A General Measure of Ecological Behavior[1]

FLORIAN G. KAISER[2]
Swiss Federal Institute of Technology (ETH)
Zürich, Switzerland

Measurement of ecological behavior across different domains has been troublesome. The present paper argues that the lack of agreement in measuring general ecological behavior may be due to the measurement approach that is commonly used. An ecological behavior measure should be grounded on a probabilistic measurement approach that takes the important features of ecological behavior into consideration. Such a measure was developed in a survey study of 445 members of 2 Swiss transportation associations. Three types of ecological behavior measures were included: a general measure, 3 multiple-item measures, and 3 single-item measures. Results are controlled for social desirability effects. Reliability, internal consistency, and validity scores indicate that a probabilistic measurement approach can measure general ecological behavior accurately and unidimensionally.

People's ecological behavior and the human impact on the natural environment are matters of public concern and have been the subject of a considerable amount of psychological research. Given the character of the concerns motivating this research, the primary outcome of interest should be the ecological behavior itself (Maloney & Ward, 1973; Pickett, Kangun, & Grove, 1993; Scott & Willits, 1994; Weigel, 1977), that is, the "actions which contribute towards environmental preservation and/or conservation" (Axelrod & Lehman, 1993, p. 153). Furthermore, whether the goal of the research is behavior change (e.g., Leeming, Dwyer, Porter, & Cobern, 1993) or the evaluation of different determinants of ecological behavior (e.g., Hines, Hungerford, & Tomera, 1986-1987), the accurate measurement of ecological behavior is a precondition.

Surprisingly, some reviews reveal that ecological behavior is rarely used as an outcome criterion (Leeming et al., 1993), while others—as they compare

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[2]Correspondence concerning this article should be addressed to Florian G. Kaiser, Swiss Federal Institute of Technology (ETH), ETH-Zentrum/HCS, CH-8092 Zürich, Switzerland.

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different determinants of ecological behavior without any notion of different types of this behavior—seem to suggest that ecological behavior is a matter of fact one need not care about (Hines et al., 1986-1987). But ecological behavior is not a matter of fact, nor is it merely accidental that ecological behavior is rarely used as an outcome measure. Rather, its rare use may be due to the lack of a widely accepted measure of ecological behavior.

Measuring Ecological Behavior: General or Specific?

There has been much discussion about how to measure ecological behavior. After summarizing some aspects of this discussion, I will consider whether some of the problems identified could be solved by using an alternative measurement approach, one that treats the features of ecological behavior more realistically.[3]

As with others (e.g., Kals, 1996), my range of ecological behavior measures is fairly broad. In the present overview, there is no distinction made between intention measures, self-reports, or objective assessments, as long they are used as behavior indicators. However, ecological behavior intention is quite often used as a predictor of ecological behavior (for examples, see Kaiser, Wölfing, & Fuhrer, 1997). If ecological behavior intention measures are included in this overview, then they represent indicators of ecological behavior and not predictors.

Some propose a general ecological behavior measure (e.g., Fejer, 1989; Fejer & Stroschein, 1991; Maloney & Ward, 1973; Maloney, Ward, & Braucht, 1975; Pickett et al., 1993; Sia, Hungerford, & Tomera, 1985-1986; Sivek & Hungerford, 1989-1990; Ramsey, 1993; Smith-Sebasto & Fortner, 1994), while others assume different, more or less independent types of ecological behavior (e.g., Berger & Corbin, 1992; Granzin & Olsen, 1991; Langeheine & Lehmann, 1986; Leonard-Barton, 1981; Levenson, 1974; Schahn & Holzer, 1990a, 1990b; Siegfried, Tedeschi, & Cann, 1982; Weigel, 1977; Weigel, Vernon, & Tognacci, 1974). Surprisingly, even though ecological behavior is seen as a multitude of behaviors (cf. Newhouse, 1990), this multitude can sometimes be collapsed into a single measure (e.g., Diekmann & Preisendörfer, 1992; Leonard-Barton, 1981; Schahn & Holzer, 1990a, 1990b; Weigel, 1977). But what appears to be a unidimensional measure in some studies (e.g., Maloney & Ward, 1973; Maloney et al., 1975) reveals itself as a multidimensional one in others (Amelang, Tepe, Vagt, & Wendt, 1977; Scott & Willits,

[3]Although measurement of ecological behavior and its application (i.e., its conceptual usefulness) are occasionally confounded, measurement and application are independent tasks. All applications of any ecological behavior measure are part of its construct validation (cf. Roscoe, 1975), which is beyond the scope of the present paper.

1994; Smythe & Brook, 1980; cf. Mosler, 1993). Other researchers use composite measures of different types of ecological behavior as an outcome criterion without any consideration of the dimensionality[4] of such a measure (e.g., Axelrod & Lehman, 1993) or at least with rather weak indicators of unidimensionality (e.g., Baldassare & Katz, 1992).

Using composite scores of ecological behavior remains controversial not only because it is assumed that aggregation across different types of behavior will cover relevant aspects of a specific type of ecological behavior, but also because of the different ways to aggregate behaviors and the different behaviors that can be aggregated (cf. the discussion: Diekmann & Preisendörfer, 1992, 1993; Lüdemann, 1993; Schahn & Bohner, 1993). Therefore, it has been supposed that ecological behavior, especially in an applied domain, has to be measured specifically through reference to concrete types of behavior (Diekmann & Preisendörfer, 1993; Lüdemann, 1993; McGuinness, Jones, & Cole, 1977). The assumption that ecological behavior cannot be generalized across different domains (cf. Kals, 1993, 1996; Schahn & Bohner, 1993) leads some authors to measure specific ecological behaviors with single-item measures (e.g., Fuhrer & Wölfing, 1997; McGuinness et al., 1977; Seiler, 1994; Van Liere & Dunlap, 1978; Vining & Ebreo, 1992), while others aggregate different behaviors *within* different domains (e.g., Diekmann & Preisendörfer, 1992; Kals, 1993, 1996; Langeheine & Lehmann, 1986; Levenson, 1974; Smith, Haugtvedt, & Petty, 1994). However, even within-domain aggregation does not guarantee unidimensionality (for the recycling domain, see Guagnano, Stern, & Dietz, 1995). Inevitably, there is no agreement about which behavior domains can be aggregated.

A common way of aggregation is an empirical one. Kals (1993, 1996), for example, aggregates her outcome measures by means of factor analysis. By using three scales measuring different kinds of readiness (readiness to adopt behaviors that are easy to perform, readiness to adopt behaviors that are difficult to perform, willingness to accept governmental prohibitions), she manages to assess relevant predictors of ecological behavior in the domain of pollution.

If aggregating is itself seen as the problem because one assumes that any aggregation of behaviors covers all the relevant aspects of a specific behavior, then the individualistic description of behavior is the consequence (cf. Lüdemann, 1993; Siegfried et al., 1982). But specifying behavior in more and

[4]The dimensionality represents the number of entities or qualities measured with a composite score. If a composite score is sensitive to two or more dimensions, the meaning of the score is ambiguous. For instance, given a measure sensitive to weight and height, a composite score of 150 may represent for Person A her height in centimeters and for Person B his weight in pounds.

more precise terms is no real solution because measurement gains meaning by allowing generalization. If we say that Person B is not willing to use a bus to go to his workplace on Monday morning between 8 and 9 a.m., there is not much left to generalize. For example, it does not help to answer questions such as: What does Person B most likely do with his soda can? Does he own an automobile? And what about Person A who never uses buses?

Measurement of specific ecological behaviors is also problematic in that the specific behaviors are susceptible to a wide range of influences (e.g., Granzin & Olsen, 1991; but also cf. Diekmann & Preisendörfer, 1993; Pickett et al., 1993). As a consequence, people would seem to be inconsistent[5] in their ecological behavior; what they do one day, they may not do on another. Aggregating behaviors within some domains is usually indicated to reduce inconsistency, and in fact aggregation has been used especially to solve this measurement problem of behavior inconsistency (Schahn & Bohner, 1993).

On the one hand, the basic problem of measuring a person's tendency remains as long as two people with the same tendency can behave differently in the same situation, and two people with different tendencies may act in the same way (cf. Schmitt, 1992). On the other hand, it is hard to assume a general behavioral tendency of people if people act ecologically in one domain but not in another. Let us assume that this apparent inconsistency is a basic feature of ecological behavior itself and not just the result of some flaw in measurement or of an inappropriate aggregation technique, as the ongoing measurement discussion seems to suggest.[6] Given this, the ongoing controversy in some other realms of environmental psychology can also be seen in a different light.

For example, the relation between attitude and ecological behavior is a relatively well-elaborated area in environmental psychology (e.g., Axelrod & Lehman, 1993; Berger & Corbin, 1992; Hines et al., 1986-1987; Newhouse, 1990; Scott & Willits, 1994). This relation appears to be rather inconsistent across different studies, and an often-recommended means to increase consistency is *measurement correspondence*, that is, measuring both attitude and behavior on the same level of specificity (e.g., Axelrod & Lehman, 1993; Newhouse, 1990; Vining & Ebreo, 1992; Weigel et al., 1974). Surprisingly, the outcome measure, ecological behavior, is often neglected in this domain (McGuinness et al., 1977), even though the inconsistency of the relation between attitude and behavior could be solely a feature of ecological behavior itself. In fact, the different interpretations of the attitude–behavior relation could

[5]Consistency judged from an observer's point of view. From an actor's point of view, it seems plausible to assume consistency (cf. Ranney, 1994, 1996) even though an observer discovers apparent inconsistency.

[6]See Footnote 5—inconsistency discovered from an observer's point of view.

be due to problems in the measurement of ecological behavior (cf. Kaiser et al., 1997). As long as a measurement approach does not take into consideration the important features of the behavior to be measured, measurement may give results that are ambiguous and inconsistent. Before I point out the methodological flaws of some general ecological behavior measures, however, I must describe some key features of ecological behavior itself.

Key Features of Ecological Behavior

Measurement problems stem from the following two features of ecological behavior: (a) Some ecological behaviors are more difficult to carry out than others, and (b) ecological behavior is susceptible to myriad influences.

Just as it is quite plausible to assume types of ecological behavior that are easier and more difficult to carry out (e.g., Diekmann & Preisendörfer, 1992, 1993; Fejer, 1989), it can also be assumed that people's ecological behavior is determined by more than their own opinion and willingness (Foppa, Tanner, Jaeggi, & Arnold, 1995). Social and cultural conditions may support one behavior but not another. Not all communities and countries support public transportation systems that are good enough to make it easy to not use automobiles. Not all communities and countries actively facilitate recycling, or force their citizens to pay for garbage disposal, a measure that further reduces waste generation and promotes recycling. In short, sociocultural constraints determine to some extent which behavior is easier and which is harder (cf. Guagnano et al., 1995). Factors on the personal level also operate on judgments of the difficulty of given ecological behaviors. For example, riding a bike instead of driving an automobile may be easy for a woman during the day, but it may become problematic at night because she may fear harassment (cf. Lüdemann, 1993). Due to such personal interpretations, people—even compulsive ones—appear to behave very inconsistently in the ecological realm. Someone who claims to be ecologically oriented may behave ecologically in one domain and unecologically in another (cf. Diekmann & Preisendörfer, 1993; Pickett et al., 1993; Scott & Willits, 1994; Vining & Ebreo, 1992).

Measures of General Ecological Behavior

Three well-established measures of general ecological behavior can be differentiated.[7] All of them either have methodological flaws or do not accurately reflect the two key features of ecological behavior.

[7]The Voluntary Simplicity Scale was developed as a multidimensional behavior scale (Leonard-Barton, 1981) and is, therefore, not included in this overview.

Maloney and Ward (1973) developed the first measure of general ecological behavior. This measure consists of one behavior scale with 36 different behavior items in a true/false format. The internal consistency (Cronbach's α)[8] was .92. The revised version of this measure consists of 10 different behavior items with an internal consistency of .89 (Maloney et al., 1975). Unfortunately this high consistency dropped to .74 (Dispoto, 1977) when a larger sample was used ($N = 127$, Maloney et al., 1975; $N = 893$, Dispoto, 1977). In addition, what seems to be a single behavior scale in one study becomes a heterogeneous measure consisting of four dimensions in other studies (Scott & Willits, 1994; Smythe & Brook, 1980; also cf. Amelang et al., 1977). Not surprisingly, some types of ecological behavior do not correlate with the Maloney and Ward behavior measure, or correlate under certain circumstances unexpectedly (e.g., Mosler, 1993). One conclusion refers to a somewhat self-contradicting measure of an ecological behavior that consists of both a consistent general behavior measure with sufficient reliabilities and several (7) heterogeneous and somewhat independent types of ecological behavior (cf. Schahn & Holzer, 1990a, 1990b).

A second measure of general ecological behavior stems from Hungerford and colleagues (Ramsey, 1993; Sia et al., 1985-1986; Sivek & Hungerford, 1989-1990; Smith-Sebasto & Fortner, 1994). This measure consists of five subscales (ecomanagement, persuasion, consumerism, political action, legal action) and is well established. It reveals a seemingly impressive internal consistency, even across these different domains ($\alpha = .90$; Sia et al., 1985-1986); however, the reported consistency is a consistency of the number of different behaviors each person claims in each of these domains, not a consistency involving the different behaviors themselves. Therefore, it remains questionable whether this measure is unidimensional and if the measure across participants is an ecological behavior measure. Furthermore, the value of this measure should be questioned because of its susceptibility to influences, such as respondents' response style and ability to remember. Participants who remember many different behaviors in one domain may also more likely remember different behaviors in another domain. This is even more the case if participants want to meet the expectations of others. Especially in the ecological domain, measures are affected by social pressure, moral norms, and, therefore, social desirability (cf. Newhouse, 1990; Scott & Willits, 1994; Van Liere & Dunlap, 1978; Vining & Ebreo, 1992). Finally, the authors do not explicitly treat the differences in the difficulties of the ecological behaviors represented by the different subscales. Examination of the data presented by Sia et al. (1985-1986) reveals a

[8]Cronbach's alpha is a widely used measure indicating internal consistency (i.e., unidimensionality): a value of 1 indicates perfect unidimensionality.

difference in the average behavior score across the five domains. Though not discussed, this would seem to be an indicator of differences in behavior difficulties.

The third, and least established, measure of general ecological behavior was developed by Fejer and Stroschein (Fejer, 1989; Fejer & Stroschein, 1991) and includes the idea of different behavior difficulties. Based on the idea of easier and more difficult types of ecological behavior, the measurement of ecological behavior was conceptualized as consistent with a Guttman scaling approach (Fejer, 1989). Originally, different specific behaviors are aggregated in seven subscales; these subscales were ordered by their difficulty. The measure accounts for the two key features of ecological behavior (i.e., inconsistency within behavior domains, and differences in behavior difficulty). Within a given behavior domain (i.e., subscale) people were free to not do some of the behaviors (at least one or two) and were still seen as behaving ecologically in regard to the behavior domain under consideration. Additionally, a simple yes/no response format means that respondents only indicate the fact of a given behavior's occurrence; they do not have to estimate the amount of the behavior. A final advantage of this measure is the integration of prosocial behavior items that allow a check on the assumption that ecological behavior is one branch of prosocial behavior in general (cf. Granzin & Olsen, 1991; Pickett et al., 1993; Van Liere & Dunlap, 1978; Vining & Ebreo, 1992).

Nevertheless, because a Guttman scale is based on a deterministic model and therefore does not allow any inconsistency of participants across behavior domains, this measurement approach still remains somewhat restricted. A concept of ecological behavior as fitting with a probabilistic Rasch scale instead of the deterministic Guttman scale gives each participant more freedom to behave inconsistently, even across different behavior domains and even if these behaviors are different in difficulty (cf. Wilson, 1989; Wilson & Iventosch, 1988). Although Fejer and Stroschein's findings (Fejer, 1989; Fejer & Stroschein, 1991) support the assumption of different types of ecological behavior, they do not give any information about the dimensionality of the different behavior measures under consideration, neither for the different behavior domains nor for the behavior in general.

Goals

In the absence of an accepted unidimensional measure of ecological behavior across behavior domains, research findings cannot be compared. Without comparability, urgently needed scientifically grounded recommendations remain somewhat vague and arbitrary. The lack of agreement in measuring ecological behavior and in some of the results reported in the environmental

psychological literature may be at least partly due to the measurement approach that is commonly used. As inconsistencies between different specific behaviors result in smaller correlations among different behaviors, behavior inconsistencies can put general behavior measures at risk to become multidimensional. However, inconsistencies between different specific ecological behaviors are a matter of fact.

The major goal of measuring ecological behavior is determining whether a person who generally behaves more ecologically is more likely to behave more ecologically in some set of specific ecological behaviors than a person who generally behaves less ecologically. A probabilistic measurement approach allows people to behave less than totally consistently across different behavior domains without rendering a general measure multidimensional. For example, such an approach makes it possible to take into account a person who generally behaves ecologically and yet drives an automobile, an activity that may contrast with all of his or her other ecologically oriented behavior. In addition, the difficulty of specific ecological behavior under different sociocultural circumstances can also be assessed; each behavior can be measured as more or less difficult than any other one, with all difficulties being compared quantitatively (cf. Wright & Masters, 1982).

In sum, I argue that a probabilistic measurement approach overcomes most of the methodological flaws of the current most commonly used approaches, and propose that a measure of ecological behavior should be grounded on such a measurement approach. To test this argument, the following questions were addressed in analyses of data from a large-scale survey study of Swiss citizens:

1. Do different specific ecological behaviors fall on a single dimension?
2. Can this dimension be measured reliably?
3. Does this dimension reflect ecological behavior? Is there some validity information available to support such a claim?

Method

Participants and Procedures

The present sample was constituted from an initial pool of 3,000 members of each of two Swiss transportation associations. The associations can be differentiated ideologically. One aims to promote a transportation system which has as little negative impact on humans and nature as possible. The other primarily represents automobile drivers' interests. To include as wide a range of diversity as possible, the two associations were further stratified by primary language (French, Italian, German) and type of residential area (city, suburb, village). Of all members of both associations, 1,643 (27.4%) were willing to

participate. This pool was asked to complete three questionnaires. The first was sent out during December 1993, and 1,371 (83.5%) completed it (Fuhrer, Kaiser, Seiler, & Maggi, 1995; Seiler, 1994). The targeted participants of the second questionnaire were those who had completed the first one. The second questionnaire was mailed in May 1994, and 1,189 (86.7%) of those who completed the first questionnaire, participated in this second study (Maggi, 1995). The present, third study was undertaken during November 1994, and targeted only the German-speaking subgroup from the first study. Note that the German-speaking subgroup of the first and second studies numbered 579 (i.e., 42.2% of the total sample) and 438 (36.8%), respectively. After 36 people declined further participation, 543 (93.8%) of the German-speaking participants in the first study remained to be surveyed in the third study. Of these, 445 (82.0%) returned completed questionnaires. Participants' (62.5% male) median age was 45.5 years ($M = 46.6$, range = 20 to 82).

The high participation rate within the pool can be seen as a result of a self-selection process of more ecologically concerned participants (cf. Fuhrer et al., 1994). Members of the automobile drivers' association were less well-represented in the sample (25.8%) in contrast to members of the association promoting a more ecological transportation system (74.2%). Although the sample is not representative of a particular population, it is sufficient that the participants reflect a wide range of diversity. Any sample bias is of minor importance because the generalizability to a general population will be scrutinized by statistical means (strictly speaking, this is what fit statistics are all about; see Results).

Measures

The questionnaire consists of three types of ecological behavior measures and a social desirability scale. The ecological behavior measures vary according to their level of aggregation and, therefore, include more or less different specific behaviors.

General measure. The general ecological behavior (GEB) measure is assumed to be the most highly aggregated and the lowest in specificity. The GEB consists of 40 items (Table 1). A yes/no response format for these items was used (cf. Fejer, 1989).[9] "No" responses to negatively formulated items were recoded as "yes" responses, and vice versa. Missing values (N items = 80; 0.45%)

[9]Whether a model based on a less rigid rating scale (e.g., Likert scale) instead of a dichotomous response scale (i.e., yes/no format) can be used has to be tested with another data set. Although such a change of response format results in a change of measurement model as well, it can still be a probabilistic approach (Wright & Masters, 1982).

Table 1

Forty Items Grouped in Seven Ecological Behavior Subscales

Item
Subscale name: Prosocial behavior
1. h Sometimes I give change to panhandlers.
2. e From time to time I contribute money to charity.
3. e If an elderly or disabled person enters a crowded bus or subway, I offer him or her my seat.
4. If I were an employer, I would consider hiring a person previously convicted of a crime.
5.- e In fast food restaurants, I usually leave the tray on the table.
6. If a friend or relative had to stay in the hospital for a week or two for minor surgery (e.g., appendix, broken leg), I would visit him or her.
7.- Sometimes I ride public transportation without paying a fare.
8.- I would feel uncomfortable if Turks lived in the apartment next door.
Subscale name: Ecological garbage removal
1.- e I put dead batteries in the garbage.
2.- After meals, I dispose of leftovers in the toilet.
3. I bring unused medicine back to the pharmacy.
4. e I collect and recycle used paper.
5. e I bring empty bottles to a recycling bin.
Subscale name: Water and power conservation
1. I prefer to shower rather than to take a bath.
2.- In the winter, I keep the heat on so that I do not have to wear a sweater.
3. I wait until I have a full load before doing my laundry.
4.- In the winter, I leave the windows open for long periods of time to let in fresh air.
5. I wash dirty clothes without prewashing.
Subscale name: Ecologically aware consumer behavior
1.- I use fabric softener with my laundry.
2.- I use an oven-cleaning spray to clean my oven.
3.- If there are insects in my apartment, I kill them with a chemical insecticide.

(*table continues*)

Table 1 (*continued*)

	Item
4.-	I use a chemical air freshener in my bathroom.
5.- h	I use chemical toilet cleaners.
6.-	I use a cleaner made especially for bathrooms rather than an all-purpose cleaner.
7.	I use phosphate-free laundry detergent.
	Subscale name: Garbage inhibition
1.-	Sometimes I buy beverages in cans.
2.- h	In supermarkets, I usually buy fruits and vegetables from the open bins.
3.- h	If I am offered a plastic bag in a store, I will always take it.
4.	For shopping, I prefer paper bags to plastic ones.
5. h	I usually buy milk in returnable bottles.
	Subscale name: Volunteering in nature protection activities
1.	I unwrap useless (i.e., nonfunctional) packages in the store. (EXCLUDED)
2.	I often talk with friends about problems related to the environment.
3. h	I am a member of an environmental organization.
4.	In the past, I have pointed out to someone his or her unecological behavior.
5.	I sometimes contribute financially to environmental organizations.
	Subscale name: Ecological automobile use
1.- e	I do not know whether I may use leaded gas in my automobile.
2.	Usually I do not drive my automobile in the city.
3. h	I usually drive on freeways at speeds under 100 kph (62.5 mph).
4.	When possible in nearby areas (around 30 km; i.e., 18.75 miles), I use public transportation or ride a bike.
5.	My automobile is ecologically sound. (EXCLUDED)

Note. Subscales and items are adapted from Fejer (1989). - indicates negatively formulated items. (EXCLUDED) indicates excluded items. Items indicated with an e represent easy to perform behaviors (defined in terms of difficulty below 1 logit unit; logits are the basic units of Rasch scales, cf. Wright & Masters, 1982), whereas items indicated with an h represent hard to perform behaviors (defined in terms of difficulty above 1 logit unit on the measured dimension).

were handled as "no" responses in general (assuming participants' doubt—represented by missing values—as indicative of not behaving alike in general). Seven subscales, which are the basis for the Guttman scale used, were constructed according to Fejer's (1989) method. They are as follows: (a) prosocial behavior, (b) ecological garbage removal, (c) water and power conservation, (d) ecologically aware consumer behavior, (e) garbage inhibition, (f) volunteering in nature protection activities, and (g) ecological automobile use.

Moderately aggregated measures. Kals (1993, 1996) attempted to measure three different kinds of readiness: (a) readiness to adopt behaviors that are easy to perform (4 items; e.g., "In principle, I am willing to bring paper, glass and cans to a recycling bin"); (b) readiness to adopt behaviors that are difficult to perform (3 items; e.g., "In principle, I am willing to pay extra taxes on power consumption and apartment heating to fight pollution"); and (c) willingness to accept governmental prohibitions (5 items; e.g., "Owners of vehicles that have more [30% and more] emissions than allowed should be punished very severely"). Wordings in 4 of these 12 items were slightly modified from the original items without distorting their meaning. By using these scales, Kals (1996) was able to assess relevant predictors of ecological behavior in the domain of pollution. Responses were made using two Likert scales that ranged from 1 (*completely willing to do*) to 6 (*under no circumstances willing to do*) for the adopt items, and from 1 (*confirm completely*) to 6 (*reject completely*) for the accept items.

Highly specific measures. Three single-item ecological behavior measures were adapted from Fuhrer and Wölfing (1997). Among other measures, these single-item indicators were found to be empirically independent from one another. Participants had the following three questions to answer: (a) "How many km do you travel by automobile (as driver or passenger) every year? Estimate your average km in a regular week and multiply by 52 weeks per year. Do not forget your vacation trips"; (b) "How many km do you travel by airplane every year? Estimate your average km in a regular week and multiply by 52 weeks per year. Do not forget your vacation trips"; and (c) "If given 10,000 Swiss Francs under the condition that you use it as charitable donations, would you contribute financially to environmental organizations? If yes, how much would you contribute?" The responses to these questions could be made open-ended.

The Social Desirability scale presented by Amelang and Bartussek (1970) consists of 32 items grouped in two subscales, Lying and Denying.[10] Although these two subscales are called Lying and Denying, dishonesty or cheating is not

[10]A translated version of the Social Desirability scale of Amelang and Bartussek (1970) is available on request.

the issues. Socially desired answers might result from social pressure or other sources. Regardless of its causes, however, what matters is whether participants answered these items in a socially desired way and whether Social Desirability is correlated with other self-reported measures. Fourteen items contribute to the Lying subscale (e.g., "I never claim to know more than I actually do") and 18 items to the Denying subscale (e.g., "I have taken advantage of people in the past"). To be consistent with the response options for the ecological behavior items, the original true/false format was changed to a yes/no format. To contribute to the Lying sum score, items had to be answered "yes." To contribute to the Denying sum score, Denying items had to be answered "no." Missing values (N items = 109, 0.77%) were treated as "no" responses for the Lying subscale and as "yes" responses for the Denying subscale (assuming participants' tendency not to answer in a socially desired way). As retest reliability (r(tt)) for the Social Desirability scale, Amelang and Bartussek (1970) report: (r(tt)) = .94 (N = 198). Time lag between two testings was from 5 to 7 weeks (M = 6 weeks).

Statistics

SAS release 6.08 and the program JMP (*JMP User's Guide*, 1989) were used for calculating all basic statistics. All Rasch models were assessed by means of the program QUEST (Adams & Khoo, 1993, 1994).

Results

The present findings are reported in three sections. First, a well-established Social Desirability scale—developed with a classical test theory approach—was reassessed as a Rasch scale. As probabilistic approaches are hardly ever used in the ecological domain, this first result section provides some information to evaluate and to compare fit statistics, reliability, and internal consistency indicators reported later on. Second, fit statistics, reliability, and internal consistency information of the GEB scale—as a Rasch scale—are presented. However, as the GEB measure was originally developed as a Guttman scale, a confirmation was intended initially. Third, two types of validity information—criterion-related and discriminant validity—are given for the new established GEB scale.

Social Desirability Scale

The Social Desirability scale and its subscales, Lying and Denying, correlated significantly with one another, with values comparable to those reported

Table 2

Means and Standard Deviations of the Three Social Desirability Scales

	Social Desirability scale		Lying subscale		Denying subscale		
	M	*SD*	*M*	*SD*	*M*	*SD*	*N*
Present	16.4	5.1	10.7	3.4	5.7	2.6	445
Original	13.4	5.7	7.2	3.6	6.3	2.8	198

Note. Social Desirability, Lying, and Denying scales grouped for the present and the original data set of Amelang and Bartussek (1970).

by Amelang and Bartussek (1970): r(Social Desirability-Lying) = .82, r(Social Desirability-Denying) = .89, r(Denying–Lying) = .47, N = 445. The means of the subscales differed, as can be seen in Table 2.

When reassessed as a Rasch scale the Social Desirability scale reveals a reliability (i.e., separation reliability; see Wright & Masters, 1982) of .78 and internal consistency (Cronbach's α) of .78 (N = 445). Even though 7 (21.9%) of 32 items did not fit to a general Social Desirability scale (i.e., item fit t value $\geq$ 1.96; cf. Wright & Masters, 1982), the overall fit statistics for the items of the Social Desirability scale are acceptable: MS = 1.0, $SD(MS)$ = .07, $t(32)$ = -0.14, $SD(t)$ = 1.58. Ideally, MS and $SD(t)$ should be 1.0, whereas t should be 0. For $SD(MS)$, no general reference value can be given. Twenty-six (5.8%) of 445 participants did not fit well according to the general Social Desirability measure (i.e., case fit t value $\geq$ 1.96); however, the overall fit statistics for the participants are quite good: MS = .99, $SD(MS)$ = .19, $t(445)$ = -0.01, $SD(t)$ = 1.04. One participant was excluded from this estimation because of his or her overall zero scale value.

Although the Social Desirability scale was initially developed based on a classical test theory approach, the Social Desirability scale comes close to being used as a Rasch scale.

Reliability of the Ecological Behavior Scale

As a Guttman scale. A first attempt to verify GEB as a Guttman scale using the original approach based on seven subscales proposed by Fejer and Stroschein

(Fejer, 1989; Fejer & Stroschein, 1991) failed. The difficulties of the seven subscales based on the 40 items of Table 1 changed from the previously reported ones (Fejer, 1989): (a) prosocial behavior in general (88.5%); (b) ecological garbage removal (87.2%); (c) water and power conservation (74.4%); (d) ecologically aware consumer behavior (44.3%); (e) garbage inhibition (25.4%); (f) volunteering in nature protection activities (47.9%); and (g) ecological automobile use (53.5%). The original rank ordering (by increasing difficulty; indicated by the letters) according to the subscale difficulties does not match with the percentage of participants that fulfill the subscales in the present analysis.[11] Furthermore, the error proportion of misclassification (i.e., coefficient of reproducibility, CR) used as quality index for Guttman scales was .81 (compared to CR = .88, Fejer, 1989), which is below the acceptable threshold (cf. Fejer & Stroschein, 1991). Note that the seven subscales are initially introduced to develop a Guttman scale. However, the following Rasch approach does not make any further use of the subscales besides the fact that these subscales guarantee a broad range of behavior diversity ranging from a prosocial to six different ecological behavior domains.

As a Rasch scale. When all 40 ecological behavior items are assessed as a GEB scale with Rasch features, the scale has a reliability of .70 and an internal consistency of .74 ($N = 353$; 92 participants with values in the top 20% of the Social Desirability scale were, as a measure of precaution, excluded).[12] (Note that the final assessment of the GEB scale is replicated with the whole sample: $N = 445$.) Two items (Table 1) were then excluded due to misfit (i.e., $t > 3$). For the remaining 38 items, the reliability is .71 ($r = .71$, respectively, if all 445 participants are included) and the internal consistency is .76 ($\alpha = .74$, respectively, if all 445 participants are included). One (2.6%) additional item did not fit to the 38-item GEB scale (i.e., item fit t value ≥ 1.96); however, the overall fit statistics for the items of this scale are quite reasonable: (a) $N = 353$, $MS = 1.0$, $SD(MS) = .06$, $t(38) = .01$, $SD(t) = .83$; and (b) $N = 445$, $MS = 1.0$, $SD(MS) = .05$, $t(38) = .00$, $SD(t) = .93$. Ten (2.8%) of 353 participants and 9 (2.0 %) of 445 participants did not fit well according to the GEB measure (i.e., case fit t value ≥ 1.96); the overall fit statistics for the participants are reasonable in both analyses: (a) for $N = 353$, $MS = 1.0$, $SD(MS) = .18$, $t(353) = .04$, $SD(t) = .81$; and (b) $N = 445$, $MS = 1.0$, $SD(MS) = .18$, $t(443) = .03$, $SD(t) = .81$. Two participants were excluded from this estimation because of their overall zero or maximal (38) scale values.

[11]The more participants that fulfill a subscale, the easier the subscale; thus, the higher the percentage, the less difficult the subscale.

[12]Ecological behavior measures are seen as affected by social desirability (e.g., Newhouse, 1990; Scott & Willits, 1994; Van Liere & Dunlap, 1978; Vining & Ebreo, 1992). Therefore, to exclude people high in Social Desirability means reducing a biasing influence on GEB.

Validity of the Ecological Behavior Scale

To get information about the validity of the proposed GEB measure, two different approaches are used: criterion-related and discriminant validation (cf. Roscoe, 1975).

Criterion-related validity. Table 3 represents all variable means, their standard deviations, all applicable internal consistency measures (Cronbach's α), and a correlation matrix where the GEB measure is correlated with three specific ecological behavior measures (estimated annual kilometers by car, KMC; estimated annual kilometers by airplane, KMA; financial contribution to ecological organizations, FCO) and with three empirically aggregated measures of ecological behavior (readiness to adopt behaviors easy to perform, BEP; readiness to adopt behaviors difficult to perform, BDP; willingness to accept governmental prohibitions, AGP). The influence of social desirability seems to be, at least on the present measure of GEB and among the present sample, somewhat marginal ($r = -.10$, $N = 443$).

Discriminant validity. Finally, following a known-groups approach to validation, an ANOVA was used to compare the mean GEB scale values for the two Swiss transportation associations. As the associations can be differentiated by their ideology, their members may differ in their ecological behavior. The expected difference was confirmed by the ANOVA, $F(1, 441) = 115.6$, $p < .0001$, $\eta^2 = 20.8\%$.[13] Members of the transportation association that primarily represents automobile drivers' interests behave less ecologically ($M = 0.91$, $SD = 0.71$, $N = 114$) than do members of the association that promotes a transportation system with minimal negative impact on humans and nature ($M = 1.82$, $SD = 0.80$, $N = 329$).

Additional discriminant validity arises out of the comparison between the two association groups regarding behavior difficulties. Note that an overall comparison of the 38 behavior difficulties yields a strong relation between the two transportation association groups regarding these difficulties ($r = .91$), $F(1, 36) = 182.5$, $p < .001$, $\eta^2 = 83.5\%$, and a nonexistent difference between the two association groups in mean behavior difficulties, $F(1, 74) = 0.00$, $p = .998$, $\eta^2 = 0.0\%$. Nevertheless, 9 out of 38 behavior difficulties differ significantly ($p < .05$) between the two transportation association groups (Table 4).

The most prominent behavior item, which was significantly easier for members of the association that promotes an ecological transportation system, is "I sometimes contribute financially to environmental organizations." This is not surprising, as this association represents an environmental organization.

[13] η^2 represents the proportion of explained variance.

Table 3

Descriptive Statistics, Internal Consistency Measures (Cronbach's α), and Bivariate Correlations

M	*SD*	α	*N*	Scale	Social Desirability	GEB	KMC	KMA	FCO	BEP	BDP
16.4	5.1	.78	445	Social Desirability							
1.6	0.9	.74	443	GEB	-.10*						
10734	8999	—	432	KMC	.09	-.29***					
4384	9332	—	364	KMA	.00	-.16**	.13*				
2460	2408	—	415	FCO	-.01	.29***	-.12*	-.12*			
22.3	2.1	.68	440	BEP	.01	.41***	-.23***	-.11*	.22***		
14.7	3.7	.88	442	BDP	-.14**	.45***	-.30***	-.11*	.34***	.52***	
23.5	5.4	.81	440	AGP	-.09	.46***	-.30***	-.11*	.36***	.47***	.73***

Note. *N* of the bivariate correlations between $N = 344$ and $N = 443$. GEB = general ecological behavior; KMC = estimated mileage drive per year (in kilometers by car per year); KMA = estimated mileage flow per year (in kilometers by airplane per year); FCO = readiness to financially contribute to ecological organizations (in Swiss Francs); BEP = readiness to adopt behaviors that are easy to perform; BDP = readiness to adopt behaviors that are difficult to perform; AGP = willingness to accept governmental prohibitions.
$^{*}p < .05$. $^{**}p < .005$. $^{***}p < .001$.

Table 4

Nine Behaviors With Different Difficulties for the Two Transportation Associations

Item	Easier for
1. If a friend or relative had to stay in the hospital for a week or two for minor surgery (e.g., appendix, broken leg), I would visit him or her.	ADA
2. Sometimes I ride public transportation without paying a fare.	ADA
3. I use an oven-cleaning spray to clean my oven.	ADA
4. Sometimes I buy beverages in cans.	ADA
5. If I am offered a plastic bag in a store, I will always take it.	ADA
6. For shopping, I prefer paper bags to plastic ones.	ADA
7. I am a member of an environmental organization.	ETA
8. I sometimes contribute financially to environmental organizations.	ETA
9. When possible in nearby areas (around 30 km; i.e., 18.75 miles), I use public transportation or ride a bike.	ETA

Note. Unecologically, negatively formulated items are reversed. ADA = automobile drivers' interest association; ETA = ecological transportation promotion association.

Discussion

Ecological behavior has two widely accepted essential features: (a) ecological behaviors can be distinguished according to their difficulty (e.g., Fejer, 1989; Fejer & Stroschein, 1991), and (b) they are susceptible to a wide range of influences and constraints (e.g., Foppa et al., 1995; Granzin & Olsen, 1991). The latter explains the low consistency people show between different behavior domains (e.g., Vining & Ebreo, 1992). Thus, some authors (e.g., Midden & Ritsema, 1983) claim that ecological behaviors do not fall into a homogeneous set; that is, a set of tasks people do consistently, even within specific domains such as energy conservation. This inconsistency of people in their ecological behavior can be seen as the basis of the controversy in environmental psychology about how to measure ecological behavior: While some propose a general ecological behavior measure (e.g., Maloney & Ward, 1973), others assume different more or less independent types of ecological behavior (e.g., Weigel et al., 1974).

Previous attempts to measure ecological behavior failed to consider either one or the other of the two key features of ecological behavior. This is because most of them used a classical test theory approach. A probabilistic measurement approach, such as Rasch scaling, facilitates a conception of ecological behavior that takes both of these features into consideration (and thus allows people to some extent to behave inconsistently).

The present results not only support the idea of a general ecological behavior, but also reveal the difficulty of different types of ecological behavior. Even though people appear not to be strictly consistent across different types of behavior, the observable ecological behaviors (indicated by a simple sum index of different behaviors) can be seen as representing one underlying general dimension. This dimension can be called *general ecological behavior*. Two sets of results support this conclusion.

First, the GEB scale gives an acceptable—not only compared to the Social Desirability scale—reliability and a sufficient internal consistency measure.[14] Additionally, the fit statistics for the GEB scale are also acceptable. As a consequence, the correlation between people's Rasch scores and their sum index of all the ecological behaviors under consideration ($r = .97$, $N = 443$) indicates that a self-reported sum of ecological behaviors can be reproduced accurately by the Rasch approach. Even though this leaves obscure what is measured, it can be concluded that it is at least a single dimension that can be measured accurately.

Second, comparisons of the GEB scale with other ecological behavior measures gives credit to the notion that the measured dimension is general ecological behavior. Six criterion-related validity measures—three single-item and three aggregated indicators—as well as a discriminant validity measure reveal only expected effects.

The criterion-related validity measures yield the following relations: The higher the GEB measure, the lower the estimated mileage one drives or flies per year, the higher the readiness to contribute financially to ecological organizations, the greater the readiness to adopt behaviors easy and difficult to perform, which have a positive impact on the environment, and the greater the willingness to accept governmental prohibitions. Moreover, the three single-item measures (cf. Fuhrer & Wölfing, 1997) correlate less strongly with general ecological behavior than do the three indicators that are aggregated within behavior domains (cf. Kals, 1993, 1996). And, the members of each of the two subgroups of indicators (single-item and aggregated) correlate in comparable

[14]It is reasonable that a change in response format—from a dichotomous to a rating scale format (see also Footnote 9)—increases both reliability and internal consistency of the proposed GEB scale (cf. Wright & Masters, 1982).

amounts with GEB (explained variances for the single-item indicators are between 2.6% and 8.4%, and for the aggregated indicators between 16.8% and 21.2%). This result supports empirically that single-behavior indicators are more susceptible to a wide range of influences than are aggregated behavior measures (cf. Diekmann & Preisendörfer, 1993; Pickett et al., 1993; Scott & Willits, 1994; Vining & Ebreo, 1992).

The GEB measure discriminates between the two transportation association groups quite nicely (20.8% explained variance). In the present sample, the lower the GEB, the more likely that one is a member of the transportation association that primarily represents automobile drivers' interests. Association membership, this single-item indicator, appears to be a good predictor for general ecological behavior because membership in an environmental organization—one of the transportation associations represents such an organization—is a task hard to fulfill in Switzerland (Table 1). Thus, harder tasks—as they are less susceptible to possible influences—appear to be better indicators of GEB.

Additional discriminant validity arises out of the comparison between the two association groups regarding behavior difficulties (Table 4). All three behaviors that are significantly easier to carry out for members of the association promoting an ecological transportation system are related either to the association's status as an environmental organization or to its primary goal (i.e., the promotion of public transportation). The six behaviors easier to carry out for members of the automobile drivers' interest association support the notion of a sample bias toward ecologically concerned participants. Although these people most likely behave unecologically regarding automobile use, they apparently compensate for automobile driving by behaving more ecologically in other domains.

Providing some criterion-related and some discriminant validity, although a beginning, is not meant to be sufficient to validate the GEB measure developed in this paper. The usefulness of the proposed measurement approach has to be supported by using the GEB scale in different well-established theoretical frameworks. To date, all such attempts to validate the GEB measure as a construct among others are promising: 75% of GEB can be explained in an environmental attitude framework (Kaiser et al., 1997), whereas 55% of GEB can be explained in a responsibility-related framework (Kaiser & Shimoda, in press).

Additionally, the results support the assumption that ecological behavior includes aspects of prosocial behavior (e.g., Vining & Ebreo, 1992). Eight out of 38 items measuring GEB represent different types of prosocial behavior (Table 1).

Ecological behavior is usually seen as being under the influence of social desirability (e.g., Scott & Willits, 1994). The present results do not fully support

this effect. The influence remains somewhat marginal (η^2 = 1%) as well as negative. But because the sample must be seen as biased toward more ecologically concerned people, no final conclusion should be drawn.

The proposed GEB scale is not seen as either the only or the best possible solution to measure general ecological behavior. It is seen as one possible measure. The purpose of the present paper is to demonstrate that people behave consistently[15] across different ecological domains if inconsistency is allowed in a certain probabilistic range, and if we consider behavior difficulty in our measurement approach. There are always better and worse items, according to the dimension one wants to measure. This is reflected by the misfit of the two excluded items (see Results section and Table 1): "I unwrap useless (i.e., nonfunctional) packages in the store" and "My automobile is ecologically sound." According to the empirical item fit there was, in fact, no need to exclude them. Internal consistency as well as reliability are acceptable with these items retained. Both items are excluded because their content seems to be problematic.

The first excluded item is a combination of a behavior and an assessment of the functionality of certain packages: I unwrap *useless* packages. People may differ not just in their behavior, but also in their assessment of the functionality of packages. Therefore, answers depend also on the functionality assessment part and not only on the behavior part of the item.

The second excluded item may clash with the participants' ideology. As our sample is biased toward more ecologically concerned participants, many of these could not take the point of view identified in this item, that is, "My automobile is ecologically sound." From my personal experience, most ecologically concerned people reject any associative relation between ecological soundness and automobiles. Whereas, some members from the automobile drivers' interest transportation association may have no difficulty answering "yes" to this question, taking a relative point of view, their automobile is as ecologically sound as possible. Thus, a probabilistic measurement approach suits not just measuring general ecological behavior; it points out somewhat problematic items as well.

As the proposed GEB measure empirically quantifies task difficulties of different types of ecological behavior, it can be used as a diagnostic tool for many contexts, such as societies or transportation associations (Table 4). For instance, if the same set of ecological behaviors is assessed with people from two different societies and both analyses reveal the usefulness of the measurement instrument but the item difficulty order is somewhat different, the different orders can be used as information about the two societies (cf. Wilson, 1992). As some types of behavior may be more constrained in one society than in another, such

[15]Consistency is indicated with a Cronbach's alpha score.

information can point out differences between societies, and also possibilities for change in societies. Let us take the present results as an example of what is meant by using the measurement instrument as a diagnostic tool for societies.

The results of the present study describe Swiss society (Table 1): While people are used to recycling some waste (e.g., bottles, paper, batteries), they do not avoid generating waste; they rarely buy milk in returnable bottles, and they take plastic bags for their purchases, and buy fruits and vegetables wrapped in plastic or paper. Regarding milk in bottles, at least two possibilities can be tested to find a way to bring consumers to buy milk in bottles more often. One is that there are too few opportunities to buy milk in bottles in Swiss grocery stores. Another possibility is that the material of the bottles is the problem; either the bottles are too inconvenient for consumers because of their weight, or they are seen as too susceptible to damage. Regarding the prewrapped agricultural products, one way to reduce the practice would be legal regulation by the Swiss government. Regarding use of plastic bags, a political campaign could be considered to attract public awareness to the fact and to offer alternative strategies for handling purchased goods.

Three additional ecological behaviors are also harder than others to perform in Swiss society (Table 1). They are: driving below 100 km per hour (62.5 mph) on freeways, being members of an environmental organization, and using special chemical cleaner for toilets. No recommendations will be made here on how to increase the number of organized environmentalists or to make drivers reduce their speeds. The latter represents the topic of entire books (e.g., Flade, 1994). Regarding the toilet cleaner, the same strategy as for the plastic bags could be used: increase knowledge. Either people do not know enough about how chemical toilet cleaners affect the environment, or they do not know an alternative.

All given recommendations cannot be taken for granted, nor are they the only possible alternatives. Yet these examples illuminate ways to use a diagnostic instrument that can provide us with scientifically grounded suggestions for societal changes.

Following other researchers (e.g., Geller, 1981; Hamilton, 1985; Kantola, Syme, & Campbell, 1984; Lloyd, 1980), I question the accuracy of self-reported measures of ecological behavior. With respect to the amount of conduct, people claim to do more than they do (cf. Scott & Willits, 1994). Nevertheless, self-reports can be fairly good indicators of what is going on (Berger & Corbin, 1992; Horsley, 1977). The objective behavior measure of the present study is one's membership in a transportation association. As the variance of the GEB measure can be somewhat explained by this membership (η^2 = 20.8%), the findings support the use of self-reports as indicators of ecological behavior. After all, self-reports are an economical and parsimonious way to get information (Pickett et al., 1993).

Once again, let me point out why ecological behavior should be measured generally, if possible, and not specifically. One's ecological concern can, for instance, lead to less automobile driving, driving at lower speeds, garbage inhibition, recycling, financial contributions, and sometimes to all of them, though not all necessarily at the same time. Either we accept that all of these behaviors have something in common that we try to measure generally, or psychological theories in the environmental domain have to include different types of behavior. In this case, the concrete choice of a specific behavior becomes either situationally dependent and somewhat arbitrary, or people's choice must also be included in the theoretical explanation. At least, theorists have to argue why they assume a relation between ecological concern and a specific ecological behavior, such as recycling, and why this relation is more plausible than one between ecological concern and, for example, automobile driving. The latter seems, at least to the author, challenging for most of the existing environmental psychological theories. Midden and Ritsema (1983) claim that, "Behaviors which are not commonly related, cannot easily be brought under the same . . . denominator" (p. 40). Such a common denominator is, however, a precondition for a common explanation. The present study supports the idea of a common denominator for different types of ecological behavior and also shows one possible way to measure ecological behavior generally.

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