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Capturing the Environmental Impact of Individual Lifestyles: Evidence of the Criterion Validity of the General Ecological Behavior Scale

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Abstract

Do behavioral measures of ecological lifestyles reflect actual environmental impact? Three convenience samples of German adults (*N* = 881) completed such a measure, the General Ecological Behavior (GEB) scale. Their household electricity consumption was self-reported (Study 1), assessed by a smart-meter (Study 2), or reported by the power company (Study 3). The latter two studies controlled for income, which can boost consumption just as it opens possibilities for behaving ecologically. Within and across studies, analyses revealed a negative association between self-reported ecological behavior and electricity consumption ($-.18 \leq rs \leq -.22$), even with adjustment for income. Furthermore, customers in a green electricity program reported more ecological engagement and consumed one third less electricity than did regular customers. These results indicate the criterion

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validity of the GEB scale for a highly practically relevant criterion and encourage the use of generic behavior measures in efforts to understand and foster more ecological lifestyles.

Keywords
behavioral assessment, conservation (ecological behavior), test validity, affluence, energy consumption

Many environmental psychologists recognize the need to promote more ecologically sustainable patterns of behavior or lifestyles (e.g., Howard, 2000; Otto, Kaiser, & Arnold, 2014). It appears, though, that what people choose to do to reduce their environmental impact often does not correspond well with what research in industrial ecology suggests they should be doing (e.g., Gatersleben, Steg, & Vlek, 2002; Stern, 2000b). This apparent lack of correspondence has called into question the criterion validity of behavioral measures of ecological lifestyles (e.g., Gifford, Kormos, & McIntyre, 2011; Steg & Vlek, 2009; Swim, Clayton, & Howard, 2011).

One problem that troubles the use of behavioral measures to estimate environmental impact is that contextual factors, such as the technologies people use in their everyday lives, mediate and amplify the environmental impact of people's behavior (see Midden, Kaiser, & McCalley, 2007). For example, the carbon dioxide (CO_2) emitted during a given daily commute differs depending on whether a person takes a bicycle, a car, or public transportation.

Another problem particular to behavioral measures of ecological lifestyles is that the circumstances surrounding individual lifestyles may have different and sometimes even opposed implications for different actions encompassed by such measures. Personal affluence, for example, allows for relatively extensive ecological engagement (e.g., giving money to environmental groups, buying certified organic foods); however, it also enables more consumption (e.g., more frequent leisure travel by air, the use of large and luxurious cars). In other words, affluence can attenuate the correspondence between behavioral measures of ecological lifestyles and actual environmental impacts. This seems to imply that there is little point in measuring the various behaviors that comprise a person's lifestyle; it would not be "counting what counts" in terms of actual environmental impact (Kennedy, Krahn, & Krogman, 2015).

Addressing these problems, the present article reports on three studies that test the criterion validity of the General Ecological Behavior (GEB) scale (Kaiser & Wilson, 2004), a self-report measure of ecological lifestyles that has widely been employed (see, for example, Corral-Verdugo et al., 2009; Evans et al., 2007; Kaklamanou, Jones, Webb, & Walker, 2015; Scannell & Gifford, 2010). In two of our studies, we adjust for household income as an indicator of affluence. In the following, we detail the rationale for our research. First, we elaborate on the role of affluence as a factor that potentially accounts for much—even most—of people's environmental impact. Second, we discuss dimensionality and stability issues with self-report measures of ecological behavior. Third and finally, we overview the evidence regarding the criterion validity of behavioral measures of ecological lifestyles.

Affluence, Behavior, and Environmental Impact

Greater affluence enables people to engage in more costly actions to protect the environment (but see, for example, Dunlap & York, 2008, for an alternative view). This effect is suggested to occur either indirectly, through fostering people's postmaterialist values (e.g., Inglehart, 1995) or directly, by making environmental protection more affordable (e.g., Diekmann & Franzen, 1999). Furthermore, it is seen to manifest either in a nonlinear, U-shaped association whereby ecological behavior first decreases but then increases with growing affluence (e.g., Magnani, 2000) or in a linear positive association (e.g., Diekmann & Franzen, 1999). In line with the "affluence hypothesis" of a direct linear association between affluence and ecological behavior, data from 21 countries revealed that the gross national product, standardized per person, converged with citizens' willingness to waive personal benefits for the priority of environmental protection goals ($r = .85$; Diekmann & Franzen, 1999; however, see, for example, Fairbrother, 2012, for conflicting evidence). Similarly, on an individual level, research with sociodemographically representative samples has found more environmentally protective activities performed by people with higher net incomes (e.g., Tabi, 2013).

Yet, a positive effect of affluence on people's behavioral engagement may be offset by an increase in overall consumption that also comes with higher income or greater wealth (see, for example, Otto et al., 2014; Tabi, 2013). Numerous studies have found that household income is among the most important determinants of impact indicators such as home energy use (e.g., Brounen, Kok, & Quigley, 2012). Because affluent individuals apparently exert a greater damaging influence on the environment, some have argued that they should be the prime targets of intervention strategies (e.g., Stern, 2000a). This view is echoed on the societal level in the renowned I = PAT formula, in which the product of affluence (A), population size (P), and the particular technologies used (T) is equated with the environmental impact (I) or damage inflicted by a society (as a result of both direct and indirect energy use, see, for example, Commoner, 1972; Ehrlich & Holdren, 1971).

The diametrically opposed efficacies of affluence render it a potential threat to the criterion validity of behavioral measures of ecological lifestyles because affluence carries the potential to undermine the association between individual behavior and actual environmental impact.

Dimensionality and Stability of Behavioral Measures of Ecological Lifestyles

Measures of overall patterns of ecological behavior have typically relied on behavioral self-reports (e.g., Corral-Verdugo et al., 2009; De Young, 1986; Leonard-Barton, 1981; Pelletier, Tuson, Green-Demers, Noels, & Beaton, 1998), as other approaches to explicitly representing a broad range of behaviors are not easily implemented or cost-effective (e.g., Bechtel, 1990). Measures based on behavioral self-reports are contested as accurate accounts of people's past overt behavior; however, they have nonetheless been recognized by some as reflections of a person's attitude toward environmental protection (e.g., Kaiser, Byrka, & Hartig, 2010) and by others as a reflection of a person's intention to act ecologically (Kormos & Gifford, 2014). Stern (2000b) has accordingly classified them as intent-measures, and distinguished them from measures employing assessments of actual impact (so-called impact measures; see also Kaiser, Doka, Hofstetter, & Ranney, 2003). In keeping with this classification, scores on the GEB scale, one such behavioral measure of ecological lifestyles, have been found to overlap 85% to 95% with scores from conventional measures of the behavioral intention to engage in activities to protect the environment, developed within the planned behavior framework (see, for example, Kaiser, Schultz, & Scheuthle, 2007).

Behavioral measures of ecological lifestyles thus have a common focus on the core subjective goal behind ecological behavior, which is the intent to protect the environment. They differ considerably, however, in the number of behavioral goals that they propose, as reflected in their dimensionality. One-dimensional measures, such as the GEB, assume that an individual's behavioral lifestyle reflects a generic intention to protect the environment. In contrast, multidimensional measures (e.g., Bratt, Stern, Matthies, & Nenseth, 2015; Leonard-Barton, 1981; Scott & Willits, 1994; Stragier, Hauttekeete, De Marez, & Brondeel, 2012) are thought to reflect different subjective goals or intentions (Stern, 2000b). Bratt and colleagues (2015), for example, suggested that home-based activities, air travel, and car use represent three distinctly different domains of environmentally protective behavior. Such results would seem to imply, for example, that persons inclined to protect the environment by refraining from car use do not necessarily intend to protect the environment at home (Stern, 2000b). Multidimensional measures may be valued for the ways in which they represent the contrasting means through which people may act to protect the environment. They are, however, subject to interpretive threats if derived through factor analysis. Not least, different dimensions can also reflect differences in the difficulties in behavioral items rather than different underlying intentions (e.g., Ferguson, 1941; Kaiser & Wilson, 2004).

In contrast to other behavioral measures of ecological lifestyles, the GEB is developed as a Rasch scale (see Kaiser & Wilson, 2004).[1] The Rasch model makes use of diverse item or behavior difficulties (i.e., item order) to measure interindividual differences (Rasch, 1960/1980). Note that this difficulty notion within the Rasch model differs from another one that is grounded in subjective or perceived difficulty (see Bratt et al., 2015). Employing Rasch scales, Kaiser and colleagues (e.g., Kaiser & Wilson, 2000; Scheuthle, Carabias-Hütter, & Kaiser, 2005) have found that self-reports of environmentally protective behaviors from different domains can be aggregated to form unidimensional measures within different sociocultural contexts.

Such research does not imply that multidimensional measures of ecological behavior are necessarily invalid. It does, however, speak to the tenability of unidimensionally scaling the GEB as a parsimonious alternative. Moreover, research with the GEB has also demonstrated the temporal stability of scores obtained with it. A recent study revealed that ecological behavior estimates were durable over 2 years, with an almost perfect ($\beta = .99$) test–retest correspondence after correction for measurement error attenuation (Kaiser, Brügger, Hartig, Bogner, & Gutscher, 2014).

The development of a behavioral measure of ecological lifestyles must, however, go beyond issues of dimensionality and temporal stability and also address criterion validity. Notably, behavioral measures of ecological lifestyles, and particularly self-report measures, can and will be challenged if the behaviors assessed do not effectively contribute to environmental protection by reducing negative environmental impact (e.g., Gifford et al., 2011). In other words, measures must acknowledge that the concept "ecological behavior" refers not only to a person's intent to protect the environment but also to the person's environmental impact (Stern, 2000b).

Evidence for the Criterion Validity of Behavioral Measures of Ecological Lifestyles

The issue thus becomes how well a behavioral measure of ecological lifestyles reflects individual differences in impact. The evidence is scarce. Published research has typically assessed either ecological behavior or environmental impact, without exploring the association (see Abrahamse, Steg, Vlek, & Rothengatter, 2005; Gatersleben, 2012). The few studies that have explored the behavior–impact link have commonly focused on a rather narrow range of behaviors and sometimes even on a single highly impact-relevant act (e.g., Gardner & Stern, 2008; Steg, Dreijerink, & Abrahamse, 2005; Thøgersen, 2014). For example, Verhallen and Van Raaij (1981) found self-reports of gas conservation behavior, such as the setting of thermostats, to explain 26% of the actual gas consumption. Likewise, Thøgersen and Grønhøj (2010) found household energy consumption to correlate with the intention to consume less household energy; the more people reported that they strived to reduce their consumption, the lower their meter-read energy consumption turned out to be (the direct effect accounts for 7% of the explained variance).

Measures consisting of relatively small numbers of behaviors or even single behaviors arouse concerns about reliability. In addition, they are typically inapt to disentangle the multitude of subjective goals or intentions that can lie behind those behaviors (Stern, 2000a). People may, for example, commute by bike for financial or health reasons in addition to or instead of environmentally protective reasons (cf. Greve, 2001). Identifying the motivational origins of behavior is, however, a precondition for inducing lasting change in individual action (see Otto et al., 2014).

It follows that efforts to understand and encourage more ecological lifestyles require rather extended sets of ecological behavior (see Otto & Kaiser, 2014; Otto et al., 2014). One recent proposition in this regard comes from Gatersleben and colleagues (Gatersleben, 2012; Gatersleben et al., 2002). They propose weighting the different ecological behaviors in their measure using information about the respective impacts. Conceivably, however, available information about the weights to use will vary greatly across sociocultural contexts and the impact criterion under consideration. Watering a lawn, for example, has different implications in Southern California versus England for people's energy consumption and their CO_2 emissions. This implies that, although they may serve well in the context for which the weights were originally derived, weighted behavior measures have inherently limited generalizability.

As an alternative to measures based on impact-weighted behaviors, the GEB has received initial support for its criterion validity from life cycle assessment data. Specifically, none of the ecological behaviors included in the GEB (e.g., recycling used paper) was environmentally less effective than a reasonable alternative behavior (e.g., putting used paper in the garbage; see Kaiser et al., 2003). As outlined below, the goal of the present research is to extend this previous work by drawing on participants' actual environmental impact.

Research Goals

In summary, the criterion validity of behavioral measures of ecological lifestyles is called into question by the lack of correspondence between what people choose to do and what they ideally should be doing to reduce their environmental impact. The association between self-reports of ecological behavior and environmental impact may be further attenuated by affluence, which allows for both more ecological engagement and greater consumption. Examples of explorations of the impact-relevance of behavioral measures of lifestyles are scarce to nonexistent in the literature. With our research, we aim to assess the extent to which the GEB, a generic self-report measure of ecological lifestyles, converges with household electricity consumption, controlling for the influence of household income.

Method

Procedure and Participants

The sample for the current study was pooled from three separate studies. In Study 1, we issued a public call for participants on the website of a local electric power company (EPC) in Magdeburg, Germany. A convenience sample of 236 customers (0.2% of the EPC's private customers) filled in a web-based questionnaire. To increase variance in ecological behavior and enable group comparison of the consumption levels, we also directly contacted all customers with a certified green electricity contract (henceforth green customers), which imposed a higher electricity price. Of the 49 green customers contacted, 28 completed questionnaires (response rate = 57.1%). No incentive was offered for participation.

Participants in Study 2 were sampled from the registers of a local EPC in Haßfurt, Germany. We directly contacted a convenience sample of 896 households (9.0% of the EPC's private customers), and 247 individuals returned their questionnaires (response rate = 27.6%). Personal feedback on one's results and participation in a lottery for 20 Amazon gift-cards worth 400€ (approximately US$425) in total were offered as incentives for participation.

Participants in Study 3 were sampled from the registers of a local EPC in Nordhausen, Germany. Of 2,500 randomly selected households (9.6% of the EPC's private customers) who received mailed invitations to volunteer, 414 individuals participated in the study (response rate = 16.6%), again in exchange for personal feedback and participation in a lottery. This time, we offered 10 gift-cards for the local shopping mall worth 200€ in total and a "smart-home" package, which was also worth 200€.

Table 1. Sociodemographic Characteristics of the Samples.

	Study 1	Study 2	Study 3	Overall
n	242	225	414	881
Age: *M* (*SD*)	51.6 (15.1)	54.4 (12.2)	60.2 (14.4)	56.4 (14.5)
Gender				
Female	55 (22.7%)	61 (27.1%)	177 (42.8%)	293 (33.3%)
Male	185 (76.4%)	153 (68.0%)	219 (52.9%)	557 (63.2%)
Household income (in €)				
<1,000/month	—	13 (5.8%)	57 (13.8%)	70 (11.0%)
1,000-1,999	—	41 (18.2%)	166 (40.1%)	207 (32.4%)
2,000-2,999	—	55 (24.4%)	79 (19.1%)	134 (21.0%)
3,000-3,999	—	39 (17.3%)	30 (7.2%)	69 (10.8%)
4,000-4,999	—	19 (8.4%)	10 (2.4%)	29 (4.5%)
>5,000/month	—	13 (5.8%)	10 (2.4%)	23 (3.6%)
Household size				
1 person	46 (19.0%)	30 (13.3 %)	70 (16.9%)	146 (16.6%)
2 persons	119 (49.2%)	101 (44.9%)	226 (54.6%)	446 (50.6%)
3 persons	45 (18.6%)	32 (14.2%)	61 (14.7%)	138 (15.7%)
4 persons	28 (11.6%)	41 (18.2%)	33 (8.0%)	102 (11.6%)
5 and more persons	4 (1.7%)	15 (6.7%)	16 (3.9%)	35 (4.0%)

Note. Household income was not assessed in Study 1.

Participants in all three studies returned their completed questionnaires in an enclosed envelope (n = 609, 65.8%) or filled in the questionnaire on the Internet (n = 316, 34.2%). Of all participants, 43 had to be eliminated due to missing electricity consumption data (i.e., n = 21 [8.0%] of Study 1's sample [including n = 4 of the green customers] and n = 22 [8.9%] of Study 2's sample). Furthermore, one outlier in Study 1 was excluded from all analyses, as that person's per-capita consumption level was more than 12 *SD* above the sample's average. These exclusions left a final total sample of N = 881.

Across studies, the average age was 56.4 years, with a range from 21 to 90 and 22 participants (2.5%) declining to state their age. The gender ratio was 33.3% (n = 293) female to 63.2% (n = 557) male, with 31 participants (3.5%) not stating their gender. Participants' self-reported monthly household net income (exclusively included in Studies 2 and 3 and assessed on a 6-point scale) revealed a level between 1,000€ and 1,999€ as the modal category (32.4%). However, 107 participants (16.7%) did not provide information on their household income. Finally, the modal household size was two persons (50.6%), with 14 participants (1.6%) declining to state the number of persons living in their household. As shown in Table 1, the samples of the three studies are heterogeneous in terms of these sociodemographic characteristics. Specifically, the percentage of female participants was significantly higher in Study 3 than in Studies 1 and 2 (both $p < .001$). Bonferroni corrected post hoc tests also revealed that Study 3's participants were significantly older than the participants in Studies 1 and 2 (both ps < .001). Furthermore, Study 2's participants lived in larger households than both Study 1's ($p = .003$) and Study 3's participants ($p < .001$). Correspondingly, Study 2's participants indicated a higher mean household income than Study 3's participants ($p < .001$).

Measures

Electricity consumption. Different means were employed to assess participants' current annual household electricity consumption in the three studies. In Study 1, we drew on self-reports of the annual consumption for most of the participants ($n = 214$, 88.4% of the valid responses). The reliability of these self-reports ($r = .80$, $p < .001$) was exclusively estimated based on actual consumption data from the EPC's billing system for $n = 23$ of our 24 green customers (i.e., 10.8% of all self-reports). For another subset of Study 1's participants, the consumption data were obtained with a so-called "smart-meter" (Darby, 2010), thus technically assuring that our measure of participants' electricity consumption was highly reliable. In Studies 2 and 3, the respective EPC provided us with consumption data for all participants from its billing system. For Study 2, these data were again smart-meter based. In keeping with the ordinary measurement level for EPCs' billing systems, electricity consumption was assessed on the household level rather than the individual level, which is also compatible with our indicator of affluence (i.e., household net income).

In all three studies, the assessment of participants' electricity consumption was retrospective. Participants provided permission to disclose their *previous year's* actual electricity consumption (Studies 2 and 3) or self-reported their consumption (Study 1) when filling-in our questionnaire. Specifically, participants in Study 1 first learned of our research when questionnaires were mailed in September-November 2012, and consumption data were collected for the year 2011. Likewise, participants in Studies 2 and 3 filled in the questionnaires in April-May and June-July 2013, respectively, and consumption data were collected for the year 2012. In other words, all participants were unaware of our study at the time they consumed the electricity.

Ecological behavior. The GEB scale (Kaiser & Wilson, 2004) served as a measure of ecological lifestyles. Example items are "I collect and recycle used paper" and "I kill insects with a chemical insecticide" (reverse coded; see Online Supplemental Appendix A for German and English versions of the scale).

Engagement in 27 behaviors could be acknowledged by a *yes/no* statement. For the remaining 47 items, we used a 5-point scale (*never* to *always*). In line with Kaiser and Wilson (2004), the responses to the polytomous items were recoded into a dichotomous format by collapsing *never, seldom*, and *occasionally* as indicators of noncompliance with environmental protection. *Often* and *always* were combined to indicate compliance with environmental protection. Simulation studies have found dichotomized indicator variables to be equally reliable as the original continuous indicators in many situations (e.g., DeCoster, Iselin, & Gallucci, 2009). Notably, dichotomizing the polytomous items has also not been found to decrease the GEB scale's reliability (Kaiser & Wilson, 2000). To make use of the 74 GEB items developed thus far but keep the assessment time for the individual participant below 15 min, we employed different subsets of the scale in the three studies (50 and 62 item subsets in Studies 1 and 3, respectively, and two overlapping 55 item subsets with a total of 65 items in Study 2; see Online Supplemental Appendix A for details). Note that joint calibration of different subsets is feasible in Rasch modeling, as long as the items fall within a single class of behavior and sufficient overlap is ensured between the item sets (see, for example, Bond & Fox, 2007). In line with previous GEB scale calibrations (e.g., Kaiser & Wilson, 2004; Scheuthle et al., 2005), all 74 items were found to reasonably fit the Rasch model ($0.88 \leq$ mean square fit value ≤ 1.16). It therefore seemed defensible to assess participants' ecological lifestyles based on a unidimensional model. Individual levels of this self-reported overall behavioral performance were estimated as logits, the natural logarithm of the engagement/nonengagement ratio of a person across all items. Larger positive logit values thus reflect a more pronounced ecological lifestyle. Person separation reliability, which captures—like Cronbach's alpha—the fraction of the observed response variance that is reproducible with the model, turned out to be acceptable with $rel = .73$.

Results

To test the criterion validity of our measure of people's ecological lifestyle, we first calculated bivariate correlation coefficients for the GEB scores and the corresponding households' electricity consumption. As expected, data from all three studies—both pooled and independently—indicate a negative linear association ($-.18 \leq r_s \leq -.22$, all $p \leq .002$, see Table 2 for details). Thus, participants reporting more ecological lifestyles consumed significantly less electricity. Importantly, this correlation remained significant when all 27 GEB items feeding into household electricity consumption (e.g., "I wash

Table 2. Descriptive Statistics and Bivariate Correlations of People's EB, Household EC, and Household Net I.

	M	*SD*	*n*	EB	EC	I
Study 1						
Self-reported EB in logits	0.37	0.74	242	.73	−.29	—
EC in kWh—Self-reported	2,764	1,622	242	−.22**	.80	—
I in €	—	—	—	—	—	—
Study 2						
Self-reported EB in logits	0.46	0.69	225	.73	−.23	.07
EC in kWh—Smart-meter reading	4,026	2,428	225	−.20**	—	—
I in €	2,772	1,320	180	.06	.28**	—
Study 3						
Self-reported EB in logits	0.51	0.66	414	.73	−.22	−.20
EC in kWh—Meter reading	3,069	1,541	414	−.19**	—	—
I in €	1,932	1,120	352	−.17**	.33**	—
Overall						
Self-reported EB in logits	0.46	0.70	881	.73	−.21	−.11
EC in kWh	3,230	1,889	881	−.18**	—	—
I in €	2,216	1,255	532	−.09*	.36**	—

Note. The bivariate correlations are Pearson *r*s, either uncorrected for measurement error attenuation (below highlighted cells on the diagonal) or corrected for attenuation (above highlighted cells). A generic correction for attenuation adjusts correlations for the reliabilities of the two measures involved (Charles, 2005). Widely accepted significance tests are available only for uncorrected correlations, so significance estimates are not given for the corrected correlations. The reliability estimates (diagonal cells of the correlation matrix) were available for the General Ecological Behavior scale and for the self-reported electricity consumption of only the green customers in Study 1. Household income was not assessed in Study 1. EB = ecological behavior; EC = electricity consumption; I = income.
$^{*}p < .05$. $^{**}p < .01$.

dirty clothes without prewashing") were removed from the scale ($-.12 \leq r_s \leq -.16$, all $p < .05$; see Online Supplemental Appendix A for a complete list of the items, and Online Supplemental Appendix B for details of the additional analysis). Equivalence testing using the *TOSTr* function of the statistical software package *R* (Lakens, 2016) shows that this correlation was not significantly smaller than the one drawing on the entire GEB scale for any of the three studies ($.08 < p < .26$). All analyses involving total household electricity consumption were also repeated with per-capita electricity consumption (i.e., total household electricity consumption divided by household size). Again, all reported associations remained significant ($-.12 \leq r_s \leq -.15$, all $p < .03$; see Online Supplemental Appendix C for details).

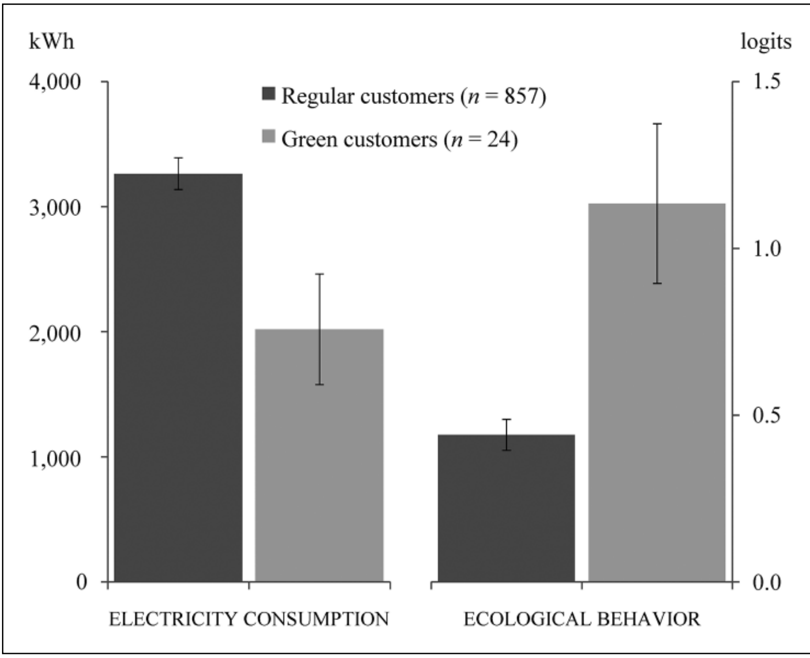

Figure 1. Annual household electricity consumption and self-reported ecological behavior of regular and green customers (mean values and 95% confidence intervals).

Next, we calculated the partial correlation of ecological lifestyles (i.e., the overall ecological behavior) and electricity consumption, controlling for monthly household net income. As income was assessed categorically, we employed the midpoint of each income category (e.g., 500€ for the below 1,000€ category). The highest category (i.e., above 5,000€) was open ended, but we used a value that maintained equal intervals among the income categories (i.e., 5,500€). Income was not assessed in Study 1, this information was thus missing for $n = 242$ participants. Without the 107 participants in Studies 2 and 3 who did not answer the income question, we had data from 532 participants for this analysis. As shown in Table 2, the bivariate association between income and household electricity consumption was positive and significant ($r = .28$ and $r = .33$, for Studies 2 and 3, respectively, both $p < .001$). The affluence hypothesis was however not corroborated, as the association of income and ecological behavior was not statistically significant in Study 2 and even *negative* in Study 3 ($r = .06$, $p = .45$ and $r = −.17$, $p = .001$, for Studies 2 and 3, respectively). Importantly, the negative linear association of ecological behavior and electricity consumption remained intact even when income was partialed out ($r = -.22$, $p = .004$ and $r = -.14$, $p = .007$, for Studies 2 and 3, respectively), speaking to the impact-relevance of our behavioral measure of ecological lifestyles. These results held up when we used 10,000€ instead of 5,500€ to represent the open-ended highest income category.

In an additional examination of the criterion validity of the GEB scale, we conducted *t* tests comparing the ecological behavior and household electricity consumption of green versus regular customers. As expected, green customers reported a higher ecological engagement. Specifically, their mean ecological behavior score measured in logits ($M = 1.13$, $SD = 0.55$, $n = 24$) significantly surpassed the regular customers' score ($M = 0.44$, $SD = 0.69$, $n = 857$), $t(879) = 4.9$, $p < .001$, $r = .16$ (see the right part of Figure 1). Comparing the two groups of customers regarding their household electricity consumption, we found the reversed pattern. Specifically, green customers' household electricity consumption ($M = 2{,}020$ kWh, $SD = 1{,}025$, $n = 24$) was on average significantly lower than that of regular customers ($M = 3{,}263$ kWh, $SD = 1{,}897$, $n = 857$), $t(27.6) = 5.7$, $p < .001$, $r = .11$ (see the left part of Figure 1). Green customers' comparatively frugal style of life—indicated by our behavior measure—was thus manifest in a level of electricity consumption more than one third lower than that of the regular customers.

Discussion

With our research, we corroborated the criterion validity of the GEB scale, a behavioral self-report measure of ecological lifestyles. Both within and across the samples of three separate studies, carried out in three German cities, we found that participants' self-reported ecological behavior was significantly inversely related to their household electricity consumption. This negative correlation held even when we controlled for income. Although the linear association between self-reported ecological behavior and electricity consumption is only small in magnitude, the more extensive ecological engagement of green (as compared with regular) customers resulted in rather pronounced electricity savings. Comparing customers enlisted in a certified green electricity program with a convenience sample of regular customers, we found that, on average, the green customers reported being more ecologically engaged and consumed one third less electricity per year than did regular customers. Notably, we have corroborated the criterion validity of the GEB scale drawing on a criterion that seems—in light of many societies' ambitious consumption reduction goals (see, for example, Commission of the European Communities, 2008)—of great practical importance. Considering the numbers of people who perform the behaviors in question and the frequency with which those behaviors are repeated, we therefore suggest that although the current findings may be small effects in statistical terms, they potentially have large consequences in the practical context (cf. Rosenthal & Rosnow, 2008).

The negative association between self-reported ecological behavior and people's actual environmental impact may seem rather obvious to some readers. After all, lifestyle measures of people's ecological behavior are thought to reflect a person's intention to act ecologically (Kormos & Gifford, 2014) and have indeed been found to converge with conventional behavioral intention measures developed within the planned behavior framework (Kaiser et al., 2007). However, empirical evidence regarding the impact-relevance of ecological behavioral engagement is scarce (see Abrahamse et al., 2005; Gatersleben, 2012), and thus far has only been provided for behavioral self-reports corresponding to the domain of environmental impact (Thøgersen & Grønhøj, 2010; Verhallen & Van Raaij, 1981). For example, when the explored behaviors refer to electricity consumption, such as switching off lights, the link to electricity consumption has already been shown. By contrast, for behaviors from multiple domains unrelated to electricity consumption, such as commuting by bicycle, such a link with electricity consumption has, to our knowledge, not been demonstrated before. Our research thus corroborates prior findings by demonstrating a negative association between ecological behavior and actual impact, but it also goes further by measuring diverse behaviors encompassed by an ecological lifestyle. Importantly, the relation between self-reported ecological behavior and electricity consumption remained significant even when all behaviors that directly involved household electricity use were removed from the scale. In contrast with recurrent concerns that self-reported ecological behavior does not reflect people's actual environmental impact (e.g., Gifford et al., 2011), our results indicate the impact-relevance of the GEB—at least in terms of household electricity consumption—as a measure of the ecological lifestyle of individuals.

Our findings with regard to household income are surprising in the light of previous research indicating diametrically opposed efficacies of affluence, allowing for both more extensive ecological behavior and impact-generating consumption (e.g., Diekmann & Franzen, 1999; Tabi, 2013). As expected, households with greater income consumed significantly more electricity; however, we did not find the positive association between people's ecological behavior and income suggested by the "affluence hypothesis." Specifically, we found no significant association between ecological behavior and household income in one of our studies (i.e., Study 2) and a negative and statistically significant association in another study (i.e., Study 3). The affluence hypothesis has previously received support on the level of nations (e.g., Diekmann & Franzen, 1999; see Fairbrother, 2012, for conflicting evidence). Our results, however, echo previous environmental psychological findings failing to corroborate the affluence hypothesis on the level of individuals (Thøgersen & Grønhøj, 2010). Thus, at least within relatively affluent societies such as Germany and Denmark, the association between people's income and their ecological behavior may not be strong (but see Pampel, 2014, for conflicting evidence). More importantly, our data show that the association of ecological behavior and actual environmental impact is robust both within and across samples even when household income is statistically controlled for. In other words, affluence—indicated by income—did not offset the effect of behavioral engagement on actual environmental impact, at least in terms of household electricity consumption.

The extent of the correlation between ecological behavior and electricity consumption was small. The effect is possibly attenuated by the specific technologies that mediate the ecological impact of the behavioral lifestyles of individuals (Midden et al., 2007). At the same time, such a modest correlation leaves much room for improvement by other behavioral measurement approaches. One way to boost the impact-relevance of behavior measures involves weighting the different ecological behaviors with information about their respective impacts (Gatersleben, 2012; Gatersleben et al., 2002). Because weights are likely to vary across contexts and the impact criteria under consideration, this increase in criterion validity will, however, likely come at the cost of reduced generalizability.

Interestingly, the GEB scale has also been employed as a measure of people's attitude toward environmental protection (see, for example, Kaiser et al., 2014). This practice is grounded in what Kaiser and colleagues (2010) called the *Campbell Paradigm*, which describes individual attitudes as a disposition to act, which become manifest in a person's self-reported past behavior. According to this perspective, the current study also speaks to the impact-relevance of people's attitudes toward environmental protection: More favorable attitudes toward environmental protection (as manifest in a more ecological lifestyle) were linearly related with lower consumption levels (see also, for example, Willis, Stewart, Panuwatwanich, Williams, & Hollingsworth, 2011). Notably, however, the Campbell Paradigm contrasts with the conventional view of individual attitudes as internal states that become apparent in verbal evaluations of certain objects and that imperfectly cause specific behavior (Eagly & Chaiken, 1993). Whereas such theoretical claims may be a matter of continuing contention, the current research also has a number of practical implications, to which we turn next.

Practical Implications

We believe that the established criterion validity of the GEB scale has at least three important implications for interventions. First, although the ultimate aim is to reduce individual environmental impact, we suggest people's goal-directed ecological behavior constitutes the prime target for psychological interventions as such interventions have particular advantages. Specifically, if a change in goal-directed (i.e., intentional) behavior can be sparked, it needs no supervision or continual governance (see, for example, Otto et al., 2014; Ryan & Deci, 2000) and it can withstand the test of time (see, for example, Kaiser et al., 2014; Pelletier & Sharp, 2008). For such an intervention to work, however, it is necessary to understand the motivational origins of the targeted behavior. This is enabled through the use of generic measures like the GEB (see Otto et al., 2014). Second, even for interventions directed at more specific actions, it is important to take the broad behavioral pattern into account. Here, a reliable and valid measure makes it possible to assess the moderating role of ecological lifestyles when evaluating the success of future interventions. Third, and similarly, a reliable and valid behavioral measure of ecological lifestyles can be used to estimate self-selection when evaluating the success of interventions in general, whether directed at specific actions or entire lifestyles.

Limitations

A number of limitations need to be kept in mind when interpreting the reported results. One limitation stems from the fact that our research drew on convenience samples of voluntary participants. Response rates were generally low and particularly so in Study 3 (i.e., 16.6%). As such—and in contrast to a number of previous tests of the affluence hypothesis—the distribution of ecological behavior as well as electricity consumption and household income is unlikely to be representative of the general population. Furthermore, Study 3 offered a lottery for a smart-home package, a device that potentially assists people in saving electricity. Thus, households receiving our invitation letters may have engaged in self-selection, leaving us with a sample of participants who were more interested in environmental protection. However, for the purpose of this study, focusing on the association of self-reported ecological behavior and electricity consumption (controlling for household income), it is sufficient that none of the variables displayed severe range restrictions. This was the case with our data.

A second limitation of the present study involves the possibility of cross-group contamination. In our data, green customers were found to consume less electricity than regular customers did. Problematically, whereas the group of green customers was identified by their EPC, the group of regular customers may have included participants who at some point were also enrolled in a green electricity program of some kind. Note, however, that such cross-group contamination would have deflated rather than increased the differences between groups in terms of both their ecological lifestyle and electricity consumption.

A final limitation relates to the criterion measure chosen. In our research, the environmentally destructive impact is only gauged in terms of the annual electricity consumption of households. We thus merely assessed a fraction of the total environmental impact and household level consumption had to serve as a proxy for individual impact. Household electricity consumption makes up roughly 20% of households' total energy consumption in Germany (Umweltbundesamt, 2017), and as such it involves a considerable environmental impact; however, the degree to which the findings of the present study can be generalized to even broader impact criteria is unknown. Future research should therefore investigate whether the current findings hold for alternative impact measures, such as people's water consumption or the fuel consumption that comes with their private mobility (for initial support that is based on life cycle assessment, see Kaiser et al., 2003). We chose household electricity consumption as a criterion for its high reliability, technically assured through (smart-) meter readings or reliably assessable (at least for the green customers in Study 1) through participants' self-reports (with an $r = .80$ correlation with actual consumption). In contrast, broader criterion measures, such as estimates of a person's carbon footprint, come with more uncertainty and lower reliability due to limitations on available data and inconsistencies across contexts (see, for example, Kennedy, Krahn, & Krogman, 2014). On a related point, whereas electricity consumption was—for practical reasons—assessed on the household level, ecological lifestyle was measured for individuals (i.e., the person holding the contract with the EPC). As couples living in one household are sometimes found to report quite differential engagement in specific environmentally protective activities (see, for example, Seebauer, Fleiß, & Schweighart, 2016), this discrepancy in level of measurement creates some uncertainty regarding the actual magnitude of the relation between people's ecological behavior and electricity consumption (Yang, Shipworth, & Huebner, 2015). However, it is likely to have deflated rather than increased the correlation of interest.

Conclusion

Environmental destruction and anthropogenic climate change call for major changes in people's lifestyles (Otto et al., 2014). However, does what people report that they do to protect the environment converge with their environmental impact? Our results indicate a small but significant correlation of ecological lifestyles measured with the GEB scale and people's actual electricity consumption. This linear association was robust both within and across three independent and sociodemographically diverse samples, even after adjustment for household income. The GEB's criterion validity is further supported by the correspondence of comparatively elevated ecological behavior levels—and in turn a lower (by as much as one third) electricity consumption—of green (vs. regular) customers. Thus, when employing the GEB scale, we are "counting what counts" (cf. Kennedy et al., 2015). People's differences in their ecological lifestyles, manifest in their self-reported ecological behavior patterns, are substantially related to their actual electricity consumption.

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Note

1. Applied to people's ecological behavior, the Rasch model (see Rasch, 1960/1980; for a recent account, see, for example, Bond & Fox, 2007) can be depicted as follows (see Equation 1): the natural logarithm of the ratio of the probability (p_{ki}) that person k engages in a specific (overt or verbal) behavior i relative to the probability that person k does not engage in behavior i ($1 - p_{ki}$) is given by the arithmetic difference between k's overall ecological behavioral performance (θ_k) and the difficulty estimate of behavior i (δ_i). The Rasch model thus distinguishes behaviors solely in terms of their difficulty and assumes that all behaviors are equally discriminating.

$$\ln\left(\frac{p_{ki}}{1-p_{ki}}\right) = \theta_k - \delta_i. \quad (1)$$

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