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Mehmet Erdogan <sup>a</sup>, Ahmet Ok <sup>b</sup> & Thomas Joseph Marcinkowski <sup>c</sup>

<sup>a</sup> Department of Educational Sciences, Faculty of Education, Akdeniz University, Antalya, Turkey

<sup>b</sup> Department of Educational Sciences, Faculty of Education, Middle East Technical University, Ankara, Turkey

<sup>c</sup> Department of Science and Mathematics Education, Florida Institute of Technology, Melbourne, USA

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## Development and validation of Children's Responsible Environmental Behavior Scale

Mehmet Erdogan<sup>a\*</sup>, Ahmet Ok<sup>b</sup> and Thomas Joseph Marcinkowski<sup>c</sup>

<sup>a</sup>Department of Educational Sciences, Faculty of Education, Akdeniz University, Antalya, Turkey; <sup>b</sup>Department of Educational Sciences, Faculty of Education, Middle East Technical University, Ankara, Turkey; <sup>c</sup>Department of Science and Mathematics Education, Florida Institute of Technology, Melbourne, USA

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Though environmentally responsible behavior (ERB) has been a focus of many studies in the field of environmental education, very few scales have been developed to assess children's ERB. In this regard, this article focuses on the development and validation of Children's Responsible Environmental Behavior Scale (CREBS) and also reports the psychometric properties of this scale. The items in the CREBS were developed initially from the responses to four open-ended items by 229 fourth and fifth grade students. This initial form was pilot tested with 673 fourth and fifth graders and then subjected to exploratory factor analysis. Later, the revised version of the scale was administered to 2412 fifth graders, and those results were subjected to confirmatory factor analysis and reliability analysis. CREBS consists of 23 items measured using a seven-point Likert-type scale, which have been organized into four sub-scales: political action (six items,  $\alpha=.92$ ); eco-management (six items,  $\alpha=.70$ ); consumer and economic action (five items,  $\alpha=.70$ ); and Individual and Public Persuasion (six items,  $\alpha=.80$ ). Study results indicate that CREBS can be used for exploring the extent to which elementary school students in Turkey demonstrate four types of behavior to help prevent and resolve environmental problems and issues.

**Keywords:** behavior; children; scale

### Introduction

Many have debated the purpose of the education, and more specifically of environmental education (EE); influencing individuals' behavior vs. changing behavior (Heimlich and Ardoin 2008). One of the initial attempts to define the purposes of EE was done within the First Intergovernmental Conference on EE in Tbilisi, Georgia in 1977. In the conference, the governments agreed that one of the goals of EE is to 'create new patterns of behavior of individuals, groups, and society as a whole towards the environment' (26) (UNESCO 1978). The Tbilisi category of EE objectives most closely related to this goal focused on 'Participation – to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems' (UNESCO 1978, 27). Considering the Tbilisi Declaration, Chawla and Cushing (2007) inter-

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\*Corresponding author. Email: merdogan@akdeniz.edu.tr

interpreted the ultimate goal of EE as one's active engagement in resolution of environmental problems. In line with the efforts dedicated to develop the area of EE in Tbilisi, as proposed and accepted by many scholars (i.e. Drs Hungerford, Volk, Marcinkowski, McBeth, Simmons, Peyton), the ultimate goal of EE is to foster participation in ERB (Hungerford and Peyton 1977) and to develop environmentally responsible and active citizens (Childress and Wert 1976; Culen 2001; Hungerford, Peyton, and Wilke 1980; Leeming et al. 1993; Roth 1970, 1992; Stapp et al. 1969). In line with conference recommendations that 'the Tbilisi goals and objectives be further clarified for use by teachers and youth leaders' (e.g. Gustafson 1983, 112; Stapp 1978, 71), Hungerford, Peyton, and Wilke (1980) developed a set of *Goals for Curriculum Development in Environmental Education*, which consisted of four goal levels and associated sub-goals. The last of these goal levels focused on developing the skills necessary for taking positive environmental action needed to achieve and maintain the stability between quality of life and the quality of the environment. Based upon the objectives proposed in Tbilisi Conference, Hungerford and Volk (1990, 9) defined environmentally responsible citizens as the ones who have:

- (1) an awareness and sensitivity to the total environment and its allied problems [and/or issues],
- (2) a basic understanding of the environment and its allied problems [and/or issues],
- (3) feeling of concern for the environment and motivation for actively participating in environmental improvement and protection,
- (4) skills for identifying and solving environmental problems [and/or issues], and
- (5) active involvement at all levels in working toward resolution of environmental problems [and/or issues].

ERB includes acquired or learned behaviors (actions), and does not operate in an isolated environment (Sia, Hungerford, and Tomera 1985/1986). Most consider ERB to be a component of Environmental Literacy (EL) (e.g. Erdogan 2009; Hsu 1997; Lee et al. 2003; McBeth 2006; Negev et al. 2006). Early definitions of EE (Stapp et al. 1969), categories of EE objectives from Tbilisi (UNESCO 1978), substantial review of general EE frameworks and models (Harvey 1977), analysis of more specific EE program frameworks (Simmons 1995), and a meta-analysis of research on ERB (Hines, Hungerford, and Tomera 1986/1987; Osbaldiston 2004) all revealed that ERB is one of five clusters of learning outcome within the framework of EL: (Cognitive) (1) Knowledge and (2) Skills; (Affective) (3) Affective Dispositions and (4) Determinants of Behavior; (Psychomotor or Conative) (5) Environmentally Responsible Behavior. As one of the components of EL, Simmons (1995) defined ERB as to 'include active and considered participation aimed at solving problems and resolving issues. Categories of environmentally responsible actions are persuasion, economic and consumer action, eco-management, political action and legal action' (Volk and McBeth 1997, 8–9).

ERB has been classified into different categories and/or components in the existing literature. Hungerford and Peyton (1977, as cited in Smith-Sebasto 1992) proposed five categories or modes of environmental action: eco-management, consumerism, legal action, persuasion, and political action. Ramsey, Hungerford, and Tomera (1981) added one more category; i.e. interaction, to the earlier categorization and identified six categories of ERB.

Later, Champeau (1982, as cited in Hsu 1997) modified one of aforementioned categories; consumerism to economic action. His definition of economic action

referred to actions with regard to response to and economic threat, consumptions habits, and monetary contribution. Most recently, these categories and descriptions were slightly modified (Hsu 1997; McBeth and Volk 1997; Simmons 1995; Wilke 1995). The category of 'interaction' is removed from these categories. Initial and more recent categorization of ERB is summarized in Table 1.

Since 1995, many scholars have accepted and used these five categories of ERB (Hsu 1997): eco-management/physical action, consumer/economic action, persuasion, political action, and legal action.

### ***Correlates and predictors of ERB***

Even though developing ERB has long been recognized as the ultimate goal of EE, limited attention had been given to research on ERB prior to 1990 (e.g. Kolmuss and Agyeman 2002; Sia, Hungerford, and Tomera 1985/1986). For example, during this period, Linke (1981) claimed that knowledge on the factors that contribute to participation in ERB was very limited, particularly in EE. However, since then, substantial effort has been given to the development and review of theories, frameworks, and models of ERB, although much of this attention has been in the social and behavioral sciences rather than in EE (e.g. Darnton 2008; Jackson 2005; Vining and Ebreo 2002). While there had been several narrative reviews of early theory and research on ERB (e.g. Cook and Berrenberg 1981; Lipsey 1977), the first quantitative meta-analysis of studies that investigated correlates of ERB was undertaken by Hines, Hungerford, and Tomera (1986/1987). Later meta-analyses of the ERB literature extended Hines' work within EE (e.g. Zelezny 1999) and well beyond it (e.g. Bamberg and Moser 2007).

Hines, Hungerford, and Tomera (1986/1987) analyzed a substantial portion of available ERB research from the social sciences, applied behavior analysis, and EE to explore possible correlates of ERB. From their results, they proposed a model that contained major correlates of ERB, which included personality variables, cognitive variables, and situational variables. Further, their model presented four groups of variables that appeared to affect ERB. Similarly, Hornik et al. (1995) meta-analyzed research studies investigating merely consumer recycling. They also suggested four groups of variables which contribute to ERB. These groups are intrinsic incentives, extrinsic incentives, internal facilitator, and external facilitator. In summary, previous meta-analysis studies (Bamberg and Moser 2007; Dwyer et al. 1993; Hines, Hungerford, and Tomera 1986/1987; Hornik et al. 1995; Osbaldiston 2004; Zelezny 1999) and empirical studies (Barr 2007; Cottrell and Graefe 1997; Hsu 1997; Manzo and Weinstein 1990; McKenzie-Mohr et al. 1995) and models proposed (Hines, Hungerford, and Tomera 1986/1987; Hungerford and Volk 1990; Sivek and Hungerford 1989/1990) revealed four main categories of variables that serve as correlates and predictors of ERB. These categories of variables are: (1) personality factors (e.g. perception of moral responsibility, environmental concern, environmental sensitivity, locus of control, environmental attitudes, environmental responsibility and verbal commitment, values); (2) cognitive factors (knowledge and skills); (3) demographic factors (e.g. age, gender, income, residence, parent education level, and so on); and (4) external factors (e.g. external or situational influences, pressure groups, opportunities to choose different action, and so on).

Table 1. Comparison of initial and recent categorization of ERB.

Initial categorization of ERB (Hungerford and Peyton 1977; Ramsey, Hungerford, and Tomera 1981)	Recent categorization of ERB (Hsu 1997; McBeth and Volk 1997; Simmons 1995; Wilke 1995)
<i>Persuasion</i> : A verbal effort to motivate someone to take positive environmental action as a function of modified values, (e.g. letter writing, debate)	<i>Persuasion</i> : It refers to those environmental actions in which individuals or groups appeal to others help prevent or resolve environmental issues
<i>Eco-management</i> : Any physical action aimed at maintaining or improving natural systems (e.g. reforestation, urban landscaping)	<i>Eco-management</i> : It is also called as physical action. It refers to those environmental actions in which people work directly with the natural world to help prevent or resolve environmental issues
<i>Consumerism</i> : An economic threat aimed at modification in business or industry (e.g. boycotting and discriminating the use of goods)	<i>Consumer/economic action</i> : It refers to those environmental actions in which people use monetary support or financial pressure to help prevent or resolve environmental issues
<i>Political action</i> : An effort aimed at persuading an electorate, legislators, or government agencies to conform to the values held by the person or persons who initiated the action (e.g. lobbying, voting)	<i>Political action</i> : It refers to those environmental actions in which people use political means to help prevent or resolve environmental issues
<i>Legal action</i> : Any legal/judicial action aimed at some aspect of environmental law enforcement or, a legal restraint preceding some environmental behavior perceived as undesirable (e.g. injunctions)	<i>Legal action</i> : It refers to those environmental actions in which people use support or enforce existing laws which are designed to help prevent or resolve environmental issues
<i>Interaction</i> : Any combination of two or more of the above components	

### ***Research on ERB measures and a need for new measure***

Assessing an individual's behaviors toward the environment can be complicated and difficult (Heimlich and Ardoin 2008; Hsu 1997). A review of 128 research studies on environmental behavior revealed that self-reported measures (i.e. interviews and pencil-and-paper measures) were most commonly used to assess ERB (Hines, Hungerford, and Tomera 1986/1987). The other measures relatively less used were, for example, rating scale and observation sheet. In the field of EE research, even though students' ERB was measured in several studies and projects (e.g. Evans et al. 2007; Shin et al. 2005), a very small number of studies were found to be reported on the development of instruments to measure ERB. These instruments were designed for use with secondary school students (Kuhlmeier, van der Bergh, and Langerweij, 1999; Marcinkowski and Rehrig 1995), college students (Smith-Sebasto 1992), and adults (e.g. Kaiser and Wilson 2000). Leeming and his colleagues (1993) conducted a review of 34 interventional studies on environmental education undertaken between 1974 and 1991 and realized that psychometric properties of the instruments used in many of these studies were not clearly reported. They emphasized the importance of careful development of a scale for measuring EE outcomes. Not long after this, they developed the Children's Environmental Attitude and Knowledge Scale (CHEAKS), which included one of the few measures of ERB for elementary students apparent in the literature (Leeming, Bracken, and Dwyer 1995).

A content analysis of 53 EE research studies undertaken between 1997 and 2007 in Turkey revealed a very limited number of studies focusing on ERB. On the one hand, no study reported an attempt to develop an ERB scale for elementary school students (Erdoğan, Marcinkowski, and Ok 2009). On the other hand, the instruments used in other studies were mostly paper-pencil measures (i.e. questionnaire). Erten (2002) developed a questionnaire to assess sixth, seventh, and eighth graders' responsible behavior toward the environment. However, he did not report its psychometric properties (i.e. factor analysis, reliability). Alp (2005) reported 6th, 8th, and 10th grade students' ERB using CHEAKS instrument developed by Leeming, Bracken, and Dwyer (1995). In the several additional studies, Erentay and Erdogan (2006), Erdogan and Erentay (2007), and Erdogan et al. (2010) reported fifth to eighth grade students' behaviors for protecting endangered species and threatened environments through the use of both open-ended and Likert-type items. Özdemir (2010) assessed sixth, seventh, and eighth grade students' behavior change as a result of nature-based EE program through the use of 'Behavior Observation Form' with three alternatives, insufficient, moderate, and sufficient. His direct observation of students in out-of-school pre-planned activities (e.g. site visit to treatment plant, forest walk) revealed various behaviors related to environmental protection, warning and persuading others, and adequate consumption.

Although CHEAKS developed by Leeming, Bracken, and Dwyer (1995) is one of the globally used instruments to assess students' pro-environmental attitudes and behavior, it has some limitations when considering the characteristics of sample and construct of ERB in the present study. First, CHEAKS does include items on eco-management, consumer action and persuasion, but does not the other categories of ERB. Second, CHEAKS was mainly developed in the USA and considered the context of the USA. Even if this instrument has been used in other countries for years, several changes and adaptation have been done within the instrument before



administration since some items do not reflect that culture and context where the instrument is used. These reasons provide the evidence that the Leeming, Bracken, and Dwyer measure was not sufficient for use in Turkey to measure elementary school students' various types of ERB (eco-management, consumer action, persuasion and political action), and thus a need emerged to develop a new instrument. It is clear from the review of EE research in Turkey and recent EE literature that a need emerged for the development of a scale to assess elementary school students' responsible behavior toward the environment, and more specifically, one that would be appropriate for use in Turkey. In this regard, this study aims to report the development and validation of Children's Responsible Environmental Behavior Scale (CREBS) for elementary school students, and to assess psychometric characteristics of scores from the CERBS. It is believed that this new instrument will be a useful measure for the researcher aiming to assess elementary school students' responsible behavior toward the environment.

## **Method**

### ***Sample***

In this study, three different samples were used to develop and validate CREBS. Sample 1 was used for building an item pool. Sample 2 was used for pilot study and exploratory factor analysis (EFA). Sample 3 was used for the main study; confirming the factor structure that was observed in exploratory factor analysis.

#### *Sample 1*

The first sample consisted of fourth and fifth grade elementary school students aged 10–11. They were administered four open-ended items to get their responses related to the sub-components of ERB. Location (rural–urban) and type of school (public–private) were considered while including the students into Sample 1. This sample was invited from two public and two private elementary schools. A total of 229 elementary school students within these schools (112 females, 117 males) volunteered to take part in this initial step. Of the students, 101 (44%) were from fourth grade and 128 (56%) were from fifth grade.

#### *Sample 2*

The second sample consisted of 673 fourth and fifth grade elementary school students (329 females, 339 males and 5 were missing data to sex item) from 28 classrooms (322 fourth graders and 351 fifth graders) in 9 different elementary schools. This sample was administered in the initial version of CREBS built from the responses of the first sample. The responses gathered from Sample 2 were used for EFA.

#### *Sample 3*

The third sample consisted of 2412 fifth grade students (1207 females, 1185 males, and 20 were missing data to sex item) from 78 schools in 26 provinces grouped by the State Planning Organization. Of the whole sample, 1891 students (78.4%) were



Table 2. Demographic distribution of Samples 1, 2, and 3 with regard to sex and grade.

Variables	Sample 1 (n = 229)		Sample 2 (n = 673)		Sample 3 (n = 2412)	
	f	%	f	%	f	%
<i>Sex</i>						
Female	112	48.9	329	48.9	1207	50
Male	117	51.1	339	50.4	1185	49.1
Missing	–	–	5	0.7	20	0.9
<i>Grade</i>						
Students in fourth grade	101	44.1	322	47.8	–	–
Students in fifth grade	128	55.9	351	52.2	2412	100

from public schools and 521 students (21.6%) were from private schools. Among those in public schools; 1059 (43.5%) were from urban areas and 832 (34.5%) were from rural areas. The sample was administrated in the revised version of CREBS to validate and confirm the factor structure emerging from EFA. Confirmatory factor analysis (CFA) using AMOS was employed to confirm the initial structure. Demographic distribution of these three samples is presented in Table 2.

### ***Instrumentation***

The instrumentation process of CREBS included five main steps. The first three of these steps resemble the procedures used by Marcinkowski and Rehrig (1995) to develop a measure of ERB for use with secondary students in the USA. The specific actions which were taken for each step are presented below.

#### *Step 1. Review of literature*

The first step in instrument development was to reveal the constructs underlying ERB. In this step, review of research on EE and ERB was undertaken to examine the possible dimensions of ERB. Even if different types of ERB structure were reported (Ramsey, Hungerford, and Tomera 1981), many of the scholars agreed on five main constructs underlying ERB: eco-management, consumer/economic action, persuasion, political action, and legal action (Erdogan, Kostova, and Marcinkowski 2009; Hsu 1997; McBeth and Volk 1997; Simmons 1995; Wilke 1995). Since CREBS was developed for the elementary school students who are not in the age level of being actively involved in law enforcement or other forms of legal action, the fifth construct of ERB, legal action was not considered as possible construct for this age group of students. Thus, based upon the review of literature and researchers' experiences in the field of EE, four dimensions were proposed related to the four constructs: (1) eco-management/physical action; (2) consumer/economic action; (3) persuasion; and (4) political action.

#### *Step 2. Generating an item pool*

Having decided on four dimensions, four open-ended items were developed each corresponding to one of the four dimensions of ERB (eco-management/physical

action, consumer/economic action, persuasion, and political action) for the purpose of constructing the item pool. The four open-ended items for which responses were considered for the item pool are given below.

Q1. *Eco-management (Physical or Direct Conservation Action)* refers to environmental actions in which individuals involve (work) directly in natural world to help prevent and resolve environmental problems and issues (e.g. cleaning up litter, recycling, planting trees).

Please write up to five *Eco-management Actions* that you, on your own or with others, have been engaged in within the last two years and/or have plans to engage in.

Q2. *Consumer Action and Economic Action* refers to environmental actions in which individuals use monetary support or financial pressure to help prevent and resolve environmental problems and issues (e.g. buying things in boxes/bottles that are recyclable, buying locally grown foods).

Please write up to five *Consumer Actions or Economic Actions* that you, on your own or with others, have been engaged in within the last two years and/or have plans to engage in.

Q3. *Interpersonal and Public Persuasion* refers to environmental actions in which individuals or groups encourage and appeal to others to help prevent and resolve environmental problems and issues (e.g. encouraging families/relatives to recycle, presenting the results and recommendations of your environmental research/projects to others).

Please write up to five acts of *Interpersonal or Public Persuasion* that you, on your own or with others, have been engaged in within the last two years and/or have plans to engage in.

Q4. *Governmental and Political Action* refers to environmental actions in which individuals use governmental and political means to help prevent and resolve environmental problems and issues (e.g. meeting and talking with national and/or local government officials about environmental protection).

Please write up to five *Governmental or Political Actions* that you, on your own or with others, have been engaged in within the last two years and/or have plans to engage in.

These open-ended items were examined by two elementary school science and technology teachers and one curriculum development specialist. They checked the items with regard to their understandability and appropriateness to the aim of the study and students' development level. In these items, a total of 229 students in Sample 1 were asked to indicate what types of behaviors they demonstrated and/or planned to demonstrate to help prevent and resolve environmental problems and issues within last two years. The students provided more responses to first item compared to the other items. Most of the students gave at least five responses to the first item. However, their responses to the last item were relatively limited. Students' responses were recorded into the separate sheet comprising more than 300

different behaviors associated with protection of the environment and prevention of environmental problems. These behaviors were grouped under each dimension and later coded and then themed. In this phase, it was interested in identifying behaviors within the sample, and thus individual student responses were not scored. The most frequent themes were considered as the essential pieces of the item pool. The most frequently given responses of 229 students were considered to create behavioral items for the scale. The initial draft of CREBS consisting of 28 items was generated on a seven-point scale ranging from 'never' to 'more than five.' Ten items were about eco-management action, six items about economic and consumer action, six items about individual and public persuasion, and six items about political action.

### *Step 3. Obtaining expert opinion for content validity*

In order to assure content and face validity of the instrument, a review panel of 17 experts from different areas of specialization (science education, environmental education, science and technology course teachers, book writers, curriculum specialists) was invited to assess the items' content, matching of the items to corresponding dimension, understandability and clarity of the items, and provide suggestions on the above-mentioned areas. It was believed that including panel members from various areas would provide rich and in-depth feedback. For this purpose, these panel members were sent a questionnaire 'External Validity Panel Evaluation Questionnaire' developed by researchers to assess CREBS. This questionnaire consisted of three main sections. The first section solicited demographic information from each panel member. The second section consisted of five YES-NO items, to be supported by an accompanying written explanation. The first three of these questions checked for gender bias or discrimination in relation to cultural, ethnic, social and regional differences in the whole instrument. The fourth item was prepared to check for the appropriateness of items to fourth and fifth grade elementary students' age level. The last item asked about the practicality of CREBS.

The third section included 18 items measured on a five-point scale ranging from strongly agree to strongly disagree. The purpose of this section was to assess whether items within the instrument were valid items to assess corresponding sub-dimensions of CREBS. Along with the 'External Validity Panel Evaluation Questionnaire,' panel members were sent four handouts: material on the theoretical background on ERB, a guide sheet on how to assess CREBS, items and related dimensions, and the first draft of CREBS.

In addition to the above-mentioned assessment process, two of the panel members were asked to check the appropriateness of items to students' age level (measurement and evaluation expert), and understandability, clarity, relevance, and length of items (Turkish Language expert).

### *Step 4. Pilot testing*

A permission request letter was sent to the Educational Research and Development Directorate (EARGED) of the Ministry of Turkish National Education (MoNE) in order to obtain permission to pilot test CREBS in the public and private elementary schools in Ankara, the capital city of Turkey. After receiving the needed permission from EARGED, CREBS was administered to students in one private and seven public elementary schools selected on the basis of location (urban, suburban) and

socioeconomic status. One fourth and one fifth grade classroom from each school were selected. Thus, the pilot test of the instrument involved 673 students (329 females, 339 males, 5 did not indicate their sex). Of these students, 322 were from fourth grade (in 13 classes) and 351 were from fifth grades (in 15 classes). The data-set obtained in this step was subjected to EFA, to check the factor structure of CREBS.

#### *Step 5. Validating the factor structure*

The CREBS instrument was administered as part of a nationwide survey of 2412 fifth grade students in Turkey (Erdoğan 2009). A SPSS data-set was established based on the responses of these students on CREBS, and later converted to AMOS program for CFA. The purpose of this CFA was to compare these results to the factor structure/constructs emerging from the EFA in an attempt to validate the factor structure and CREBS. The factor structure observed in previous step was matched with the factor structure in this step.

#### **Data analysis**

The data analysis process involved four steps: (1) constructing a table based on open-ended responses of Sample 1 data; (2) identifying the factor structure underlying CREBS through making use of EFA with Sample 2 data; (3) cross-validating the initial factor structure through the use of CFA with Sample 3 data; and (4) calculating reliability coefficient (Cronbach's alpha) for each dimension.

### **Results**

#### ***Constructing a pool of items based on the open-ended responses of Sample 1***

Students in Sample 1 generated more than 2300 responses to the four open-ended items. Prior to the content analysis of the responses, two tables were created to better present and portray the students' responses. In the first table (raw data), the responses were grouped according to the school type and grade. This table is a combination of the responses falling into each theoretical dimension of ERB. In the second table, refined responses were presented in frequency (see Table 3). For constructing this table, the responses were firstly coded, and then common codes were brought together to result in more broad themes. The codes which were not grouped into any themes were named as 'others.' As presented in Table 3, 14 themes were found to be associated with physical action dimension; 10 to be associated with consumer and economic type of ERB; 23 to be associated with persuasion type of ERB; and 9 to be associated with political type of ERB. The themes with the most frequent responses within the overall sample were selected for inclusion in the item pool, primarily because the purpose of this instrument was to generate a general portrait of student participation in ERB (i.e. infrequent themes were not selected because the purpose of the CREBS was not to use items or scores to discriminate between students on the basis of their level self-reported ERB). The reason for this was to ensure that the behaviors selected into the themes were within the 'behavioral repertoire' of most students of this age. Of the total number of 56 themes, 28

themes were selected as possible items in the instrument. Upon selection, they were transformed into a sentence format.

A list of items was then sent to 17 experts to assure content and face validity. No experts indicated any gender, cultural, ethnic, social, and regional bias in the items. They further reported that the items in the initial instrument were appropriate for fifth graders in terms of understandability and readability, and also a valid measure of ERB. Some of them suggested changing wordings in some of the items, but not excluding any items. Prior to administering the instrument to Sample 1, required changes (e.g. wording) were done based on the experts' comments.

### ***Identifying the factor structure of CREBS with Sample 2***

An exploratory factor analysis (EFA) was performed to examine the factor structure underlying the initial form of CREBS with 28 items. Prior to EFA, the data were cleaned by considering the following analysis: normality of each variable (skewness and kurtosis); outliers; and missing cases. The normality of each variable (item) was ensured with the accepted level ( $\pm 3.29$ ) of skewness and kurtosis values (Hair et al. 2006). Then, missing data analysis was run to protect the data-set and minimize loss of cases. This statistical procedure, a form of imputation, permits to replace the missing value with mean if each variable has at least 5% missing value (Tabacknick and Fidell 2001), and at least 10% missing value when the sample size is relatively high (Hair et al. 2006). It was observed that each of the cases had missing value, but <5% of the given responses. Thus, each missing value was replaced with mean. After that, outlier analysis was performed with the data including 673 cases. Univariate outlier(s) was examined by use of scatter plot and multivariate outlier(s) was examined by use of Mahalanobis distance (Tabacknick and Fidell 2001). Three multivariate outliers and 17 univariate outliers were detected and deleted from the data-set.

Construct validity is basically used to determine whether an instrument measures the hypothetical psychological construct (non-observable traits such as intelligence, attitude, and anxiety) to be tested (Fraenkel and Wallen 2006; Gay, Mills, and Airasian 2006). In order to examine the construct validity and factor structure, 28 items of CREBS were subjected to EFA using Principle Component Analysis (PCA) method. A Kaiser–Meyer–Olkin Measure of Sampling Adequacy test, which measures whether distribution of values is adequate for performing factor analysis, yielded .910 which was well above acceptable levels (Field 2005) and therefore acceptable. This meant that factor analysis could be performed adequately with this sample. Bartlett's test of sphericity, which measures multivariate normality and tests whether the correlation matrix is an identity matrix, had a significant value [ $\chi^2(325) = 325, p < .0001$ ], which meant that the normality assumption was met.

As a result of EFA five factors emerged with an eigenvalue greater than 1.0 (Hair et al. 2006). However, the scree plot revealed four sharp descents and the remained plot started to level off. Then, EFA was run again for the rotation for four factors by use of PCA. An oblique rotation (direct oblimin) with Kaiser Normalization was used, since it was believed that the factors are correlated. These results revealed four factors behind the scale. The four factors accounted for 53.56% of the total variance in the participants' responses. The eigenvalue of first factor was 7.272 (accounted for 27.97%), of second factor was 4.155 (accounted for 15.98%), of third factor was 1.373 (accounted for 5.28%), and of fourth factor was 1.123 (accounted for 4.32%).

The factor loading and communality values of each item are given in Table 3. Factor loading values less than .30 (Stevens 2002) were suppressed and dropped from this analysis. Thus, the items represented as DAVA10 and DAVB5 were excluded, and not considered for further analysis. These two items are not included in Table 4.

The factors were interpreted by considering their size of the factor loading, and then named according to conceptual framework used in the recent EE and EL literature (Lee et al. 2003; McBeth 2006; McBeth et al. 2007; Negev et al. 2006; Volk and McBeth 1997) and according to the responses of 229 students who were asked to respond to a four-item open-ended behavior questionnaire. As it is observed in Table 4, factor 1 included seven items, all of which loaded only on this factor. This factor was named as 'Political Action (POLITICAL).' Factor 2 included six items. However, even though one of the items (DAVA1) loaded both on factor 2 and factor 3, this item was included under factor 2 due to its higher loading on the factor 2 and the conceptual framework present in the literature. Similarly, based on the same resources (literature and students' responses) and the content of the items, this factor was named as 'Eco-Management (PHYSICAL).' Factor 3 included five items, each of which loaded only on this factor. These all items are regarded as individuals' actions of consumption and effective use of individuals' own money. Thus, this factor was named as 'Consumer and Economic Action (ECONOMICAL).' Factor 4 included eight items, each of which loaded only on this factor. These items are regarded not only as public but also as individual persuasion. Thus, this factor was named as 'Individual and Public Persuasion (PERSUASION).'

### ***CFA: cross-validating initial factor structure with Sample 3***

In order to confirm the factor structure that emerged in the EFA using data from Sample 2, a CFA was performed using data from Sample 3 using the statistical package of analysis of moment structures (AMOS.18) (Byrne 2010). A set of criteria was computed to determine whether the proposed model fit the data. The multiple goodness-of-fit tests/indexes used in CFA were: Normed Fit Index (NFI); Comparative Fit Index (CFI); and Root Mean Square Error Approximation (RMSEA). NFI is a normed fit index that has shown a tendency to consider fit index in large sample. NFI ranges between 0 and 1. CFI assesses the change in fit between the hypothesized model and the independence model (Byrne 2010). The independence model compared with hypothesized model assumes that the variables in the model are unrelated. The CFI indicates the total co-variation in the model and ranges between 0 and 1. The values of NFI and CFI greater than .90 indicate a good fit to the data. RMSEA is based on the analysis of residuals (Kelloway 1998). The expected value for a good model data fit is possible when RMSEA index value is below .08 (Kline 2011). The value of RMSEA shows sensitivity to degree of freedom and complexity of the proposed model.

CFA using AMOS.18 was first undertaken to determine the fit between the hypothesized model with 26 items and the data. Three indexes of NFI, CFI, and RMSEA were considered to assess this fitness. However, even if RMSEA index indicated acceptable fit value (RMSEA=.065), other measures in first CFA did not result in satisfactory fit indexes (NFI=.873, CFI=.883), indicating a questionable fit of the model to the data. This result pointed out the need for some modification



Table 3. Frequency of fourth and fifth graders' responses to four open-ended questions.

Possible dimensions of the instrument	Public School		Private School	
	Fourth grade (n = 78)	Fifth grade (n = 73)	Fourth grade (n = 23)	Fifth grade (n = 55)
<i>(1) Behaviors related to eco-management/physical action</i>				
(1.1) Proper dispose of trash <sup>a</sup>	39	37	9	25
(1.2) Use of garbage bins <sup>a</sup>	20	6	22	13
(1.3) Clean-up and hygiene <sup>a</sup>	27	53	28	47
(1.4) Avoiding air pollution	1	2	—	1
(1.5) Recycling (i.e. papers, battery, cans) <sup>a</sup>	37	57	11	57
(1.6) Re-using old materials <sup>a</sup>	23	2	—	1
(1.7) Planting (i.e. tree, flower, vegetable) <sup>a</sup>	44	33	25	56
(1.8) Protecting plants <sup>a</sup>	34	10	11	11
(1.9) Protecting animals <sup>a</sup>	26	36	11	15
(1.10) Involving in club studies	3	46	1	5
(1.11) Working in projects	26	27	1	11
(1.12) Water saving <sup>a</sup>	22	21	3	19
(1.13) Electricity saving <sup>a</sup>	31	20	4	16
(1.14) Paper saving	4	3	7	2
(1.15) Others	5	1	2	2
<i>(2) Behaviors related to consumer and economic action</i>				
(2.1) Donating to NGOs <sup>a</sup>	22	27	8	23
(2.2) Donating to school <sup>b</sup>	4	7	4	11
(2.3) Donating to aid organizations <sup>b</sup>	2	2	8	16
(2.4) Purchasing recyclable products <sup>a</sup>	17	25	3	16
(2.5) Purchasing products from bazaar <sup>a</sup>	18	9	6	21
(2.6) Purchasing organic food <sup>a</sup>	14	11	2	11
(2.7) Purchasing fresh and healthy foods	4	8	—	9
(2.8) Purchasing carton-packaged products	13	1	—	—
(2.9) Purchasing certified products <sup>a</sup>	5	11	—	—



Table 3. (Continued).

Possible dimensions of the instrument	Public School		Private School	
	Fourth grade (n=78)	Fifth grade (n=73)	Fourth grade (n=23)	Fifth grade (n=55)
(2.10) Controlling expiry dates of products	3	9	—	—
(2.11) Others	8	15	10	9
<i>(3) Behaviors related to persuasion</i>				
(3.1) Sharing information through talking <sup>a</sup>	30	33	8	29
(3.2) Sharing information through visualizing <sup>a</sup>	46	57	23	29
(3.2) Persuading for recycling <sup>a</sup>	18	19	7	19
(3.3) Persuading for protecting animals and plants <sup>a</sup>	11	12	5	12
(3.4) Persuading for saving	1	1	1	2
(3.5) Persuading for environmentally friendly purchasing	3	—	—	1
(3.6) Persuading for waste management	—	1	—	2
(3.7) Persuading for environmental protection and hygiene	—	6	1	4
(3.8) Warning for recycling	—	1	—	—
(3.9) Warning for protecting animals and plants <sup>a</sup>	12	14	19	19
(3.10) Warning for saving	1	3	—	1
(3.11) Warning those who throw their garbage out <sup>a</sup>	23	41	8	17
(3.12) Warning for environmental protection and hygiene	8	8	—	10
(3.13) Organizing campaigns	—	—	2	7
(3.14) Others	5	3	—	6
<i>(4) Behaviors related to political action</i>				
(4.1) Writing petition and letter <sup>a</sup>	2	2	—	6
(4.2) Talking with officials for solving environmental problems <sup>a</sup>	19	11	—	8
(4.3) Talking with officials for improving the environmental beauty <sup>a</sup>	11	30	1	13
(4.4) Talking with officials on the decisions to be taken to protect the environment <sup>a</sup>	16	21	—	2
(4.5) Protesting	—	1	2	—
(4.6) Cooperating with officials in the projects <sup>b</sup>	11	6	—	9

Table 3. (Continued).

Possible dimensions of the instrument	Public School		Private School	
	Fourth grade ( <i>n</i> = 78)	Fifth grade ( <i>n</i> = 73)	Fourth grade ( <i>n</i> = 23)	Fifth grade ( <i>n</i> = 55)
(4.7) Cooperating with NGOs <sup>b</sup>	4	7	–	3
(4.8) Talking with officials to develop societal consciousness <sup>a</sup>	24	16	1	4
(4.9) Complaining	1	2	–	1
(4.10) Others	2	1	–	4

Note: The items with no asterisk were not considered for the item pool due to their low frequency.

<sup>a</sup>The items considered for the item pool.

<sup>b</sup>The items considered for the item pool, but these items were combined into a single item (2.2– 2.3 and 4.6– 4.7)

Table 4. Factor loadings and communalities of CREBS items.

Items	Factor loadings				Communality
	Factor 1	Factor 2	Factor 3	Factor 4	
DAVD4	.872				.738
DAVD5	.864				.752
DAVD3	.814				.659
DAVD2	.814				.644
DAVD6	.782				.697
DAVD1	.754				.650
DAVC6	.490				.497
DAVA2		.745			.590
DAVA9		.705			.564
DAVA1		.607			.550
DAVA7		.591	.321		.384
DAVA3		.563			.402
DAVA8		.319			.262
DAVB4			.725		.579
DAVB6			.724		.588
DAVB3			.628		.483
DAVC4			.477		.510
DAVA5			.367		.321
DAVB2				-.771	.569
DAVC2				-.623	.539
DAVB1				-.621	.562
DAVC3				-.619	.566
DAVC1				-.609	.540
DAVC5				-.560	.584
DAVA6				-.509	.296
DAVA4				-.388	.397

in specification to find the best fitting model for the data from Sample 3. The output of CFA showed that suggested regression paths (modification indexes) of three pairs of items (DAVA3–DAVA4, DAVB1–DAVB2, and DAVC5–DAVC6) were extensively high. The nature and the content of the items were assessed and observed to be overlapping to some degree, then one of the items in each pair was excluded (DAVA4, DAVB2, and DAVC6) from the second CFA based upon the theoretical structure of ERB (Erdogan, Kostova, and Marcinkowski 2009; Erdogan, Marcinkowski, and Ok 2009; Hsu 1997; McBeth and Volk 1997; Simmons 1995; Wilke 1995). The items of DAVA3–DAVA4 measured students' participation in recycling. The items of DAVB1–DAVB2 measured students' participation in protection of the environment through monetary support and donation to NGOs and societal organizations. The items of DAVC5–DAVC6 measured students' participation in preparing posters and documents to make public aware of environmental issues and problems. Since CREBS aims to portray young students' involvement in environmental protection and the students in Sample 2 tended to cite DAVA3, DAVB1, and DAVC5 more frequently than their above-mentioned pairs, we tended/decided to include these three items into CREBS. Thus, CFA with 23 items was run again to identify the model that represented the best fit to these data ( $n=2410$ ). This second CFA revealed that four factors emerged and confirmed the structure. It was a good fit for data from Sample 3, with the fit indexes of NFI=.90 CFI=.91 and RMSEA=.06. All path coefficients were found to be significant at  $p<.01$  indicating a significant contribution of each item to the related factor. As Figure 1 illustrates, four dimensions of CREBS were allowed to correlate to each other.

### ***Calculating reliability coefficient(s) for CREBS using Cronbach's Alpha***

Reliability refers to consistency of the scores (Fraenkel and Wallen 2006; Murphy and Davidshofer 2005) and is expressed numerically, as a reliability coefficient. There are several types of evidences for reliability, each for a different kind of consistency (Gay, Mills, and Airasian 2006). Internal consistency refers to the consistency among responses to items when there is only one version of an instrument and only on administration of it. Thus, this was used for testing the reliability of the data collection instrument in this study. Considering results of the second CFA (Figure 1), reliability analysis for each factor was performed through the use of SPSS 11.5 version. Each analysis yielded satisfactory results. Cronbach's alpha reliability coefficient ( $\alpha$ ) of first factor with six items (political action) was found to be .92, reliability ( $\alpha$ ) of second factor with six items (physical action/eco-management) was found to be .70, reliability ( $\alpha$ ) of third factor with five items (consumer and economic action) was found to be .70, and reliability ( $\alpha$ ) of fourth factor with six items (individual and public persuasion) was found to be .80. Item total correlation score of all items in each reliability analysis revealed satisfactory results, which are higher than .30 (Field 2005).

### ***Final version of CREBS***

The full list of the items both in Turkish and in English is provided in Table 5. The Turkish version of the instrument was translated into English in cooperation with a bilingual translator who is highly fluent in both English and Turkish.

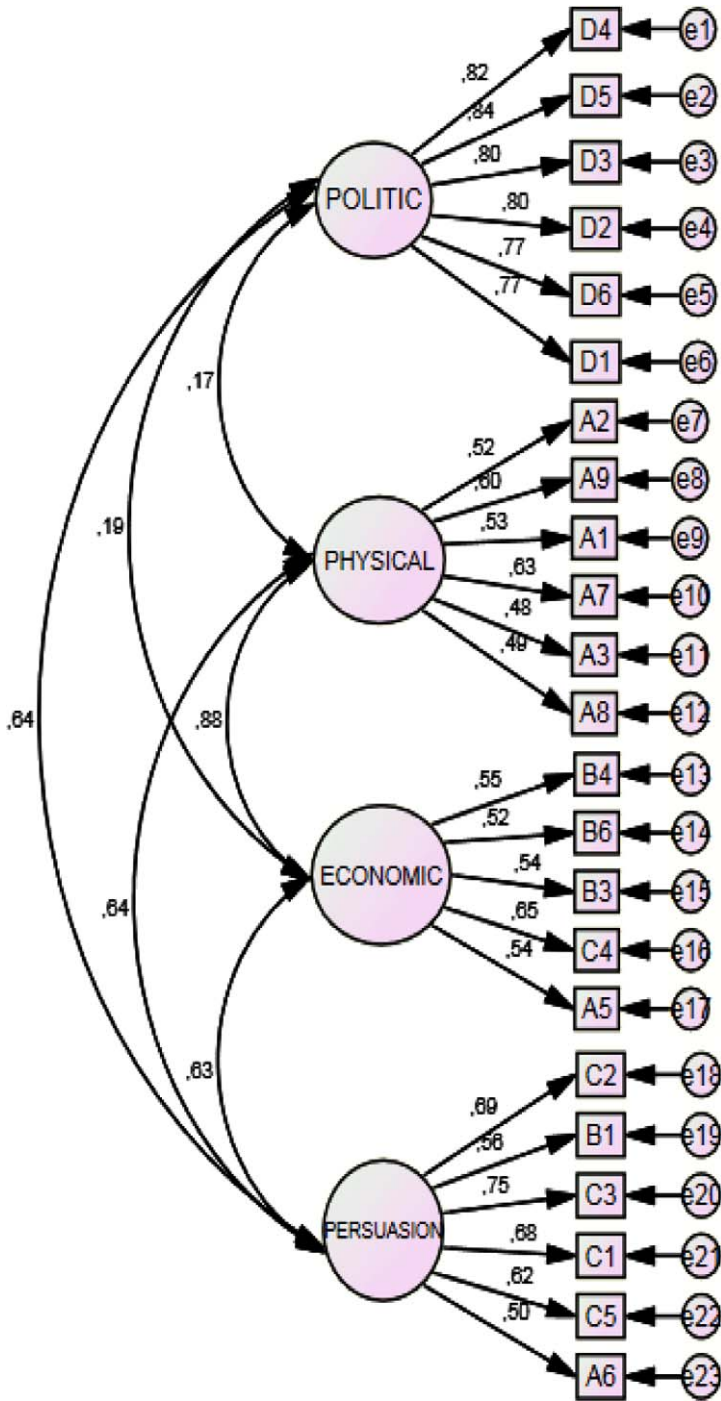


Figure 1. Standardized coefficients for the four-factors model for CREBS based on CFA through AMOS. All coefficients are significant at  $p < .001$ . NFI=.90, CFI=.91, RMSEA=.06; *POLITIC*: political action, *PHYSICAL*: physical action/eco-management, *ECONOMIC*: economical action and *PERSUASION*: individual and public persuasion.



Table 5. (Continued).

CREBS	Never (Hiç)	Once (1 kere)	Twice (2 kere)	Three times (3 kere)	Four times (4 kere)	Five times (5 kere)	More than five times (5'den daha fazla)
Çocukların Çevreye Yönelik Sorumlu Davranışları Ölçeği							
(DAVD3) 3. Çevre koruma önlemleri almaları için mahalle muhtarını ziyaret ettim ve bu konuda onu teşvik ettim.	( )	( )	( )	( )	( )	( )	( )
(DAVD4) 4. I talked to government officials in order to enforce environmental laws or punish people who violate these laws	( )	( )	( )	( )	( )	( )	( )
(DAVD4) 4. Kurallara ve yasalara uymayarak çevreye zarar veren kişilere ceza vermesi için yerel devlet yetkilileri ile konuştum.	( )	( )	( )	( )	( )	( )	( )
(DAVD5) 5. I encouraged government officials to create a newspaper, a magazine, and public bulletin boards in order to increase public support for environmental protection	( )	( )	( )	( )	( )	( )	( )
(DAVD5) 5. Halkın çevre duyarlılığını ve çevreyi korumaya yönelik desteğini arttırmak için, çevre ile ilgili gazete, dergi ve sokak panoları hazırlamaları konusunda devlet yetkililerini teşvik ettim.	( )	( )	( )	( )	( )	( )	( )



Table 5. (Continued).

CREBS	Never (Hiç)	Once (1 kere)	Twice (2 kere)	Three times (3 kere)	Four times (4 kere)	Five times (5 kere)	More than five times (5'den daha fazla)
Çocukların Çevreye Yönelik Sorumlu Davranışları Ölçeği (DAVD6) 6. I cooperated with government officials and NGOs representatives to prepare environmental protection projects and implement these projects. (DAVD6) 6. Devlet yetkilileri ve sivil toplum kuruluşlarının temsilcileri ile çevre koruma projeleri hazırlamak ve bu projeleri uygulamak için ortak çalıştım	( )	( )	( )	( )	( )	( )	( )
<i>Physical action / eco-management</i> (DAVA1) 7. I properly disposed of and avoided improper disposal of trash/garbage in schools, home, picnic areas, parks, and streets. (DAVA1) 7. Okuldayken, evdeyken, piknikteyken, parkta/yen ve sokaktayken çöplerimi uygun bir şekilde çöp tenekesine attım. (DAVA2) 8. I picked up litter, trash, and garbage in schools, picnic areas, parks, and street and threw them in garbage bins. (DAVA2) 8. Okulda, piknikte, parkta ve sokakta yerlere atılan çöpleri toplayıp çöp tenekesine attım.	( )	( )	( )	( )	( )	( )	( )

Table 5. (Continued).

CREBS	Never (Hiç)	Once (1 kere)	Twice (2 kere)	Three times (3 kere)	Four times (4 kere)	Five times (5 kere)	More than five times (5'den daha fazla)
Çocukların Çevreye Yönelik Sorumlu Davranışları Ölçeği							
(DAVA3) 9. I threw materials such as paper, glass, plastic, cans, aluminum, and batteries into recycling bins	( )	( )	( )	( )	( )	( )	( )
(DAVA3) 9. Kağıt, cam, plastik, kutu, alüminyum ve pil gibi atıkları geri dönüşüm kutusuna attım							
(DAVA7) 10. I took steps to protect plants (i.e. watering the trees and flowers, warning the ones who harm and step on the plants)	( )	( )	( )	( )	( )	( )	( )
(DAVA7) 10. Bitkileri korumak için önlemler aldım (örn. kurumaması için ağaç ve çiçekleri suladım, bitkilere zarar veren ve ezenleri uyardım)							
(DAVA8) 11. I took steps to protect animals, i.e. dogs, cats, and birds, living in the streets (i.e. creating house, feeding, protecting them from the hazards)	( )	( )	( )	( )	( )	( )	( )
(DAVA8) 11. Sokaklarda yaşayan kedi, köpek ve kuş gibi hayvanları korumak için önlemler aldım (örn. onlara yuva yaptım, onlara yiyecek verdim, onları zararlardan korudum)							



Table 5. (Continued).

CREBS	Never (Hiç)	Once (1 kere)	Twice (2 kere)	Three times (3 kere)	Four times (4 kere)	Five times (5 kere)	More than five times (5'den daha fazla)
Çocukların Çevreye Yönelik Sorumlu Davranışları Ölçeği (DAVB4) 14. Türk Standartları Enstitüsü (TSE) ve Tarım ve Köy İşleri Bakanlığı tarafından onaylanan ve test edilen ürünlerden satın aldım. (DAVB6) 15. I purchased fresh, healthy, organic/ecological products only after checking the expiration date (DAVB6) 15. Taze, sağlıklı, son kullanma tarihi geçmemiş ve organik / ekolojik ürünler satın aldım. (DAVC4) 16. I warned my family, my friends, and other people not to use water and electricity if not necessary (DAVC4) 16. Su ve elektriği gereksiz yere kullanmamaları için ailemi, arkadaşlarımı ve diğer insanları uyardım (DAVA5) 17. I gave old books, dress, toys, and other things, which are not used, to people and institutions in need. (DAVA5) 17. Eski ve kullanmadığım kitap, giysi, oyuncak ve diğer eşyaları gereksimini olan kişi ve kuruluşlara verdim.	( )	( )	( )	( )	( )	( )	( )

Table 5. (Continued).

CREBS	Never (Hiç)	Once (1 kere)	Twice (2 kere)	Three times (3 kere)	Four times (4 kere)	Five times (5 kere)	More than five times (5'den daha fazla)
Çocukların Çevreye Yönelik Sorumlu Davranışları Ölçeği	( )	( )	( )	( )	( )	( )	( )
<i>C. Individual and public persuasion</i>							
(DAVC1) 18. I talked with my family about what measures to be taken to protect and not harm the environment	( )	( )	( )	( )	( )	( )	( )
(DAVC1) 18. Çevrenin korunması ve çevreye zarar vermemek için ne yapacakları konusunda ailem ile konuştum	( )	( )	( )	( )	( )	( )	( )
(DAVC2) 19. I talked with my friends about what measures to be taken to protect and not harm the environment	( )	( )	( )	( )	( )	( )	( )
(DAVC2) 19. Çevrenin korunması ve çevreye zarar vermemek için ne yapacakları konusunda arkadaşlarım ile konuştum	( )	( )	( )	( )	( )	( )	( )
(DAVC3) 20. I talked with other people about what measures to be taken to protect and not harm the environment	( )	( )	( )	( )	( )	( )	( )
(DAVC3) 20. Çevrenin korunması ve çevreye zarar vermemek için ne yapacakları konusunda diğer insanlar ile konuştum	( )	( )	( )	( )	( )	( )	( )
(DAV6A) 21. I planted and grew trees, flowers, vegetables, and other types of plants in order to embellish the environment.	( )	( )	( )	( )	( )	( )	( )



## Discussion

The CREBS consisted of four dimensions and was developed as a result of five-step instrument development processes: (1) an extensive review of research on ERB; (2) generation of items pool; (3) a review of panel experts on various fields to provide content and face validity; (4) a pilot study with 673 fourth and fifth graders to reveal initial factor structure; and (5) a validation study with 2412 fifth graders to confirm the four-factor model and to ensure reliability evidences. The Confirmatory Factor analytic model showed that all path coefficients (see Figure 1) were high and significant at  $p < .05$ , representing a meaningful contribution of each item to the corresponding scale. Having conducted two confirmatory factor analyses, the four-factor model was found to show a good fit with acceptable fit indexes (NFI=.90, CFI=.91, and RMSEA=.06.). CFA provide an evidence for the construct validity of CREBS with the sample of elementary school students. Separate reliability analysis for each factor revealed Cronbach's alpha coefficient reliability scores fell within the acceptable limit (.70) (Georgy and Mallery 2001). Thus, undertaking the above steps and CFA, the CREBS was found to consist of four factors underlying 23 items, all of which were measured on a seven-point Likert-type scale. The first factor, political action (POLITIC), refers to environmental actions in which individuals use governmental and political means, and also persuade government agencies to take action to help prevent and resolve environmental problems and issues. The second factor, physical action or eco-management (PHYSICAL), refers to environmental actions in which individuals involve (work) directly in natural world to help prevent and resolve environmental problems and issues. Also, this action requires maintaining, restoring, and/or improving the natural systems. The third factor, consumer and economic action (ECONOMIC), refers to environmental actions in which individuals use monetary support or financial pressure to help prevent and resolve environmental problems and issues. The fourth factor, individual and public persuasion (PERSUASION), refers to environmental actions in which individuals or groups encourage and appeal to others to help prevent and resolve environmental problems and issues. Also, this action involves a verbal effort in an attempt to encourage and/or motivate someone or group of people to take desired environmental action.

Having good psychometric properties, this measure of environmentally responsible behaviors for elementary school students can be used in the further research to assess students' physical, political, economical, and persuasive types of behaviors to help prevent and resolve environmental problems and issues. It is observed that CREBS could serve better for assessing students' ERB who were enrolled in both first cycle (fourth to fifth grades) and second cycle (sixth to eighth grades) of elementary education and learners of equivalent ages in Turkey. The students in both cycles could demonstrate similar behaviors, but very minor changes should be done in CREBS to be administrated to those enrolled in second cycle. It might also be used for older students (9th to 12th grades) and university students, but some major modification in the items may be required because older students have a greater potential to be involved in legal action which is not considered for the elementary school samples involved in this study (e.g. each individual 18 years of age or older is eligible to vote). Furthermore, CREBS should also be first administrated to different regions that share similar cultural and environmental conditions like Balkans, Mediterranean, and later expanded to other cultures to explore and extend its



external validity and therefore its international usability. CREBS might be used and slightly adapted for use in the countries with similar culture and educational system. But, enhancing its utility within diverse population and culture can only be assured through continued efforts to refine and revise the items in CREBS. Social context (e.g. beliefs systems, religion, culture, and policy) where the instrument will be used should also be examined critically and reflected into the items.

Furthermore, the total score to be obtained from each sub-scale should be interpreted cautiously. For example, the behaviors (e.g. recycling, throwing trash into a bin) related to eco-management or physical action could be performed several times even in a day, but this may not be valid for the behaviors related to political action. Such behaviors related to working with NGOs, communicating with government officials are rarely performed by children, but most likely by adults. Thus, even if the raw score obtained from each item is numerically equal, the numerical results obtained from each item in different sub-scales should be interpreted carefully.

CREBS did not include items for all behaviors written in by students in Step 2, and more generally, did not include all possible behaviors that had been or could be taken by students of this age and developmental level. CREBS included only the most common behaviors written in by students. Thus, CREBS serves as a measure of 'typical' behaviors undertaken by youth of this age, but not 'all' such behaviors.

It is important to indicate that developing CREBS especially for Turkish elementary students is necessary for several reasons. First, the most frequent responses (self-reported behaviors) of 229 fourth and fifth Turkish students in the pre-pilot study to four open-ended questions which were included in CREBS were not fully observed in other measures (e.g. CHEAKS). Second, the constructs of ERB do not fit well into the items in other measures. For example, even though CHEAKS (Leeming, Bracken, and Dwyer 1995) does measure students' pro-environmental behaviors related to eco-management, consumer action, and persuasion, it does not measure students' behaviors related to the other categories of ERB.

### **Limitation of the study**

All responses on the CREBS were self-reported. The validity of self-reported behavioral data has been questioned by numerous researchers, so this is recognized as a limitation of this study. However, in very few reviews of research on environmentally responsible behavior has the problem of self-reporting been analyzed carefully (e.g. Zelezny 1999). In nearly all instances in which blind reviewers were used to check on or to corroborate students' self-reported behavior (e.g. Asch and Shore 1975; Horsley 1977; Ramsey, Hungerford, and Tomera 1981; Winett et al. 1978), the study sample was relatively small (under 200) and limited to a relatively small geographic area (one school or community). Using blind raters/reviewers to observe the participants' behaviors could be mostly feasible with the small group, but not for a large group. The authors are unaware of any attempt that uses blind reviewers to check on self-reported behavior in large-scale national surveys such as the present study. The inclusion of 673 students in the pilot study and 2412 students in the full study from a large number of schools and communities made this nearly impossible. One of the few practical means available to researchers in studies such as these is the use of negatively worded items (e.g. I did not ...), and the removal of cases from the study data-set that clearly indicate signs of response bias

(e.g. McBeth et al 2011, 2008). Because CREBS did not include negatively worded items, this could not be used as a means to detect and remove cases that showed evidence of response bias. Thus, the absence any means to check on bias or invalidity in self-reported behavior serves as a limitation of this study.

Individual student responses were not scored during Step 2, and no attempt had been made to compare such an overall ERB score for each individual student to their ERB score based on only behaviors that reflected items included in the CREBS.

### **Implications for environmental and science education**

The topic of environment is one of the main dimensions of current fourth to eighth grade science and technology education curricula in Turkey (Milli Eğitim Bakanlığı [MEB] 2005). Due to the fact that there is no separate EE course within the elementary and the secondary school curriculum, the goals of EE are mostly integrated into the science and technology course, and least integrated into the social studies and life sciences course in elementary school level. Through making use of CREBS, elementary school teachers can assess their students' various types of behavior and use the results, along with other sources of information (e.g. student, parent, and community interest), to determine if there is a need to focus more on environmental problems and issues. Accordingly, they can make modifications and add extra-curricular activities, (e.g. field trips, water monitoring, bird watching, recycling, and collecting old materials) to their own instructional plans so as to better prepare students for, stimulate them to participate in, model for them, or immerse them in ERB.

The extent to which CREBS would serve as a valid measure of ERB either among youngsters of other ages in Turkey or among fourth and fifth graders in neighboring countries with similar environmental and cultural conditions or among any other population is not known because no attempt has been made to gather data needed to determine this. Therefore, it is recommended that studies be conducted to determine which section of the CREBS, if any, can be used in a valid way with populations other than fourth and fifth graders in Turkey. Furthermore, CREBS was developed using the sets of procedures which is a valid measure for fourth and fifth graders in Turkey. It is recommended to other researchers to follow similar sets of procedures to develop similar measures for age- and culture-specific populations in other countries.

In future instrument development studies of this kind (other age groups, other countries), the researcher could be involved in such effort to include the type of analysis of open-ended responses described in the limitation section (comparing an overall ERB score for each individual student to their ERB score based on only behaviors that reflected items included in the instrument) as a part of Step 2 procedures, and to use the findings from such an analysis appropriately.

Ecology-based nature education programs during summer breaks have been widely implemented for several years for elementary school students in Turkey (see [www.tubitak.gov.tr](http://www.tubitak.gov.tr)). These programs aim at developing students' environmentally responsible behavior as well as environmental awareness. As a result, CREBS may be an effective tool to assess students' development of ERB as a short-term or long-term outcome of these programs.

Factors associated with ERB have been substantially investigated over the past few decades. However, most of these studies focused upon students' general ERB scores and therefore examined the effects of selected factors on general ERB. In this regard, with the four factors developed in this study, CREBS will now allow and encourage the researchers to explore the relationship between selected factors and each of these four dimensions of ERB. This may deepen the research studies with regard to which dimension(s) of environmental behavior (i.e. political, physical, economic, and persuasion) is/are more strongly associated with specific demographic, educational, cognitive, and affective variables. For example, along with demographic information items, CREBS also can be used to explore the association of selected demographic characteristics of students (e.g. gender, age, parent education level) to various types of responsible behavior regarding the protection of environment.

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### Notes on contributors

Mehmet Erdogan is an assistant professor in the Department of Educational Sciences at Akdeniz University, Antalya, Turkey. He is running courses on research methods in education, educational statistics, and curriculum & instruction. His main research areas are predictors of responsible environmental behavior, environmental literacy, test construction and curriculum development, analysis and evaluation.

Ahmet Ok is an associate professor in the Department of Educational Sciences at Middle East Technical University, Ankara, Turkey. He runs courses on comparative teacher education, curriculum evaluation and foundations of curriculum development. His main research interests are teacher education and curriculum development.

Thomas Joseph Marcinkowski is an associate professor in the Department of Science and Math Education, Florida Institute of Technology, Melbourne, Florida, USA. He is running courses on historical foundations of environmental education, and methods on ecology and environmental sciences. His main interests are service learning, environmental literacy and predictors of responsible environmental behavior.

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