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Gary W. Evans
Cornell University
Gernot Brauchle
University of Innsbruck
Aliya Haq
Rachel Stecker
Kimberly Wong
Cornell University
Elan Shapiro
Ecovillage

Two reliable and valid instruments to assess first- and second-grade children's ($N = 100$, $M = 6.8$ years) environmental attitudes and behaviors are presented. A series of games derived primarily from dimensions of the new ecological paradigm theory of environmental attitudes are described for the assessment of environmental attitudes. The games include felt board construction, a board game, and an adjustable worry thermometer. Environmental behaviors are assessed in the same sample using magnitude estimation (jumping different distances to indicate frequency of engagement in behavior) based on an adoption of Kaiser's General Environmental Behavior Scale for adults. The behavior scale employs a Rasch measurement model because environmental behaviors are viewed as a consequence of attitudes in concert with difficulties to implement actions.

Keywords: *children; environmental attitude*

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Although debate about the state of the natural environment persists, few would dispute that human behavior has the potential to dramatically influence the health of the Earth. Thus developing an understanding of children's environmental attitudes and behaviors becomes an essential component of providing for a healthier planet. In contrast to a well-established and rapidly expanding knowledge base concerning adult environmental attitudes and behaviors (Gardner & Stern, 2002; Gifford, 2002; Schultz, 2001; Staats, 2003; Stern, 2000; Vining & Ebreo, 2002; Winter & Koger, 2004), there is a marked paucity of scholarship on the structure and developmental trajectory of environmental attitudes and behaviors in children. This article reports on the development of two instruments to assess first- and second-grade children's environmental attitudes and behaviors. Our long-term objective is to use the data herein as the foundation for a longitudinal assessment of the developmental trajectories of environmental attitudes and behaviors from early childhood through adulthood.

Adults' environmental attitudes are rooted in beliefs about anthropocentrism, limits to growth, the balance of nature, and concerns about ecological crisis (Dunlap & van Liere, 1978; Dunlap, van Liere, Mertig, & Jones, 2000; Gardner & Stern, 2002). Adults with higher educational attainment, less political conservatism, more feminist beliefs, and less religious fundamentalism hold more proenvironment, "green" attitudes and values (Gardner & Stern, 2002; Gifford, 2002; Winter & Koger, 2004). A topic of ongoing attention in this literature, as in the larger attitudinal literature, is the extent to which environmental attitudes predict environmental behaviors. Generally this work shows environmental attitudes predict behavioral intentions well; however, translation into environmental behaviors is dependent on the obstacles and difficulties associated with implementing the environmental behavior (Gardner & Stern, 2002; Kaiser, 1998, 2004). For example, in a meta-analysis of environmental attitudes and environmental behavior studies, the mean correlation between environmental attitudes and behaviors was .35 (Hines, Hungerford, & Tomera, 1987). When the available opportunities and difficulties and/or obstacles of engaging in a specified environmental behavior are incorporated into the attitude–behavior estimate, the correlation more than doubles (Corraliza & Berenguer, 2000; Guagnano, Stern, & Dietz, 1995; Kaiser & Gutscher, 2003).

The small amount of work on children's environmental attitudes has focused primarily on how children comprehend nature and on the investigation of underlying moral reasoning in relation to the emergence of ecological belief structures. Little is known about the contents of early childhood environmental attitudes and behaviors. Second graders tend to view animals as subservient, nonsentient organisms without autonomy. By the fifth

grade, however, animals are recognized as having autonomy and feelings, and by middle school, youth understand basic ecological principles, and appreciation for the potential intrinsic value of nature begins to emerge (Eagles & Muffitt, 1990; Kellert, 1995). More recently, Eagles and Demare (1999) showed that similar attitudes prevailed among fifth graders about more general environmental concerns, not just animals, thus extending Kellert's pioneering work on children's beliefs about animals.

Kahn and colleagues (Kahn, 1999; Kahn & Lourenco, 2002), using Kohlberg's moral dilemma methodology, have examined in detail young children's comprehension and evaluation of their relationships with nature (e.g., impact of throwing garbage into a local river, value of animal life vis-à-vis human life). Developmental analyses suggest a shift from anthropocentric reasoning among 6- to 8-year-olds to an appreciation for the potential adverse human impact of mistreating the environment and awareness of damage to the environment itself by age 11 years. Another important contribution of Kahn's (1999) groundbreaking work is the broad generalizability of his developmental trends in moral reasoning about the child–environment relationship across cultures (North American, Portugal, Brazil) and across social class within the United States.

Kahn's work and that of others (Cohen & Horm-Wingard, 1993; Miller, 1975) showed that young children are aware of various environmental problems (e.g., pollution, litter, hazardous wastes) and can reliably distinguish environmental problems from one another. Knowledge of the causes and solutions for environmental problems appears to be more difficult for children to comprehend. For example, nearly 50% of second graders attributed pollution to people who threw things on the ground whereas 60% of eighth graders more accurately noted that pollution was a by-product of industrial production and/or human inaction to restrict pollution sources (Miller, 1975).

Three teams of researchers have developed scales to assess children's environmental attitudes. Williams and McCrorie (1990) and Leeming and Dwyer (1995) based their item sampling domains on Maloney, Ward, and Braucht's (1975) scale of adult environmental attitudes, inquiring in first through seventh graders about behavioral commitments (e.g., "I would not be willing to save energy by using less air conditioning"), affective states (e.g., "I get upset when I think about things that people throw away that could be recycled"), and knowledge (e.g., "The most common poisons found in water are [five option multiple choice"]). Several limitations of these initial attempts to assess young children's environmental attitudes and behaviors are noteworthy. First, the authors relied on an outdated, environmental

attitude model posited more than 30 years ago. Maloney et al.'s scale was designed to gauge adult environmental attitudes, feelings, and knowledge. Second, several items included in these early child measures tap behaviors that young children have no discretion over (e.g., using less air conditioning) and/or might have difficulty comprehending (e.g., "The world will be dead in 40 years time if people do not do enough about our environment"). Third, reliability estimates were quite low for first through third graders, and their performance on the knowledge test did not significantly exceed chance. On the other hand, the Leeming and Dwyer scale functioned better with older children and converged with teacher ratings of degree of environmental interests shown among sixth graders.

Musser and colleagues (Musser & Diamond, 1999; Musser & Malkus, 1994) have developed an assessment tool for young children that does not suffer from inclusion of items outside of children's volitional control and was derived from more contemporary sets of environmental issues and problems than those emphasized by Maloney et al.'s (1975) 30-year-old scale. Musser and colleagues also employed a forced-choice technique rather than 5-point Likert-type scales as used by Williams and McCrorie (1990) and Leeming and Dwyer (1995). These various improvements probably explain the much-improved reliability estimates found by Musser and colleagues (.68 alpha vs. .46 for Leeming & Dwyer, 1995). Nonetheless, this scale also has room for improvement. First, the instruments developed by Musser and colleagues are not based on theoretical and empirical research on environmental attitudes. Second, as noted in the other child scales above, attitudes and behaviors are combined into one index. Third, though one of Musser and colleagues' scales uses drawings to supplement verbal probes, their instrument is primarily semantic, consisting of verbal descriptions of forced choices. Finally, their instruments are not highly interactive or in a game format and provide no variability in the type of child responses elicited. The latter raises concerns about maintenance of attention and involvement in the instrument among young children.

We build on and extend these earlier attempts at environmental attitude scale development for young children in several respects. Foremost, we rely on a more contemporary, well-developed conceptual model of environmental attitudes and values as our starting point for creating a pool of environmental issues to address. Dunlap and van Liere (1978; Dunlap et al., 2000) have conceptualized and extensively developed the New Environmental Paradigm Scale (NEP) for more than two decades that has become the standard for environmental attitude assessment. Nearly all contemporary discussions of adults' environmental attitudes rely on Dunlap and van Liere's

NEP (renamed the New Ecological Paradigm Scale in the latest revision; Gardner & Stern, 2002; Gifford, 2002; Vining & Ebreo, 2002; Winter & Koger, 2004). The original NEP consisted of three underlying dimensions: the balance of nature, anthropocentrism, and limits to growth (Dunlap & van Liere, 1978). The revised NEP scale incorporated two additional sets of items: One set focused on the idea that human beings, unlike other species, are exempt from the constraints of nature (human exemptionalism), and additional items focused on concerns about the occurrence of potentially catastrophic environmental changes (ecocrisis). Validation of the original NEP scale, including cross-cultural data (Bechtel, Verdugo, & Pinheiro, 1999), has encompassed known group comparisons, multimethod convergence, confirmatory factor analysis, sensitivity to experimental interventions, and convergence with intensive, ethnographic investigation. The NEP scale also has excellent temporal reliability and evidences high internal consistency across multiple heterogeneous (class, race, culture) samples (Dunlap & van Liere, 1978). Recent work with the revised NEP scale also reveals excellent reliability and validity (Dunlap et al., 2000).

One aspect of both versions of the NEP scale that remains unclear is the dimensionality of the scale. Principal components analyses tend to reveal one dominant factor, considerable cross factor loadings, and high internal consistency for the total scale. Confirmatory factor analyses with varimax rotation indicate variable numbers of factors across different samples and, similar to the principal components analysis, several items loading across factors (Dunlap et al., 2000). Dunlap and colleagues found, for example, a Cronbach's alpha of .84 for the overall NEP scale, and a four-factor solution with varimax rotation indicating that human exemptionalism was not a separate factor, instead loading with anthropocentrism. They also found considerable overlap among balance of nature and ecological crisis items.

A second contribution we make in addition to building our instruments from the NEP conceptual model is the separation of environmental attitude assessment from environmental behavior measurement. As noted above, adult environmental attitudes correlate well with behavioral intentions; however, the strength of the association is typically significantly lower when behaviors are assessed. The difficulty of engaging in environmental behaviors either because of obstacles such as *financial* or *time commitments*, as well as the availability of the option in the first place (e.g., mass transit), are critical determinants in converting behavioral intentions to environmental behaviors (Gardner & Stern, 2002; Kaiser, 1998, 2004). Thus rather than combine environmental behaviors and attitudes into one score as in previous work on environmental attitudes in children, we developed separate instruments to assess

each of these constructs. We were also sensitive to present behavioral options that are age appropriate (i.e., potentially available to first and second graders).

Third, we have moved away from verbally intensive, semantic questionnaire techniques to reliance on game formats that are predominantly pictorial, interactive, and highly concrete in their substance. We were mindful of limitations in voluntary attentional control in children of this age and thus deliberately constructed a variety of formats, each of modest duration, to keep the interactions lively and engaging for a young child.

A fourth contribution is our in-depth psychometric development and evaluation of the instruments herein. As described in more detail in the Method section, we generated a broad, initial item pool based on prior theoretical work on the NEP along with in-depth, qualitative interviews with children in conjunction with random probing of items in the final instruments. Reliability was assessed for the environmental attitude measure with indices of temporal stability and internal consistency. For the environmental behavior measure, Rasch model separation coefficients along with temporal stability estimates were made (see Results for more details on Rasch modeling).

Extensive efforts were then made to validate the two measures. We examined convergence between children's scaled answers on the games with open-ended probes on attitudinal and behavioral items. For behavioral items, Rasch model item and person-fit statistics were employed, and we compared independent maternal assessments of behavioral frequencies with those provided by her child in one of the games. With a different sample of children, we compared attitudes and behaviors before and after a 1-week, outdoor nature education program. Finally, we collected data on parental environmental attitudes and behaviors on standard scales, parental education and political beliefs, plus child gender to examine whether parental environmental attitudes and behaviors would influence their children and to investigate possible sociodemographic correlates of environmental attitudes that have been uncovered in the adult literature (e.g., more education and more liberal ideology are positively correlated with environmental concerns).

In sum, our goal herein was to develop a reliable and valid set of instruments to assess young children's environmental attitudes and behaviors. We endeavored to create a set of instruments that reflect current, state-of-the-art thinking about environmental attitudes and values that could be mapped onto Dunlap and van Liere's pioneering work on the NEP. We also wanted to extend the groundbreaking works of Kahn and Kellert (2002) on young children's reasoning about environmental dilemmas. We separated measures

of attitude from behaviors and have recognized the importance of considering obstacles and difficulties of engaging in various behaviors when probing about environmental behaviors. We also sought to develop a methodology and a content domain that were developmentally appropriate for first and second graders but amenable to subsequent modifications so that these same children could be evaluated as they mature. Our long-term objective for this research program is to track the developmental course of environmental attitudes and behaviors beginning in early childhood throughout young adulthood.

Method

Participants

One hundred first- and second-grade children (M = 6.8 years) were recruited through public schools in rural areas and small towns in upstate New York. Every family who returned an interest postcard brought home from school by their child agreed to participate when the research program was explained in full. Fifty percent of the participants were girls, and nearly all were White (92%). The children were from well-educated (76% of mothers college graduates) and upper-middle-income families (median annual income between US$60,000 and $75,000). These affluent, well-educated families are not representative of the population of rural and small town, upstate New York communities. Each child was given a small toy at the end of the procedure. For the samples of children who participated in a test–retest reliability check or who participated in piloting with extensive item probing, an additional $10 gift certificate for a bookstore was provided.

Materials

Three games were developed to assess environmental attitudes and values, and one game was used to measure environmental behaviors. An initial set of items was generated from the adult NEP (Dunlap et al., 2000) that represented four dimensions of the revised NEP scale: anthropocentrism, limits to growth, the balance of nature, and concern about environmental catastrophe. We did not attempt to assess beliefs about human exemption from the constraints of nature given the abstract nature of this concept and the fact that these items load highly with anthropocentrism items on the adult NEP scale (Dunlap et al., 2000). Piloting also revealed, it is not surprising to note, that 6- to 8-year-olds could not comprehend the concept of *impending environmental catastrophe*

(e.g., global warming, ozone depletion). It is worth reiterating that ecocrisis items on the adult NEP also overlapped considerably with balance of nature items (Dunlap et al., 2000). Thus we constructed a scale with items representing the three primary dimensions of the NEP: anthropocentrism, balance of nature, and limits to growth.

The first environmental attitudinal measure consisted of a game board wherein the child "competed" against the interviewer by trying to finish the game first. At the roll of dice, the child moved his or her piece first, followed by the experimenter. At various junctures around the board, the child had to choose between various options he or she would prefer. The choices were depicted graphically on the board and read aloud to the child. The five choices included play outside versus watch television inside, separating paper from regular trash versus mixing them together in one trash can, do artwork on one or both sides of paper, people ride to work in cars versus in buses, and using a leaf blower or a rake to clear leaves. Unbeknownst to the child, the game was structured so that the child always came to each decision point before the experimenter. The experimenter then made the same choice that the child had previously made. See Figure 1 for exemplars of the three environmental attitude assessment games.

The second attitudinal assessment technique consisted of felt board constructions depicting two alternative environmental scenarios. The child constructed both alternatives, each on a separate felt board, and then responded to a query regarding which board more closely matched how he or she felt about the issue. The environmental dilemmas were human domination versus parity with animals, water pollution causing serious versus minor harm to the environment, use of pesticides in the garden to kill pests but protect flowers versus no pesticide application but damage to flowers, and receipt for birthday of an older but long-lasting teddy bear versus a new teddy bear but with a shorter expected life.

The third attitudinal game utilized a worry thermometer depicting three faces indicative of no worry, some worry, and a lot of worry. These faces were arrayed vertically equidistant from the bottom to the top of a moveable thermometer. The five worry scale issues included air pollution in the local community, water pollution in a nearby stream and/or lake, deer not having enough food because of overpopulation, toxic waste from a landfill encroaching upon a neighborhood, and the bulldozing of a wooded park area. The three alternative worry thermometer scales (not worried, worried, very worried) were collapsed into a 2-point scale (0 = *not worried*, 1 = *worried or very worried*). This was done to enable scale construction with the two other games that consisted of dichotomous choices.

Figure 1
Sample Environmental Games Items

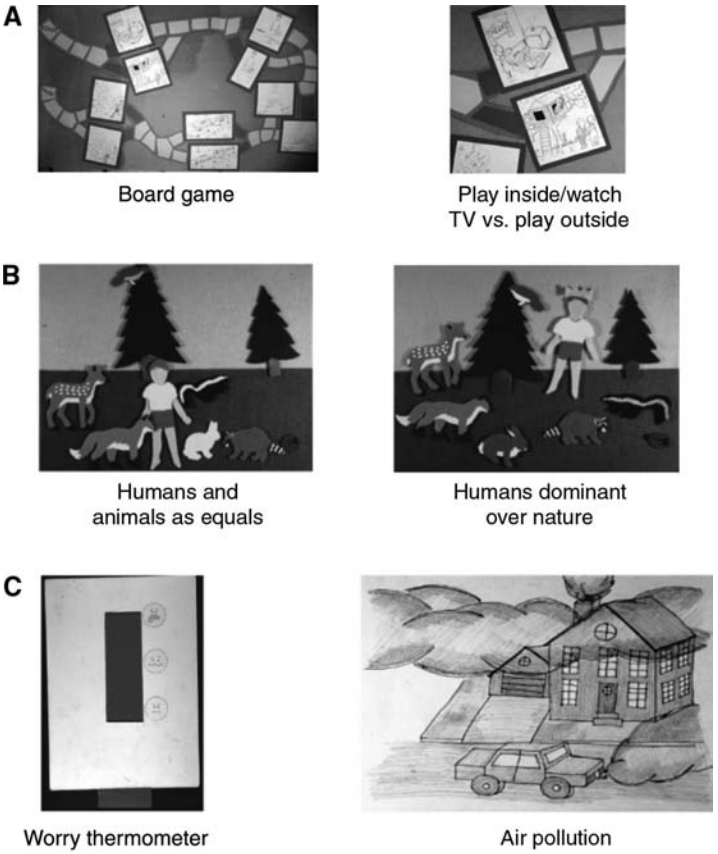
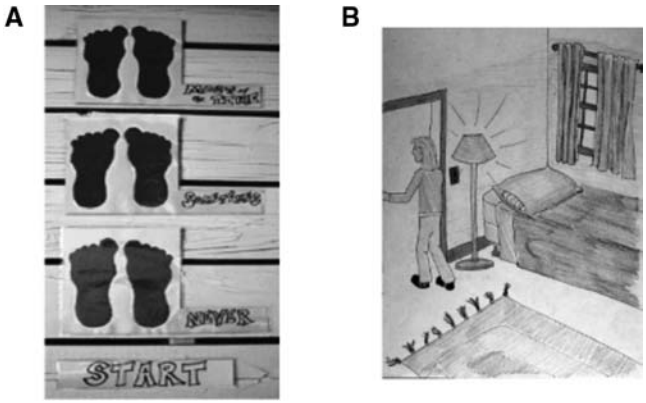


Figure 2 illustrates how environmental behaviors were assessed with a jumping game. The child was instructed to jump to the appropriate line to indicate how frequently (*never, sometimes, most of the time*) he or she engaged in the behavior. This format was adapted from Bandura and Schunk (1981). The eight behavioral items probed were recycling a bottle versus throwing it into a trashcan, walking in nearby nature with a parent,

Figure 2
Sample Environmental Behavior Item



accidentally leaving the light on when leaving the bedroom, reminding friends not to litter after they left trash on a picnic table, leaving water on while brushing teeth, buying too much food and having to throw some away at a restaurant, reading a nature book with a parent, and holding open the refrigerator door while deciding what to eat. For the initial behavioral item (bottle recycling), the child was asked to show the experimenter where in the child's house recycling occurred if available. This was done to ensure this option was available to the child and to check on comprehensibility of the query.

The mother completed a sociodemographic information sheet and the NEP scale (Dunlap et al., 2000). As indicated in the introduction, the NEP is the most widely used adult index of environmental attitudes and has undergone extensive psychometric development. We also asked the mother to complete the General Environmental Behavior (GEB) Scale developed by Kaiser and associates (Kaiser, 1998; Kaiser & Biel, 2000; Kaiser & Keller, 2001). This scale consists of 50 yes/no questions about engagement in discrete environmental activities varying in relative difficulty. Items range from quite simple (e.g., I wait until I have a full load before doing my laundry) to behaviors requiring considerably more sacrifice and/or commitment (e.g., I refrain from owning an automobile). Kaiser has repeatedly demonstrated the superiority of this Rasch model scale to other environmental behavior assessments

because of its inclusion of items that vary along a continuum of attitudes and the feasibility of behavioral engagement. This is in contrast to behavior scales constructed according to the domain sampling approach that presumes similar, underlying frequency distributions for engagement in each specific behavioral item (Bond & Fox, 2001). We also developed a set of eight questions that asked the mother how often (never, sometimes, most of the time, don't know) her child engaged in each of the eight behaviors included in the Children's Environmental Behavior Jumping Game. The child's mother also indicated her political ideology (liberal, moderate, conservative) and indicated whether she had actively participated (volunteer or paid) in addressing an environmental issue.

Procedures

Each first or second grader interacted with a trained college undergraduate in the kitchen or dining room of the child's home. After informed consent was obtained from the mother, the child was given an assent procedure to ensure the child understood she or he was welcome to play the games or not and could stop at any time without penalty. No child at any time in the conduct of the research requested early termination of the procedures. In fact, many children requested to play the games again and/or invited us back to their homes to repeat the games. This information and numerous spontaneous verbal and nonverbal comments and behaviors indicated a high degree of involvement, interest, and enjoyment with the games.

Each game was explained and then illustrated with a practice item to help ensure comprehensibility. After the child answered the practice question, the experimenter asked the child to verify what her or his answer meant. The three attitudinal games were conducted in order (felt boards, worry thermometer, game board) with a short refreshment break between the second and third game. After the third attitude assessment game, the child played the jumping game to gauge environmental behaviors. At the end of the three attitudinal games and the behavioral jumping game, the child was given his or her choice of a small, inexpensive toy.

The experimenters (three female college undergraduates) were trained to respond uniformly throughout the procedures with special emphasis on not indicating degree of approval toward specific answers. Children were praised in a uniform manner (i.e., experimenters memorized a script) at set points for their efforts and asked if they wanted to play some more. No experimenters collected any data from the final sample until her codings were perfectly reliable (i.e., $r = 1.0$) with the first author's coding. We also

evaluated where there were any experimenter effects on the total attitudinal or total behavior scale scores. There were no differences among the data collected by the three experimenters.

Results

Reliability data and descriptive information about children's results are presented first, followed by validity information. There were no gender, age, or ethnicity differences so all information is collapsed across these three variables. Data are also provided on parental environmental attitudes and behaviors as part of the validation procedures.

Reliability

For the environmental attitudes scale, internal consistency (Cronbach's alpha) for 11 items was .69. Three items were eliminated from the final scale scoring because they proved unreliable. These items included an assessment of human dominance over nature (felt board construction of dominance over animals) and two items from the game board (people take car vs. bus to work, separate paper from trash vs. throw all in same can). The latter item had no variance; all children chose to separate their paper. The human dominance over nature item was probably too difficult for children of this age, and the second item was confusing because few children's parents had the option of taking a bus to work given the rural areas they inhabited. Test–retest reliability over a 3-week period was high for the children's environmental attitudes scale, $r = .89$, $p < .01$. A randomly selected subset ($n = 20$) of the original sample was chosen to assess temporal stability. Table 1 depicts the percentage distributions for responses to each of the 11 environmental attitude items.

For the behavior scale, reliability and validity were assessed using a partial credit Rasch model. *Partial credit* simply refers to the three-level scale of behavioral options (*never, sometimes, most of the time*). Rasch measurement models take advantage of the fact that engagement in a behavior or endorsement of an item may not have the same underlying frequency distribution for each item as assumed in classical measurement theory. Rasch models are similar to a Guttman scale in that they enable one to order both items along a continuum (degree of relative difficulty required to engage in a proecological behavior in the current case) and allow the researcher to order individuals with respect to that same continuum. Rasch measurement

Table 1
Frequency Distributions of Environmental Attitudes

	% Scoring 1 (High on NEP) Versus 0 (Low on NEP)
Board game	
Play outside/watch television	75
Draw on both/one side of paper	61
Rake leaves/leaf blower	60
Felt board construction	
Nature fragile/nature resilient	52
No use/use of chemicals to kill pests in garden	62
Older, better made/new short-lived teddy bear	75
Worry thermometer	
Worry/no worry about air pollution in community	79
Worry/no worry about water pollution from industrial dumping	82
Worry/no worry about inadequate/poor resources with overpopulation of deer	85
Worry/no worry about garbage/waste too near residential area	67
Worry/no worry about destruction of park space for development	80

Note: NEP = New Environmental Paradigm Scale.

models presume that more difficult (or extreme) items will be endorsed less often than easier ones. Psychometric statistics within a Rasch model provide mathematical estimates of fit to the posited single continuum, estimates of person heterogeneity with respect to the continuum under assessment, and reliability information for the scale. Unlike a Guttman model, however, Rasch models are not deterministic, requiring each item to either be surmountable or not in the same relative degree across persons. Thus Rasch is a probabilistic version of the deterministic Guttman model. See Bond and Fox (2001) for an introduction to Rasch modeling.

All eight items were retained in the behavior index because it yielded the most reliable Rasch scale with a separation reliability coefficient of .49. Internal consistency estimates (e.g., Cronbach alpha) are not appropriate given the underlying Rasch model of a continuum of items varying in difficulty to perform or endorse, in the current case, proecological behaviors. Item endorsements are not assumed to be normal and equally distributed across persons. In a Rasch model, separation reliability represents the ratio between the true person variance and the variance of the estimated overall

Table 2
Frequency Distributions of Environmental Behaviors

	% Scoring		
	Never	Sometimes	Most of the Time
Recycling at home	23	28	49
Walking or working outside with parent	4	46	50
Forget to turn lights off when leaving bedroom	29	52	19
Pick up trash left behind by your group of friends when exiting picnic table	22	29	49
Forget to turn off water while brushing teeth	73	20	7
Order too much food at restaurant and had to leave extra food	27	62	11
Look at book about environment (nature, trees, animals)	17	50	33
Leave refrigerator door open while deciding what to eat	37	33	30

behavior engagement scores. The modest separation reliability statistic value of .49 reflects the fact that the scale does not have a sufficient number of discriminating items, in this case, more challenging items requiring a higher degree of commitment items. Ideally one would want a separation reliability value around .60 or higher. Most children performed most of the behaviors at least to some extent. There were no items that only a small number of children engaged in, hence the somewhat weak separation reliability index. Test–retest reliability over the same 3-week time period was more satisfactory, $r = .70$, $p < .01$. Table 2 depicts the percentage distributions for responses to each of the 11 environmental attitude items.

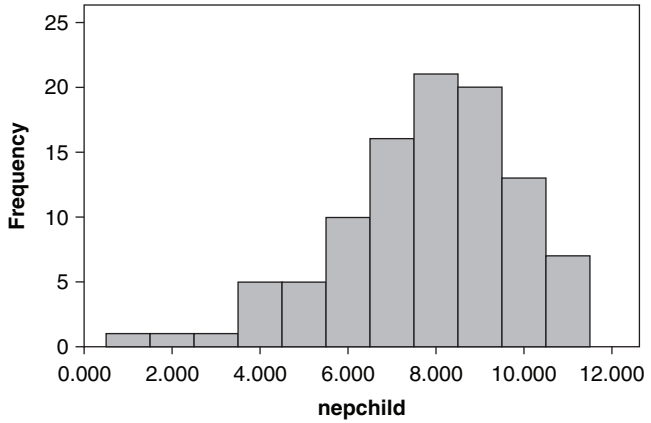
Figures 3 and 4 depict histograms of total scores for the environmental attitude and environmental behavior scales, respectively. The environmental attitude scale scores varied from 1 to 11 across the full range of the scale, with a mean of 7.78 and a standard deviation of 2.06 (see Figure 3). The median score was 8 with little skewness (–.76).

For the environmental behavior scale, scores varied from 9 to 23 of a possible range of 8 to 24, with a mean of 17.55 and a standard deviation of 2.75 (see Figure 4). The median score was 18, and skewness equaled –.37.

Validity

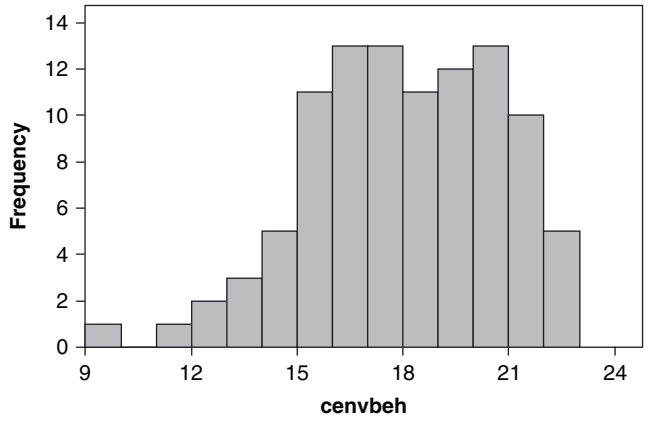
Multiple strategies were followed to build and evaluate the validity of the scales. Several one-on-one interviews were conducted with 6- to 8-year-olds,

Figure 3
Children's Environmental Attitudes



Note: nepchild = child's environmental attitude scale.

Figure 4
Children's Environmental Behaviors



Note: cenvbeh = child's environmental behavior scale.

asking them open-ended questions with follow-up queries about environmental issues. Children were asked what did the environment mean to them and were there any things about the environment they liked, did not like, or were concerned about? As indicated under Method, items were initially chosen to represent the three primary dimensions of the NEP: anthropocentrism, balance of nature, and limits to growth.

We then pilot tested questions with a different sample of 30 children. Following each game, we went back over each question and asked children about the question, probing for comprehension. Based on this qualitative information, we again revised the pilot instruments and then administered the scales to a different sample of 100 first- and second-grade children.

Random probing for the current scales was used to evaluate whether the child's understanding of the question matched our intention. Each child was probed about five different, randomly selected questions. The probe consisted of repeating the child's answer and then for attitudinal questions: "Can you tell me why you said that?" and for behaviors "Why did [didn't] you do that?" Answers were then scored dichotomously as consistent/nonconsistent with the scaled response. Three items did not have 100% consistency. Eighty percent of the scaled and open-ended probe answers were consistent for one of the attitudinal items, a felt board construction and dialogue about the resiliency of nature (depiction of polluting factory and water mildly vs. strongly impacted). Eighty and seventy-eight percent of scaled and probed answers were consistent about the behaviors of reading a book about nature with a parent and leaving open the refrigerator door while looking for food, respectively. All other items had 100% consistency between the child's scaled answer and the open-ended probes.

Child engagement in environmental behaviors (jumping game) was compared to maternal reports of these same eight behaviors. The overall score from the child jumping game correlated modestly with maternal reports ($r = .17$, $p < .05$) based on the same eight behaviors ($\alpha = .97$ for the maternal scale). Six of the eight specific behaviors in the child's jumping game were significantly correlated with the corresponding item on the mother's rating scale (r's ranged from .18 to .22). Two items *leaving the water on while brushing teeth* and *leaving the refrigerator door open while deciding what to take out* were not significantly correlated between the child and maternal reports.

We also assessed validity via experience in an outdoor nature education camp. Scale scores of first- and second-grade children who attended a 1-week, outdoor nature day camp were compared pre- and postcamp. None of these children were in the major study sample. A comparison of pre- and

postcamp experiences taken on the first day at camp (Monday) and the last day (Friday) revealed significant changes in environmental attitudes from Day 1, $M = 7.27$ ($SD = 2.36$) to Day 5 $M = 7.95$ ($SD = 2.42$), $t(40) = 1.90$, $p < .03$. Children's reports of environmental behaviors did not change, however, from Day 1, $M = 16.73$ ($SD = 2.38$) to Day 5, $M = 16.85$ ($SD = 2.33$), $t(40) < 1.0$. Note that the environmental behaviors scale for children attending the nature camp had one fewer item than the scale for the general sample. This was because one of the items in the behavior scale entailed the children showing the interviewer where in their home they recycle bottles prior to asking a question about recycling. Because the nature camp pre- and posttests were conducted at the nature camp site, in-the-home evaluation of recycling was not possible.

Validity for the Rasch-based behavioral scale can also be assessed with item and person-fit statistics (Wright & Masters, 1982). All individual items fit the 8-item scale (t values between –.6 and .7) with a mean t value equal to .03 and a standard deviation of the t values equal to .49. Model fit can also be assessed using mean square statistics weighted by the item variance. The lowest *MS* value was .92 and the highest 1.12 for the eight items with a mean *MS* value of 1.0 and a standard deviation of the *MS* values equal to .07. An *MS* value of .90 for example corresponds to a 10% lack of variation in the model prediction compared to the empirical data. Ideally the t values should be between +1.96 with a mean of 0 and a standard deviation of 1. The mean *MS* value should be 1 with no ideal value available for the standard deviation of the *MS* (Wright & Masters, 1982). Fit statistics can also be calculated for persons. Two children fit poorly ($t > 1.96$), and two responded overdeterministically ($t < 1.96$). Overall fit statistics for the total sample of 100 children were excellent, M (*MS*) = 1.0 with a standard deviation of .44. Corresponding t values were a mean of .01 and a standard deviation of .99.

A final approach to validation entailed exploration of potential correlations between sociodemographic characteristics and children's environmental attitude and behavior scores. Adults who are more politically liberal, more educated, and more feminist in their beliefs reflect greater concerns about environmental issues (Gardner & Stern, 2002; Gifford, 2002; Winter & Koger, 2004). Thus we also examined whether parental political identification and education as well as child gender were associated with children's environmental attitudes and behavior. We also reasoned that parent's own environmental attitudes and behaviors might influence those of their children. Thus we also examined parental environmental attitudes and behaviors in relation to children's environmental attitudes and behaviors. Table 3 presents a zero-order correlation matrix for children's environmental attitudes and behaviors with

Table 3
Zero-Order Correlation Matrix

	2	3	4	5	6	7	8	9
1. Child environmental attitudes	.02	.01	–.02	–.15	.16	–.02	.12	.02
2. Child environmental behaviors		.11	.07	.04	–.09	–.05	.05	.07
3. Parent environmental attitudes			.50**	–.16	–.02	.21*	.44**	.28*
4. Parent environmental behaviors				–.13	.04	.10	.25*	.21*
5. Child gender					.08	–.09	–.04	–.03
6. Household income						.58**	–.03	.22*
7. Maternal education							.09	.15
8. Parental political beliefs								.14
9. Parental involvement in environmental activities								

*$p < .05$. **$p < .01$.

those of their parents, their parents' political beliefs (conservative, moderate, liberal), maternal education, family income, and child gender.

Two things are readily apparent when examining the correlation matrix. First, consistent with the adult literature, more highly educated and politically liberal adults have higher environmental attitudes and engage in more environmentally conscious behaviors. Second, their first- and second-grade children, however, appear to be unaffected by maternal education, parental political beliefs, or family income. Similarly, child's gender was unrelated to her or his scores. As inspection of Table 3 reveals, children's environmental attitudes and behaviors were also unrelated to those of their parents.

Discussion

The large, relatively well-developed literature on adult environmental attitudes and ecological behaviors is not matched by work on the maturation of these constructs in young children. The content and developmental patterns of children's environmental attitudes and behaviors are largely unknown, with existing work focused on how young children morally reason about their relationship to the natural world (e.g., polluting local waterways, describing animals' autonomy and feeling states; Kahn, 1999; Kahn & Kellert, 2002; Kellert, 1995). To learn more about young children's attitudes toward environmental issues and how they behave with actions that have ecological consequences, we developed a set of games appropriate for first- and second-grade children. The contents of these games were built

from the NEP Scale (Dunlap & van Liere, 1978; Dunlap et al., 2000), the most widely used assessment tool for environmental attitude measurement among adults. We also conducted a series of open-ended conversations with young children about their knowledge and feelings about environmental issues to generate possible items for inclusion in our set of games. We then pilot tested several iterations of our scale items, relying on children's own open-ended explanations of their answers to our game items.

We also separated environmental attitudes from reports about environmental behaviors given theoretical work in the general attitude literature and for environmental attitudes specifically, showing the critical importance of attitudes and the feasibility of behavioral engagement in explaining environmental behaviors (Kaiser, 2004). We adopted a magnitude estimation technique suitable for young children (jumping distance to indicate frequency of engagement in activities) to assess ecological behaviors within a Rasch measurement model. This model, unlike a summated rating scale, consists of an underlying continuum of material that is expected to vary in frequency according to the difficulty of accomplishing various items, in the current case engaging in ecological behaviors varying in difficulty and/or challenge. We also were especially careful to choose behavioral options that would fall under the purview of young children in the age range studied herein. As noted in the literature review above, a limitation of some previous attempts to assess environmental behaviors in children has been the inclusion of questions about behaviors outside the volition of many young children.

As indicated in Tables 1 and 2 along with Figures 3 and 4, 6- to 8-year-old children hold moderately high environmental attitudes and tend to behave in a manner that is ecologically responsible. These children can reliably report on environmental attitudes and ecological behaviors. Indices of internal consistency and temporal stability were satisfactory, and as shown in Figure 3, our environmental attitude scale appears sensitive, reflecting a range from low to quite high positive environmental attitudes. Note also in Figure 3 that the data approximate a normal distribution with little skewness. Figure 4, although not as normally distributed as Figure 3, also indicates a range of engagement in ecological behaviors. The high median score on the behavioral scale (18 of a possible 24) in concert with the modest Rasch item separation estimate (.49) likely reflects insufficient spread across item difficulty—in this case the degree of commitment required to engage in various actions. Our environmental behavior assessment tool could be improved by inclusion of a few more higher difficulty and/or obstacles behaviors. The challenge is to find more challenging and/or difficult environmental behaviors that children between age 6 and 8 years have the option to engage in should they want to. Recall that one of the drawbacks of earlier child

environmental attitude and behavior scales was the inclusion of items outside the volitional range of a typical 6- to 8-year-old (e.g., use of mass transit). None of the items indicative of high levels of behavioral commitment from the adult GEB (Kaiser, 1998; Kaiser & Biel, 2000; Kaiser & Keller, 2001) are appropriate for preadolescent children.

Another contributor to the modest heterogeneity of behavioral responses among our participants may be the sample itself. Children in first and second grade may simply not vary much in their participation in various environmentally salient behaviors available to them while still in elementary school. The sociodemographic characteristics of our sample may have exacerbated this problem as well. Recall our children were from well-educated, affluent families, and all lived in small towns and rural areas in upstate New York. An important adjunct to the current study would be the collection of data from a more heterogeneous sample. For example, some work with urban adolescent perceptions of environmental quality suggests greater saliency of the social aspects of youth's surroundings (e.g., crime, neighborhood disorder) compared to physical environmental properties such as pollutants (Satterthwaite et al., 1996). On the other hand, it is worth reiterating that Kahn (1999) found an impressive degree of convergence in moral reasoning about environmental issues among young children in multiple samples, across a wide range of cultural and social class backgrounds. Another important limitation in our sample that has psychometric consequences is the probable proenvironmental bias of those parents who read our letter and decided to allow their child to participate in a research project on environmental attitudes and behaviors. We suspect that a randomly drawn sample might yield a greater range of environmental attitudes and behaviors that would have the effect of enhancing the psychometric properties of our instruments, particularly validity given the compromised sensitivity of the behavior index in particular, as discussed above.

Validity for both scales was investigated through a series of procedures. Content validity was derived by item adaptation of well-developed adult scales (i.e., NEP and GEB) in conjunction with reliance on open-ended discussions with young children. Random probes during data collection indicated a high degree of convergence between scaled responses and open-ended queries about the meaning of the questions to the children. Children's own reports of the frequency of their environmental behaviors were significantly correlated with maternal reports, although the magnitude of the correlations was modest. It is difficult to know how to interpret the small but significant intercorrelations between child-reported behaviors and those of the child's mother. One view is that these results indicate weak

validity, treating the mother's reports as the reference standard. The weak concordance might also reflect children's difficulties in rating the frequency of their behaviors relative to the standards their parents might use. Alternatively, it is unclear how much access parents may have to the range of behaviors observed. It is interesting that the two behaviors uncorrelated with maternal reports included rather micro behaviors (water on while brushing teeth, leaving the refrigerator door open while selecting food) that parents could easily miss. The behavior with the highest child-to-mother correlation, walking in nearby nature together, is more overt.

Concordance within the same child from different methods yielded stronger evidence for validity. There was excellent consistency between open-ended explanations of answers and scaled data, with most scale items 100% in consistency. We also found a significant change in environmental attitudes before and after children attended a week-long nature education experience. Although environmental behaviors among these same children did not change pre- and postcamp, fit statistics for the Rasch model indicated good validity with an average *MS* value equal to 1 and item *t* statistics well within the acceptable range. Nonetheless as indicated above, the relatively high degree of participation in environmental behaviors suggests the need for greater discriminability in behavioral items, particularly those that require higher levels of behavioral commitment to engage in them. It is also conceivable that a 1-week interval is insufficient to register changes in environmental behaviors that might take longer to develop. Given that children attending a nature camp are likely already positively disposed toward environmental issues (or at least their parents are), sample bias may have conspired against the sensitivity of this approach to validation as well. Additional validation work with more intensive and/or longer environmental education experiences would provide a better test of the validity of the environmental behavior instrument. Ideally one could also randomly assign children to various programs varying in the extent of focus on environmental education to more rigorously evaluate the instruments.

We also found that although adults' educational levels and political values are related to their environmental attitudes and behaviors (see Table 3), which is consistent with the literature (Gardner & Stern, 2002; Gifford, 2002; Vining & Ebreo, 2002; Winter & Koger, 2004), parental attitudes and behaviors were not correlated with their children's attitudes and behaviors (see Table 3). It is interesting to note that Musser and Diamond (1999) also found a similar lack of correspondence between child environmental attitudes and parental environmental attitudes. One possible reason for these null findings could be the young ages of our sample (6 to 8 years). Perhaps

as children mature we can expect to see the emergence of modest convergence between parent and offspring's environmental attitudes and behaviors. Little is known about the developmental course of young children's acquisition of attitudes and their relation to what their parents believe and/or how they behave.

It is also interesting to note that parental environmental attitudes and behaviors are correlated ($r = .50$) at a higher level than the magnitude typically found in prior studies (Hines et al., 1987). This is precisely the result one would expect given that the index employed for environmental behavior measurement, the GEB, incorporates a Rasch model, encompassing the degree of difficulty for engagement in environmental behavioral options (Kaiser, 1998, 2004; Kaiser & Biel, 2000; Kaiser & Gutscher, 2003; Kaiser & Wilson, 2004). Young children, on the other hand, evidence no correlation between attitudes and behaviors. Recall that in adults, one of the critical factors in attenuating the attitude–behavior relation is the degree of control one has over engagement in the behavior. When obstacles are removed and/or environmental behaviors are rendered easier to engage in, the attitude to behavior correlation expands significantly (Corraliza & Berenguer, 2000; Guagnano et al., 1995; Kaiser & Gutscher, 2003). Thus one possibility for the absent attitude–behavior congruence among young children could be their truncated set of behavioral options for engagement in ecological behaviors. One improvement in future assessments of environmental behaviors among children and youth would be the inclusion of assessments of opportunities for and difficulties to engage in various environmental behavior options. A more socioeconomically and geographically diverse sample might also yield a greater range of behavioral engagement in environmentally relevant actions.

The construction and evaluation of the two scales herein lay the groundwork for future, longitudinal work on the development course of children's environmental attitudes and behaviors. To our knowledge, no longitudinal data on children's environmental attitudes and behaviors exist. From cross-sectional comparisons, we know that young children become less anthropocentric around age 11 years (Kahn, 1999; Kellert, 1995). Another important and unknown topic is the origin of young children's environmental attitudes and ecological behaviors. One hypothesis is the potential role of early childhood encounters with nature as a precursor to more positive environmental values. Retrospective reports of environmentalists, for example, are replete with stories of early and memorable encounters with largely unfettered nature (Kahn & Kellert, 2002). The more general public's environmentalism may also be influenced by early childhood experiences in nature

(Wells & Lekies, 2006). As indicated above, we also suspect that parental environmental attitudes and behaviors may eventually play a role in shaping the development of children's environmental attitudes and behaviors. How and when this occurs is an important question worthy of scholarly attention.

Although the current set of instruments are not without flaws, they provide a set of reliable and valid tools to assess environmental attitudes and ecological behaviors in young children. How children come to frame environmental issues for themselves and then translate these beliefs into actions have critical implications for the future of our planet. Research on this important topic is truly in its infancy. Much important, path-breaking work lies ahead.

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Gary W. Evans, Elizabeth Lee Vincent Professor of Human Ecology, Cornell University, is an environmental and developmental psychologist interested in the role of the physical environment in children's health and well-being. Much of his work is on environmental stress and poverty.

Gernot Brauchle is an environmental, disaster, and emergency psychologist with Medical University of Innsbruck, Austria, interested in the impact on health from destroyed environments. Much of his work is on traumatic stress, posttraumatic stress disorder (PTSD), and coping strategies.

Aliya Haq is an organizer with Public Interest Research Group working to save the planet and affiliated with Cornell University.

Rachel Stecker is a graduate student in architecture at the State University of New York, Buffalo, interested in designing buildings that support human health and well-being.

Kimberly Wong is a graduate student in communication and social psychology at Cornell University interested in the mental and emotional processes involved in decision making from media messages.

Elan Shapiro, adjunct professor, Environmental Studies, Ithaca College, is education director of Ecovillage, a model sustainable community. Ecovillage is an active participant in the UN Decade for Sustainability, offering a variety of educational programs on sustainability locally in Tompkins County, NY, and throughout the world. He and his colleagues, with the support of the National Science Foundation, are implementing curriculum and programs to infuse sustainability throughout the undergraduate experience at Ithaca College. More information about Ecovillage can be found at http://www.ecovillage.ithaca.ny.us/