluation project of programs being implemented at one program site in each of the three states, the specific schools involved in each state sometimes differed between years. While many of the schools participated in the programs for multiple years, every year, a few schools for a variety of reasons did not continue participating in one of the programs and a few other schools participated for the first time. While we are confident that the types of schools did not vary greatly from year to year, we also wanted to examine the attitudes and values over time of children from a single school. We selected the school with the largest representation in the data set. That school, from Louisiana, participated in programs at the site there for all eight years of the study. A total of 1,272 children from that school are represented in our data set over the eight years.

We were also interested in comparing the attitudes and values of children of different ages, so we included participants from four different school grades—fourth, fifth, sixth and seventh. Because we did not have any seventh-grade participants from Pennsylvania (Table 1) and no sixth-grade participants from Arizona, we combined the sixth and seventh graders for our analyses.

Both scores, Utilization and Preservation, were measured with the 2-MEV scale (Bogner & Wiseman, 1999, 2006) by using 16 out of the original 20 items (Johnson & Manoli, 2008). The response pattern followed a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Previous studies confirmed a two-factor structure of these items with one higher order factor labeled Utilization, the other

Table 1. Participants by grade level and location

	Pennsylvania	Louisiana	Arizona	Total
Grade 4	153	3,546	707	4,406 (41.3%)
Grade 5	2,507	1,370	593	4,470 (41.9%)
Grade 6	1,056	43	0	1,099 (10.3%)
Grade 7	0	606	95	701 (6.6%)
Total	3,716 (34.8%)	5,565 (52.2%)	1,395 (13.1%)	10,676

Table 2. Selected items of the 2-MEV scale (PRE: upper item block; UTL: below item block)

1. If I ever have extra money, I will give some to help protect nature
2. To save energy in the winter, I make sure the heat in my room is not on too high
3. I would like to sit by a pond and watch dragonflies
8. I would help raise money to protect nature
9. I always turn off the light when I do not need it any more
10. I like to go on trips to places like forests away from cities
15. I try to tell others that nature is important
16. I try to save water by taking shorter showers or by turning off the water when I brush my teeth
17. I like the quiet of nature

4. People have the right to change the environment (nature)
5. Building new roads is so important that trees should be cut down
11. I like a grass lawn more than a place where flowers grow on their own
12. Because mosquitoes live in swamps, we should drain the swamps and use the land for farming
18. To feed people, nature must be cleared to grow food
19. People are supposed to rule over the rest of nature
21. Weeds should be killed because they take up space from plants we need

Table 3. Factor structure of the total sample ($n = 10{,}676$) as well as of the state subsamples: Arizona ($n = 1{,}395$), Louisiana ($n = 5{,}565$), Pennsylvania ($n = 3{,}716$). All scores below 0.3 are suppressed. Order of loadings follows the order of items listed in Table 2

Total		Arizona		Louisiana		Pennsylvania	
PRE	UTL	PRE	UTL	PRE	UTL	PRE	UTL
.612		.610		.570		.628	
.533		.516		.484		.588	
.571		.589		.579		.551	
.648		.620		.633		.646	
.554		.506		.493		.636	
.509		.469		.549		.531	
.676		.647		.649		.679	
.693		.631		.686		.704	
.508		.591		.499		.509	
	.685		.609		.685		.653
	.461		.471		.485		.449
	.424		.513		.430		.455
	.515		.515		.537		.523
	.628		.620		.642		.577
	.522		.614		.513		.497
	.386		.384				.547

factor labeled Preservation. The method of scoring, the selection of the items, the relevant psychometric techniques are outlined in Bogner and Wilhelm (1996) and subsequent studies (Bogner & Wiseman, 1999, 2002a). The combined data set was subjected to factor analysis.

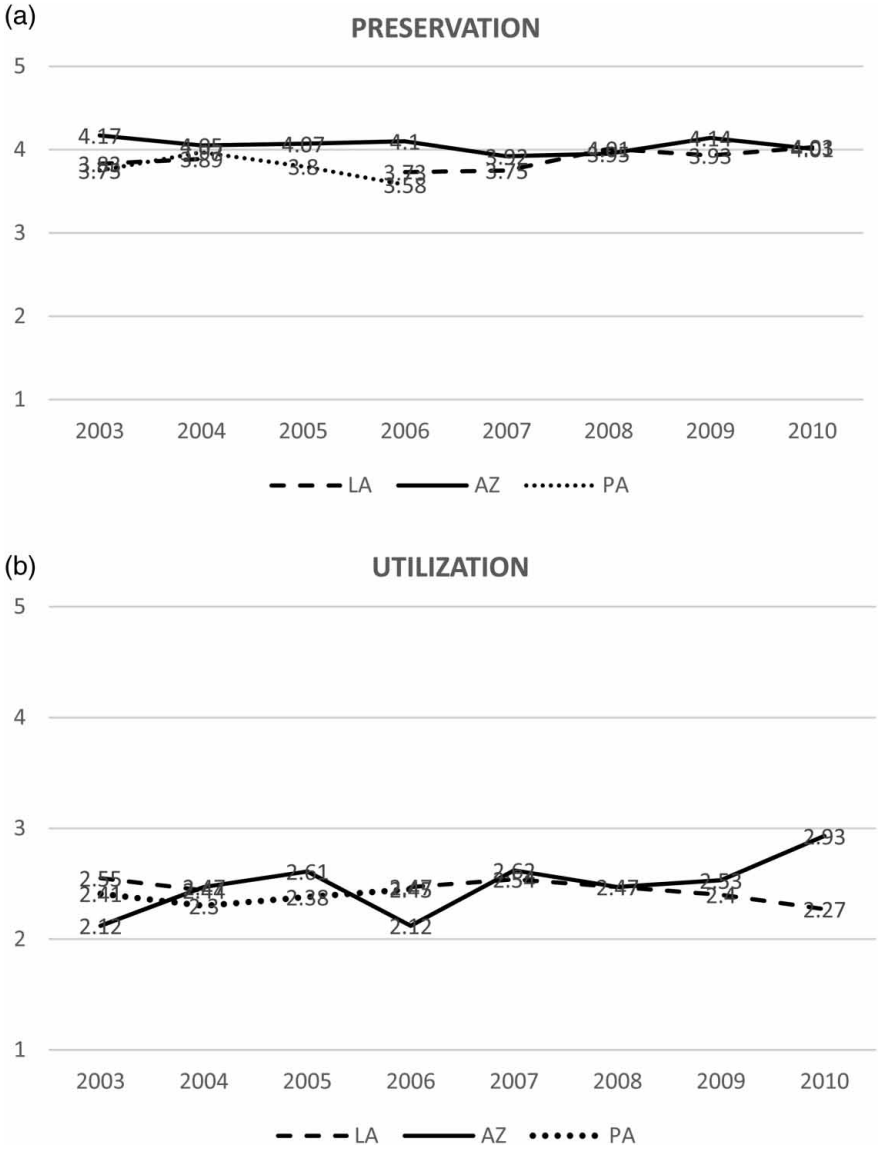

Figure 1. Multi-annual course of PRE-scores (a) and UTL-scores (b), split into three state subsamples (Louisiana—LA, Arizona — AZ, Pennsylvania—PA) Note: There are no data shown from 2005 for the Louisiana cohort because that was the year that Hurricane Katrina occurred, and the program site did not offer programs that year

Analyses were completed by using IBM SPSS Statistics 21. A principal axis factor analysis was conducted to validate the 2-MEV's factor structure at for the total sample as well as for each of the three subgroups (program sites/states). The next analysis was an examination of the Preservation and Utilization means across the eight years. We then compared the Preservation and Utilization means of children

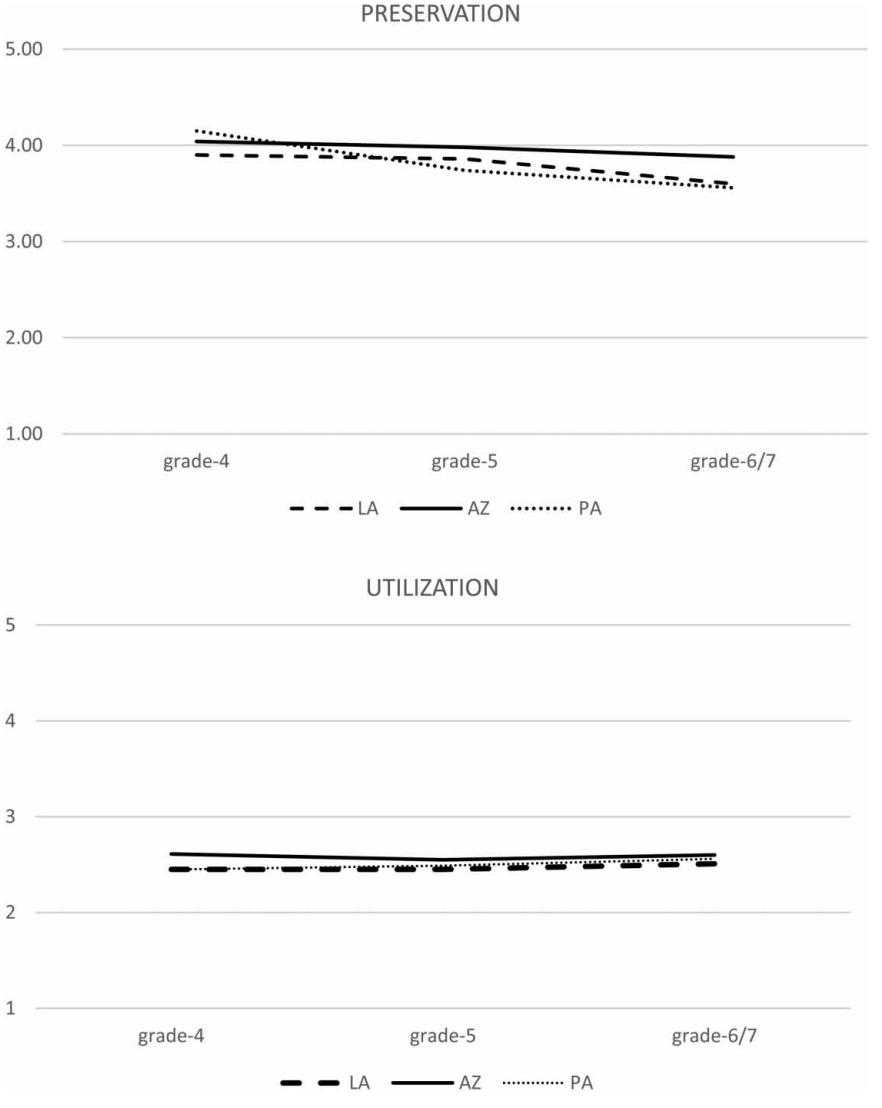

Figure 2. PRE-and UTL-scores, split state-wise into grades 4 to 6/7

from the different grade levels. The final analysis was of the Preservation and Utilization means of children from one school in Louisiana (Table 2).

Results

First of all, the factor analysis confirmed the theoretically proposed model of the two underlying latent variables Preservation and Utilization, as outlined in the 2-MEV model. The items and their loadings (regression weights) of both factors are depicted in Table 3. The model confirms the data structure of the applied questionnaire

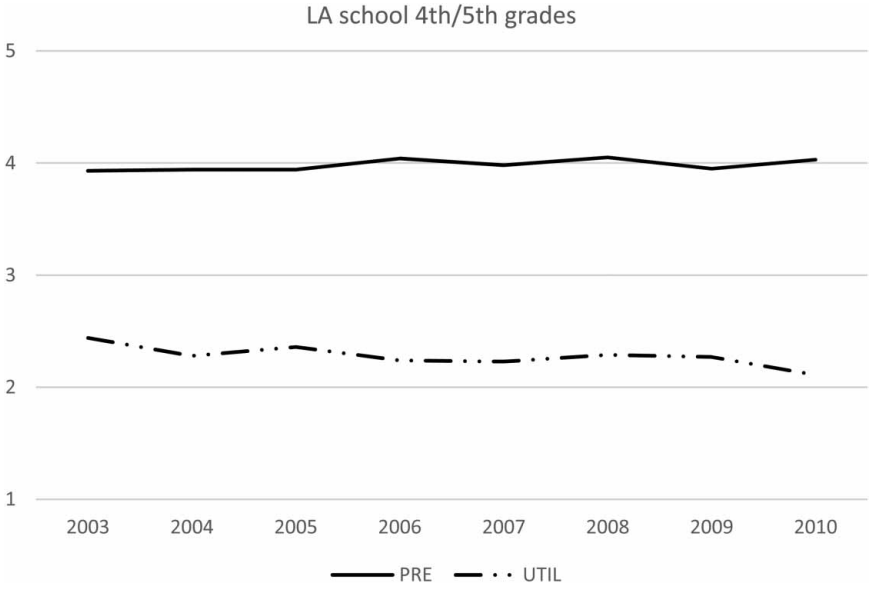

Figure 3. PRE-and UTL-scores of fourth and fifth grades cohort of one selected Louisiana school

according to the theoretical predictions and highlights that this is a valid measurement for both attitude sets: The total sample and the three cohorts' sample show the expected loading pattern. No cross-loadings surpassing 0.3 occurred. Of course, there are slight differences in loading scores, but never in the loading pattern itself. This indicates a high stability of the model itself.

Consequently, a subsequent analysis of the value scores produced a stable foundation of scores: For instance, a visual comparison of Preservation scores over a time span of eight years displays a meaningful pattern: All three cohorts show consistent scores with little variation across the eight years (Figure 1(a)). In the case of Utilization, there is more variation but only in the Arizona cohort (Figure 1(b)) (see discussion).

Regarding age effects (based on school grade information), Preservation scores showed a tendency to decrease over a period of 3–4 years (Figure 2). Regression analysis showed a statistically significant decline from grade 3 to 7 ($p < .001$) with an unexplained variance of 3%. Nevertheless, this was not the case on the Utilization scores which showed a consistent score across the years. Gender produced just negligible differences, in PRE or in UTL as well (Preservation (girls: 3.82, boys: 3.79), significance .029, $\eta^2 = .001$; Utilization (girls 2.46, boys 2.53) significance .003, $\eta^2 = .003$) (Figure 3).

Finally, the analysis of single Louisiana school ($n = 1{,}272$) showed consistent Preservation scores over the eight years, while the utilitarian ones showed a slight decreasing tendency. However, if the data of the first year (2003) and of the last year (2010) were excluded from analysis, the small differences vanished (Figure 3).

Discussion

The first outcome of the present study is the solid structure stability even in a data set of diverse cohorts sampled over a period of eight years. The data were gathered for quality assessment of field center programs, but the data collection originated from pre-program administrations and is not affected by educational interventions. Therefore, it is a very encouraging finding when student samples from quite different backgrounds (regionally and demographically) respond to an item battery with such consistency. Thus, the present study builds on the previous studies confirming the factor-analytic basis of the 2-MEV regarding different populations (summary: see Bogner & Wiseman, 2002b), but for the first time introduces longitudinal stability too. This important knowledge reduces the frequent need to repeatedly monitor populations, for instance, within the context of evaluating field programs (see below).

The stability of the 2-MEV scale provides sufficient evidence of a scale confirmation, even when item numbers are shortened from 20 to 16 (as it was the case in our study). This also is in line with previous attempts (e.g. Fremerey & Bogner, 2015; Liefländer & Bogner, 2014; Munoz et al., 2009). Consequently, the custom of some evaluation initiatives in outdoor sites to reduce due to time constraints the item number in order to facilitate evaluation plans of program modules seemingly does not hurt the scale's validity. This simple information might turn out as very helpful, especially with the background of often small sample sizes in field center initiatives which in general do not allow the use of valid psychometric measures.

Background information about tendencies in different populations often turn out to be essential when educational efforts are in progress. Geographical origins can heavily intervene with attitudinal preferences. For instance, Bogner and Wiseman (2002b) compared primary factor scores of five different national European samples, unveiling substantially different differences; even bi-national comparisons elucidated significant discrepancies (e.g. Bogner & Wiseman, 1996, 1998). Similar studies from even more countries have supported this further (e.g. Bechtel, Corral-Verdugo, Asai, & Riesle, 2006; Evan et al., 2007; van Petegem & Blieck, 2006; Szagun & Pavlov, 1995). Therefore, the seeming uniformity of our data points to a much higher homogeneity in the USA compared to European countries with its heterogeneous diversities including language barriers. In the USA, patterns follow similar lines: Preservation preferences score high (well above average), utilitarian do just below average.

The knowledge about individual 'baselines' of attitudinal preferences is a very helpful argument for any educators when planning interventions. For instance, knowledge about ceiling and bottom effects are likely to allow only a low magnitude of change produced by participation in educational programs. When pre-test levels show such a ceiling (bottom) portray, no great deal of space for change in desired directions is likely anymore, which is, increasing in Preservation but decreasing in Utilization. Additionally, awareness is required about the fundamental problem in assessing change since changes in a score may be dependent on the pre-test value. Consequently, a high-scoring participant (on the pre-test) may have little space for scoring yet higher on the post-test. In other words, any change potential correlates

to a high degree with the pre-test score. Therefore, intention just to focus on change alone may mislead conclusions besides any methodological incorrectness. With valid pre-test knowledge, educators may plan differently to get out the optimum of a program. For a later-on analysis, employing a post-minus-pre-test difference as a dependent variable and a pre-test score as the covariate helps to overcome this dilemma.

Age (or the proxy school grades) is a significant negative correlate of the Preservation scale, which as a fact is in line with many previous studies (e.g. Bogner & Wiseman, 1997, 1999, 2002a). Many potential reasons are possible, for instance, they could be developmental: Younger children may simply need time to develop the understanding and knowledge of implementation strategies needed to translate attitudes and thus they might follow subjective maturation processes (Evan et al., 2007). Or simply, socialization processes may occur by following educational initiatives. The slight dropping tendency of the Preservation scores in relation to subsequent grades 4 to 6/7 might originate in an effect of social desirability: Students might have had less tendency to select answers according to what they are expected to say (or what is communicated as right) with their increasing age. One way to clarify this issue might have been to add a social desirability measure (e.g. Oerke & Bogner, 2011) excluding or confirming such a potentially biasing self-reported measures. Eco-friendliness nowadays may increasingly be considered a social norm, which may lead to a general inflation of tendencies to agree to green issues. In children, the tendency of responding within a social desired expectancy is well known: Younger children show a higher social desirability than older ones do (Boehnke, Silbereisen, Reynolds, & Richmond, 1986). In general, the impact of social desirability on environmental values exists, although it generally has a moderate correlation (Oerke & Bogner, 2011): It especially showed significant effects on Preservation, explaining about 8% of unique Preservation variance, and a higher portion of it was shown to relate on age or stratification level.

The independency of Utilization attitude set from social desirability, shown in our data set, is quite in line with the literature. Quite similarly, Oerke and Bogner (2011)) and Milfont (2009) reported no effect of social desirability on Utilization. Fisher and Katz (2000) in their intent to explain this lack of impact on Utilization brought an absence of social norms into the discussion. This apparent discrepancy points to a scoring pattern that individuals may ascribe in varying degrees to Preservation and Utilization: someone may hold ecocentric views while yet behaving in an anthropocentric fashion. Especially in adolescence, individuals need to stabilize their own views. The younger ones tend to have more 'green' attitude set by opposing the competing traditional belief system causing environmental degradation problems (Blaikie, 1992; Bogner & Wilhelm, 1996). Additionally, the young ones do not yet benefit from advances to exploit nature, which is, they subjectively do not see a personal loss when supporting preservation preferences (Bogner & Wiseman, 2002a; Oerke & Bogner, 2011).

Nevertheless, we see some limitation potential in our study. First of all, our subjects came from convenient samples rather than representative samples of the involved

states. This by itself could intervene with the subjects' backgrounds when just certain portions of a population join in for field courses. For instance, it might be that teachers intentionally or unintentionally influence their students which might have subtle biases on children's values even before the program. Nevertheless, because this study was not examining changes due to participation in programs and because the focus of the study was stability across years, ages and locations, this concern might vanish. Finally, data were not available for every age level for every year across all three locations; ideally, that would have been the case. While three areas of the USA provided a diverse range of participants, the site selection was based on the locations where programs were being evaluated rather than being chosen to be representative of the USA. The consistency of the results across the three different locations, however, indicates that similar results might be expected in other locations in the country. In addition, the participants completed the 2-MEV before participating in an earth education program designed to influence environmental understandings, values and behaviors. Consequently, there were enough data across the years, ages and locations to provide a data constancy over the years.

By focusing on a single school data, the constancy of scoring over the years is still apparent. This is especially true for Preservation preferences and in part for Utilization. In the latter, by excluding the 2003 and the 2010 data, constancy also would exist. Therefore, program evaluators might consider dispensing with pre-program measures, since with one solid measure forecasting a population's future baseline seems reasonable without any data acquisition.

Altogether, investigating both attitude sets in three US states has yielded additional support for the 2-MEV scale as a promising tool for evaluation studies in field centers. Therefore, the 2-MEV scale offers an empirical standard which, in some future, may allow comparing even more intervention studies. Far too often, (environmental) educators have produced their own ad hoc instruments, with the result that there have been as many instruments as there are researchers working in the field (Eysenck & Eysenck, 1968; Wiseman & Bogner, 2003). Therefore, a valid and systematically developed scale can serve as a useful research tool and provide a standardized device quantifying (and comparing) the efficacies of educational interventions (e.g. Bogner, 1998b; Johnson & Manoli, 2008). The 2-MEV may thus provide an important tool for teachers/educators to monitor outcomes of educational implementations, both to evaluate and to optimize such interventions.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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