A Household Is Not a Person: Consistency of Pro-Environmental Behavior in Adult Couples and the Accuracy of Proxy-Reports

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Abstract

Studies on environmental behavior commonly assume single respondents to represent their entire household or employ proxy-reporting, where participants answer for other household members. It is contested whether these practices yield valid results. Therefore, we interviewed 84 couples, wherein both household members provided self- and proxy-reports for their partner. For use of electrical household appliances, consumption of hot water, space heating, everyday mobility, and environmental values, many variables fail to achieve criteria for validity. Consistency (agreement between self-reports of household members) is higher if behaviors are undertaken jointly or negotiated between partners. Accuracy (agreement of proxy-reports with corresponding self-reports) is higher for routine behaviors and for behaviors easily observable by the partner. Overall, indices perform better than items

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on single behaviors. We caution against employing individual responses in place of the entire household. Interventions for energy conservation should approach the specific person undertaking the target behavior.

**Keywords**
household energy consumption, proxy-reporting, intra-household interaction, pro-environmental behavior, pro-environmental values

**Introduction**

Energy consumption of private households contributes substantially to carbon emissions in Western industrialized countries (e.g., European Environment Agency, 2012). As a consequence, understanding and promoting energy conservation in households plays a major role in environmental research and policy (e.g., European Union, 2012). Most approaches view households as a homogeneous unit. This assumption is correct insofar as all household members share the same building characteristics, jointly pay the energy bill, and have their electricity consumption measured by the same meter. Accordingly, policy measures such as energy taxes, building regulations, or subsidies for retrofitting/insulation affect all household members in the same way. However, the persons comprising a household may not act and decide in a uniform way; they may engage in diverging, sometimes even conflicting actions depending on their individual preferences, restrictions, and everyday activities (Kang & Scott, 2011; Thøgersen & Grønhøj, 2010). Furthermore, the determinants of household energy consumption are often located at the individual as well as on the household level. This makes a clear attribution of behavioral antecedents to individual or household actions difficult (Bateman & Munro, 2009; Carlsson-Kanyama & Lindén, 2007; Grønhøj & Ölander, 2007; Longhi, 2013).

Many studies on energy conservation behavior rely on the perspective of just a single household member in place of the entire household. Even if the behavior of all household members is elicited, it is common that one household member provides proxy-reports on the behaviors of the others. We argue that a household should not be considered a “person.” Potential incongruence between household members poses substantial caveats: Intervention studies may be less effective if they encourage just a single target person instead of all household members to mutually perform energy saving actions. From a methodological point of view, imprecise or even biased data on energy conservation efforts and their determinants may result if household members...
engage in pro-environmental behaviors to a different degree or if they hold incorrect perceptions about their partner’s pro-environmental actions.

Yet, despite these caveats, many studies implicitly assume fully consistent behavior or perfectly accurate proxy-reports within households. We question these assumptions and provide empirical evidence of whether (a) household members act consistently, that is, whether and under what circumstances their self-reported actions converge and (b) household members accurately perceive their partner’s behaviors, that is, whether proxy-reports indeed conform with self-reports and what determines their accuracy. We conducted standardized interviews with 84 couples in Austria. Each person provided self-reports on his or her own pro-environmental behavior as well as proxy-reports on the behavior of the partner, covering energy saving in space heating, hot water consumption, and use of electrical household appliances as well as everyday mobility. Furthermore, we compare which environmental values a person holds and attributes to his or her partner.

When comparing self- and proxy-reports, we find considerable incongruence between partners. Our results suggest that “soft” energy conservation measures should ensure that all household members act in concert instead of pursuing diverging conservation agendas. For standardized surveys of pro-environmental behavior, we strongly caution against using the responses of a single person as a substitute for the behaviors and values of all household members.

In the following section, we review the current practice of (not) differentiating persons within the household and discuss evidence indicating systematic biases in proxy-reports. After outlining our data and measures (see the “Method” section), the main part of this article presents our findings (see the “Results” section). We report quantitative estimates for validity pertaining to indices as well as to specific items, showing that inconsistency and accuracy substantially vary between specific behaviors. The “Results” section covers a number of different variables, to give detailed reference for future empirical studies focusing on selected aspects of pro-environmental behavior and values. We conclude with a discussion on methodological restrictions and robustness of the results (see the “Limitations” section), and provide implications for future research on pro-environmental behavior in households (see the “Conclusion” section).

**Literature Overview**

**Consistency Within the Household**

The energy consumption of multi-person households is the aggregated outcome of the actions of all household members. However, different household
members may pursue energy saving with varying commitment. If they act inconsistently, such as one person turning down the room heating over night while the other person does not, the impact of individual energy saving behavior on the overall household energy consumption is diluted.

Few studies provide quantitative results on this issue. Longhi (2013) reports that male and female partners living in the same household correspond with \( r = .52 \) in pro-environmental behavior and with \( r = .36 \) in environmental concern. Yet, the applied pro-environmental behavior index includes 11 specific behaviors from the fields of energy conservation, waste avoidance and separation, and mobility behavior, which may hide discrepancies in specific behaviors. Thøgersen and Grønhøj (2010) compare electricity saving behaviors within adult couples and find that consistency varies widely between specific behaviors, ranging from \( r = .60 \) when using a tumble dryer in the summer to \( r = .09 \) for switching off the TV when nobody watches. In Grønhøj and Thøgersen (2009), biospheric values between parents and their children correlate with \( r = .18 \). Consistency of behaviors is higher when buying organic and environment-friendly products \( (r = .49) \) or separating waste \( (r = .41) \) but weaker when saving electricity \( (r = .13) \). However, as parents gradually educate and socialize their children (Hurrelmann, Grundmann, & Walper, 2008), consistency between parents and children may differ from consistency between partners who have equal say when agreeing on mutual action.

Other studies show that various personal characteristics drive pro-environmental behavior, above and beyond the influence of the household and dwelling context (Newton & Meyer, 2012; Stern, 2000): sociodemographic characteristics such as gender, age, or education, as well as factors such as environmental concern or perceived behavioral control (Gatersleben, Steg, & Vlek, 2002; Thøgersen & Grønhøj, 2010). If people living in the same household differ in regard to these personal characteristics, it is therefore likely that they also differ in their pro-environmental engagement, and therefore act inconsistently. In other words, from the established finding that personal characteristics influence pro-environmental behavior, and following that members of the same household usually do not feature identical personal characteristics, it seems more or less inevitable that they act inconsistently to some extent.

The present study focuses on gender as a source of inconsistency, as we investigate men and women living together as a couple. Male and female partners engage in different energy consumption practices because traditional gender roles still affect the division of household tasks. Women undertake domestic chores more often, and therefore have more opportunities for energy conservation when using electrical devices such as washing machines, tumble dryers, dishwashers, or when cooking (Statistics Austria, 2009; Thøgersen
Also, couples coordinate their everyday mobility schedules, sharing the workload for shopping and escorting children (Ho & Mulley, 2013; Kang & Scott, 2011; Schwanen, Ettema, & Timmermans, 2007). Finally, men and women differ in their pro-environmental values (Xiao & McCright, 2015). Yet, our perspective on inconsistencies between men and women goes beyond mere gender differences in environmental actions. We compare men and women who chose to live together in the same household, not just unrelated men and women randomly drawn from male and female populations. Thus, the inconsistencies observed in our study highlight gender differences when controlling for identical living conditions and building characteristics.

Potential lack of consistency has important implications: It is a common practice to use the responses given by a single household member to explain household-level variables such as the overall household electricity consumption obtained from meter readings and energy bills (e.g., Newton & Meyer, 2012) or derived from self-reported statements on household energy use (e.g., Abrahamse & Steg, 2009; Gatersleben et al., 2002). Yet, individual-level characteristics are weak predictors of household-level energy consumption (Seebauer & Wolf, 2016). Gender-biased results may emerge if the household head (predominantly male) or the person who spends the most time at home (predominantly female) is selected as an informant, and this informant’s responses are assumed to represent the full scope of energy saving behaviors enacted by all other household members. So far, only very few studies attempt to collect data from all persons in the household (Longhi, 2013; Thøgersen & Grønhøj, 2010).

The practice of approaching just a single household informant follows from practical considerations: Collecting comprehensive data from all persons in the household is costly and time-consuming. Yet, compounding household- and individual-level information introduces error, if not systematic bias, into the analysis and cannot account for variance within the household.

Accuracy of Proxy-Reports

Proxy-reporting is employed for multiple reasons (Stopher & Alsnih, 2004): The target person rejects questioning or is absent, is sick, or cannot respond due to cognitive restrictions from age or disability or due to language problems. Many survey studies draw on proxy-reports to prevent low response rates. More than 90% of proxy-reporters are the corresponding partners because they are easily available and supposedly familiar with the required information (Richardson, 2005).
Proxy-reports provide a considerable share of responses in major surveys: 50% of all information is provided by proxy-respondents in the U.S. Current Population Survey (Reynolds & Wenger, 2012), 23% in the Australian Coastal South-East Queensland Travel Survey 2003/2004 (Richardson, 2005), and 35% in the U.S. National Household Transportation Survey 2001 (Wargelin & Kostyniuk, 2004).

Proxy-reporters apply cognitive strategies when estimating the target person’s responses, possibly leading to inaccurate or biased data: Proxy-reporters estimate rather than count how often the target person engages in certain actions (Menon, Bickart, Sudman, & Blair, 1995), aim for a consistent answer pattern (Todorov, 2003), and base their inferences on the general image they have of the person addressed (Falk & Zimmermann, 2012). When uncertain, people tend to take readily available information of the setting as an anchor for their assumptions (Tversky & Kahneman, 1974). Thus, proxy-reporters may take their own routines as anchors to infer the energy conservation behavior of the target.

Compared with self-reports, proxy-reports on mobility behavior fail to declare 10% to 20% of overall trips (Richardson, 2005; Wargelin & Kostyniuk, 2004). Moreover, trip distances are significantly underestimated if stated by proxy. Generally, proxy-reports cover long-distance and routine trips fairly well but tend to miss short and more spontaneous trips (Stopher, Alsnih, Bullock, & Ampt, 2004).

Aside from mobility behavior, research on proxy-biases regarding household pro-environmental behavior is scarce. Grønhøj and Ölander (2007) compare self- and proxy-reports of couples concerning organic food consumption, energy consumption, and waste. Perceived differences are bigger than the actual differences between the partners, pointing to inaccurate information about the partner. Grønhøj and Ölander suggest that people anchor their response to certain sub-behaviors where they outdo their partner. In Lam and Cheng (2002), self- and proxy-reports within student couples correlate around $r = .45$; however, the correlated behavioral indices cover foremost political action regarding environmentalist groups and only marginally address everyday behaviors such as recycling paper. Bateman and Munro (2009) show for the case of household food purchases that interviewing each partner separately on behalf of the couple, and then averaging these responses, yields significantly different data than if agreed choices are elicited in joint interviews.

Overall, the literature reveals that proxy-reports on pro-environmental behavior are impaired by substantial biases. The following results illustrate these biases for a wide range of behaviors.
Method

Sample

The study population is constituted by multi-person households with male–female adult couples and any number of children below the age of 18. More than 75% of adults in Western-European countries live in this type of family situation (Grønhøj & Ölander, 2007). Sampling couples is the common practice when investigating within-household incongruence (Bateman & Munro, 2009; Lam & Cheng, 2002; Longhi, 2013; Thøgersen & Grønhøj, 2010). Couples are included in our study regardless of the legal aspects of their relationship (living together, marriage, or civil union). Same-sex couples were not excluded a priori, but the sampling process yielded only respondents living in heterosexual partnerships.

A random sample was drawn from three residential areas of different urban density in the city of Graz, Austria: a high-rise apartment building, a compact low-rise apartment complex, and a less densely populated area with single-family houses. From a comprehensive list of all households living in these areas (based on address data and doorbell plates), a random sample of 586 households was drawn. At least three attempts to contact each household face-to-face were made at different times of day. Out of the initial sample, 206 households could not be contacted, and 61 were excluded as single-person households or households with more than two adults. Two hundred thirty-five households refused to participate. Therefore, our sample consists of 84 couple households, resulting in 168 paired interviews. Based on the number of eligible households that could be reached, the response rate amounts to 26.3%.

Table O.1 (available in the online appendix) compares the sample to the population. Older people and those higher educated are overrepresented in the sample; this is fairly common in empirical social research (Bauer & Blasius, 2014) and might be due to the sampling areas being located in better-off districts of the overall Graz urban area. Yet, the respondents hold environmental values very similar to the general Austrian population. As our results may be considered representative only for the more affluent, we would welcome future studies to replicate our findings in other social strata. Notwithstanding, an eventual self-selection bias would not undermine our results: Consistency increases with age and educational level (see section “Determinants of Consistency and Accuracy”). Although we would expect that the sampling bias implies higher consistency, the observed discrepancies are still considerable. A more representative sample might yield even higher discrepancies.
Household interviews were conducted simultaneously by a pair of interviewers, so that each partner completed the questionnaire at the same time but in a separate room; thereby, we ensured that the interviewees could not harmonize their responses. Interview duration was about 30 min. Interviews were conducted between June 2013 and April 2014. Each interviewee completed the identical questionnaire twice: each item block first for himself or herself as a self-report and then for his or her partner as a proxy-report. Therefore, we are able to compare self-reports of both partners to investigate consistency, drawing on $n = 84$ paired cases. When analyzing accuracy, we contrast the proxy-report of one partner to the self-report of the other partner, yielding $n = 168$ paired responses (within each couple, the proxy-report of the male contrasted to the self-report of the female, and vice versa).

**Variables and Operationalization**

We focus on residential energy consumption and everyday mobility because they both substantially contribute to the carbon footprint of households in Western industrialized countries (e.g., Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009) and are widely researched in environmental psychology and other social science and economics disciplines. In residential energy consumption, the research questions on consistency and accuracy emerge clearly, as all household members jointly use the same appliances. Similarly, mobility behavior is not just a subject of accurate proxy-reports on otherwise unrelated individual actions. Up to 50% of all trips in multi-person households involve some degree of interaction between the household members (Ho & Mulley, 2013); this raises the question for intra-household consistency as well.

**Energy conservation behavior.** Individual energy conservation behavior was measured by 14 items on activities performed during the last month, covering a wide range of energy conservation behaviors, such as cooking with the lid on the pot, using the standby mode of electronic devices, tilting windows at night (i.e., opening the window a small amount), or turning off the light when leaving the room. Similar items were used in previous studies (Gatersleben et al., 2002; Thøgersen & Grønhøj, 2010; Whitmarsh, 2009), and the relevant behaviors are also addressed in established scales such as the General Ecological Behavior Scale (Kaiser, 1998). Note that the behaviors assessed were mainly curtailment behaviors. Responses were given on a 5-point bipolar rating scale ($1 = always, 5 = never$; four items with negative wording were reverse-coded). Regarding hot water use, the respondents stated the frequency of showering and bathing in a typical week.
Mobility behavior. To assess travel mode choice, respondents distributed 100 percentage points of usage during the previous month between the transport modes car/motorbike, public transportation, bicycle, and walking. Travel mode choice was assessed for several trip purposes. In the article at hand, we only report car and public transport use for work trips and weekend leisure trips. Respondents stated the number of out-of-home activities during the last 7 days for work, shopping of convenience goods, meeting friends, and other purposes. Furthermore, annual car mileage both as driver and passenger was separately assessed in kilometers.

Trip diary. Respondents listed all trips undertaken during the last 2 days, providing starting point and destination, purpose, travel mode, distance, and duration for each trip (conforming to the German KONTIV design for mobility surveys; see Axhausen, 1995). In this study, data from the diaries were aggregated to number of trips, and overall distance traveled, regardless of travel mode.

Environmental values. We employed the 9-item environmental concern scale by Diekmann and Preisendörfer (2003). The scale is frequently used in German-speaking countries and resembles common value scales such as the new environmental paradigm (Amburgey & Thoman, 2012). Responses were given on a 5-point bipolar rating scale (1 = fully agree, 5 = fully disagree; one item with negative wording was reverse-coded).

To reduce measurement error, mean indices were calculated. The individual conservation behavior index includes the 14 items on energy conservation behaviors answered on rating scales, reaching moderate reliability due to the diversity of featured behaviors (Cronbach’s α = .53 in self-reports, α = .53 in proxy-reports). The environmental values index includes all nine items and achieves satisfying reliability (α = .72 in self-reports, α = .77 in proxy-reports).

Data Analysis Procedures

We employ five analysis procedures to compare the responses of household members: First, we report means of all female versus male responses (to examine consistency) and self-reports versus proxy-reports (to examine accuracy), aggregated over the entire sample, testing for significant mean differences with two-tailed t tests for paired samples. This procedure illustrates the overall extent of gender roles or proxy bias.

Second, we report Spearman correlations between the respective responses as validity coefficients. Although some metric variables (such as annual car
mileage) would justify Pearson correlations throughout to facilitate comparison between the respective results and to provide robustness against some forms of non-linear relationships or lack of bivariate normal distribution.

The first and second procedures were employed in previous studies (Grønhøj & Thøgersen, 2009; Lam & Cheng, 2002; Thøgersen & Grønhøj, 2010). However, we consider aggregate means and correlations insufficient to judge consistency of household behavior and accuracy of proxy-reporting. When calculating aggregate means, positive and negative deviations within couples could cancel each other out resulting in identical aggregate means despite an underlying inconsistency. Even strong correlations might not detect underlying inconsistency and inaccuracy. If, for example, all men consistently underestimate their partner’s self-reported traveled distance by 100 km, this would result in a perfect correlation of 1, but the proxy-reports would still be biased. We therefore apply a third and a fourth analysis procedure.

In the third procedure, we calculate the mean absolute deviation for each variable. We do so by first computing the absolute difference within each couple (in case of consistency) and within each pair of corresponding self- and proxy-reports (in case of accuracy), and then calculate the mean of those absolute differences over all couples and paired reports, respectively. We use one-tailed one-sample \( t \) tests to test whether the mean absolute deviations are significantly larger than zero. Thus, in this procedure, we assume the strictest possible null hypothesis that couples agree exactly; that is, that they deviate by 0%.

However, perfect concordance between partners seems virtually impossible in practice. Therefore, we include a robustness check for the third analysis procedure where we allow for a relative deviation of 10% between partners before we consider them inconsistent. We take 10% as a threshold to reflect an “acceptable” or “realistic” level of inconsistency across all behavioral contexts, although other thresholds would of course be possible. Relative instead of absolute deviations are used to facilitate comparison between different response formats. For open-ended response formats (number of showers/baths, mobility behaviors), the relative deviation is calculated by dividing a self-report by the average of the two self-reports in the respective couple. For example, if the male reports an annual car mileage of 8,000 km and the female reports a mileage of 4,000 km, this results in a relative deviation of 33%. For the 5-point rating scales, relative deviations range from 0% if both partners select the same answer category to 100% if their responses differ by the maximum of four scale-points. Thus, inconsistent responses on a rating scale deviate at least by 25%, which equals a difference of one scale-point. Yet, deviations smaller than 25% may appear as individual responses are
averaged across cases (in the mean relative deviations for each item) or across variables (in the indices for energy conservation behavior and environmental values). Therefore, the 10% threshold is applied to all variables.

We refrain from conducting a similar robustness check for “acceptable” inaccuracy of proxy-reports because of severe difficulties: The natural reference for calculating the relative deviation of a proxy-report is the self-report of the person described in that very proxy-report. In the case of open-ended response formats, the relative deviation becomes infinite or very large if the self-report is zero or very small. For example, consider a female’s self-report of 0 or 2 km overall distance traveled in the trip diary, and a proxy-report by the male of 5 km. This results in a division by zero or a relative deviation of 150%, respectively. For low absolute levels of self-reports, the relative deviations often vastly exceed 100%; Figure O.1 (available in the online appendix) illustrates this for annual car mileage as a driver. The relative deviation may also hide large absolute inaccuracies. Following the previous example, the inaccuracy between 2 and 5 km yields the same deviation of 150% as 200 and 500 km, although the latter proxy-report can be considered far more inaccurate in absolute numbers. In the rating scales bounded to a 5-point range, the absolute level of the self-report defines the maximum possible relative deviation. If the self-reporter stated the mid-category (3), the most discrepant proxy-report could be two scale-points off (1 or 5). In contrast, if the self-reporter responded on a scale endpoint (1, 5), the proxy-report could deviate by up to four scale-points (5, 1). Thus, we cannot define a common reference for determining the relative deviation of proxy-reports in rating scales. For these reasons, we show only for consistency whether mean relative deviations significantly exceed 10%. The section “Revisiting the Null Hypothesis of Perfect Congruence” revisits the null hypothesis of perfect congruence and discusses the robustness check.

As a fourth analysis procedure, scatterplots demonstrate potential non-linear relationships. As some of our data are discrete and therefore prone to producing overlapping observations, we overlay each scatterplot with a jittered light gray version of the plot. Jittering slightly shifts the location of points to illustrate the underlying frequencies of overlapping points; note, however, that random noise from jittering only applies to the plots, not to the numerical analyses. The overlay allows us to visualize overlapping observations (in gray) while showing the original position of the observations (in black). All scatterplots show a 45° diagonal (with a slope of 1) as a reference for perfect consistency/accuracy (i.e., cases that lie on this diagonal).

Fifth, we regress the absolute deviation between partners on sociodemographics and indicators of communication between partners. Conducted for exemplary variables, this illustrates possible underlying causes for varying
degrees of consistency and accuracy within households. Again, as a robustness check, we replicate this procedure in a logit regression explaining whether a couple acts consistently within the 10% boundary or not.

Post hoc power analyses help to assess whether the small sample size impaired statistical significance of our results. In the one-tailed one-sample $t$ tests, given a power of .8 and a significance level of $p < .05$, we could detect effect sizes of $d > .27$ in the consistency analyses with $n = 84$ cases and of $d > .19$ in the accuracy analyses with $n = 168$ cases. All calculated effect sizes lie over these thresholds. Thus, we are confident that our results are not limited by power despite the small sample size. Possible limitations from cumulative alpha error are discussed in the “Limitations” section. Note that Cohen’s $d$ as a measure of effect size refers to the mean absolute deviation divided by its standard deviation. Therefore, depending on the standard deviation, the effect size can be larger or smaller than the mean absolute deviation.

For all procedures, casewise deletion of missing values was applied; cases were included in the respective analyses only if the other household member also gave a valid response. Thus, self-report values in the tables on accuracy may be slightly different from the values given in the tables on consistency.

Due to space constraints, this article presents just a selection of the rich data collected, focusing on those aspects of environmentally relevant behavior where the lack of consistency and accuracy is most apparent and/or that are commonly studied.\(^2\)

**Results**

**Consistency of Environmental Behavior**

To investigate the consistency of environmental behavior within households, we compare self-reports of both partners. Our analysis is therefore based on the responses of 84 couples. Table O.2 lists the scatterplots of selected items (all available as online appendix).

**Consistency of energy conservation.** Energy conservation behavior of couples is widely consistent when measured with an index including a wide range of behaviors (Table 1). The index correlation of $r = .53$ conforms well to Longhi (2013; $r = .52$ in pro-environmental behavior index) and Thøgersen and Grønhøj (2010; $r = .57$ in electricity saving behavior index). The respective scatterplot shows a compact spindle pattern surrounding the diagonal (Figure O.2, available as online appendix). When taking various behaviors together, partners share a similar tendency to engage in energy conservation.
Table 1. Consistency of Energy Conservation and Environmental Values.

| Index of energy conservation behaviors | Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|----------------------------------------|-------------|-----------|-------------------------|---------------|------------------------|---------------------|
| Reducing the room temperature at night during the cold season | 2.1 2.1 | 0.3*** | 1.02 | 0.096 | .53** |
| Tilting the window at night during the cold season | 2.1 2.3 | 0.9** | 0.71 | 0.219** | .52** |
| Keeping the doors between heated and unheated rooms closed | 2.4 2.2 | 1.0*** | 0.76 | 0.244** | .39** |
| Reducing room temperature when leaving the dwelling | 3.2 3.2 | 1.4** | 0.96 | 0.355** | .29** |
| Rather dressing warmer than increasing the room temperature | 2.5 2.7 | 1.3** | 0.99 | 0.326** | .28* |
| Considering energy consumption when purchasing household appliances | 1.5 1.4 | 0.6** | 0.63 | 0.137 | .32** |
| Hot-washing laundry with 60 °C or less | 1.4 1.8* | 0.7** | 0.65 | 0.168* | .45** |
| Using the washing machine even when half-loaded | 2.0 2.0 | 0.9** | 1.09 | 0.221 | .27 |
| Using the standby mode of PCs or TVs | 2.6 2.8 | 1.3** | 1.02 | 0.319** | .32** |
| Putting a lid on the pot when cooking | 1.4 1.7* | 0.7** | 0.78 | 0.176** | .22 |
| Turning on the dishwasher only when fully loaded | 1.3 1.3 | 0.4** | 0.52 | 0.108 | .17 |
| Turning off the light when leaving the room | 1.9 1.5* | 0.9** | 0.79 | 0.211** | .16 |
| Turning off the water while soaping under the shower | 3.2 2.8 | 1.5** | 0.88 | 0.369** | .28* |
| Letting the water tap run while brushing teeth | 1.8 1.9 | 1.2** | 0.76 | 0.296** | .09 |
| Number of showers taken per week | 6.1 6.2 | 2.3** | 0.68 | 0.409** | .41** |
| Number of baths taken per week | 1.1 0.5* | 0.8** | 0.43 | 1.539** | .32** |
| Index of environmental values | 2.0 2.3** | 0.5** | 1.12 | 0.124 | .50** |
| I am afraid when I think about environmental conditions for future generations | 1.9 2.1 | 0.9** | 1.05 | 0.232** | .18 |
If we continue our current style of living, we are approaching an environmental catastrophe

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 2.0         | 2.2       | 1.0**                   | 1.19          | 0.260**                 | .10                 |

Watching TV or reading in the newspaper about environmental problems, I am often embarrassed and angry

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 1.9         | 2.3**     | 1.2**                   | 1.19          | 0.290**                 | .03                 |

The great majority of Austrian people do not act in an environmentally responsible way

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 2.2         | 2.3       | 1.1**                   | 1.21          | 0.269**                 | -.00                |

There are limits of economic growth which the industrialized world has already reached or will reach very soon

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 1.8         | 1.8       | 0.9**                   | 0.82          | 0.224**                 | .18                 |

In my opinion, environmental problems are greatly exaggerated by proponents of the environmental movement

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 2.2         | 2.6*      | 1.2**                   | 1.25          | 0.289**                 | .36**               |

It is still true that politicians do much too little to protect the environment

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 1.7         | 2.0*      | 0.9**                   | 0.92          | 0.228**                 | .23*                |

To protect the environment, we all should be willing to reduce our current standard of living

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 1.7         | 2.0*      | 0.9**                   | 0.85          | 0.226**                 | .19                 |

Environmental protection measures should be carried out, even if this reduces the number of jobs in the economy

| Mean female | Mean male | Mean absolute deviation | Effect size d | Mean relative deviation | Spearman correlation |
|-------------|-----------|-------------------------|---------------|-------------------------|---------------------|
| 2.7         | 2.7       | 1.2**                   | 1.29          | 0.294**                 | .08                 |

Note. Five-point response scale, lower values indicate more environmentally friendly behavior (except number of showers/baths) and stronger pro-environmental values. Two-tailed t tests for paired samples compare male and female means. One-tailed one-sample t tests check whether the absolute mean deviation is larger than 0 (effect sizes refer to these tests) and whether the mean relative deviation is larger than 0.1 (i.e., larger than 10%). Note that effect sizes are also influenced by response variability and may therefore be larger or smaller than the corresponding mean absolute deviations.

aNegative item wording (values given are reverse-coded).

*p < .05, **p < .01.
For the specific behaviors, the picture changes drastically. Large absolute mean deviations within households as well as weak correlations indicate considerable inconsistency, especially for egocentric behaviors such as hot water use for personal hygiene. The scatterplot for the number of showers shows that in the majority of cases, both shower 7 times per week. Contrastingly, turning off the water while soaping polarizes many couples (Figure 1).

Heating behaviors during the cold season feature higher consistency, possibly because these behaviors affect both partners and can be expected to be negotiated to some extent. The scatterplot on tilting the windows at night demonstrates this mutual agreement between partners, as households cluster in the “extremes” of either undertaking this behavior all the time or not at all (Figure O.2). Contrarily, inconsistency emerges if the enactment of a certain behavior is decided independently by an individual either undertaking the behavior for the entire household (e.g., doing the laundry) or for oneself (e.g., brushing teeth).

The results on energy conservation behavior widely conform to the interrelations found among Danish couples: Thøgersen and Grønhøj (2010) also report weaker intra-couple correlations for specific behaviors than for an aggregate index; for some behaviors (loading the washing machine or the dishwasher, turning off the light), they find even weaker consistency of couples’ behavior.

**Consistency of mobility behavior.** We observe substantial inconsistency within couples regarding mileage, number of trips, and travel mode choice. Women and men feature substantial mean absolute deviations regarding annual car mileage, both as driver and as passenger, as well as regarding the total distance calculated from the trip diary (Table 2). Although weak positive correlations indicate that high mileage by one partner to some extent goes together with high mileage by the other partner, scatterplots reveal a more nuanced picture (Figure O.4). Consistent distances in the trip diary mainly appear in the majority of households who travel less than 50 km. In contrast, a small number of households show large deviations if one partner travels long distances, which cancel each other out when calculating the mean values.

Regarding the overall number of trips during the last 2 days, the male and female means seem fairly consistent. However, the mean absolute deviation, the weak correlation, and the shotgun pattern in the scatterplot (Figure O.6) speak of little consistency. Looking into trip purpose, we find men undertaking more work trips and women undertaking more shopping trips (Table 2). Scatterplots in Figure O.6 show two clusters of households on the “extreme” ends of the diagonal: Either both partners seem to work full-time, traveling to work 5 days a week, or both partners are not employed, undertaking no work
Figure 1. Consistency and accuracy of selected energy conservation behaviors.
### Table 2. Consistency of Mobility Behavior.

|                          | Mean female | Mean male | Mean absolute deviation | Effect size $d$ | Mean relative deviation | Spearman correlation |
|--------------------------|-------------|-----------|-------------------------|-----------------|-------------------------|----------------------|
| Annual car mileage       | 3,849.9     | 10,984.3**| 8,908.8**               | 1.31            | 1.404**                 | .23*                 |
| as driver (km)           |             |           |                         |                 |                         |                      |
| Annual car mileage       | 4,578.4     | 2,273.6** | 4,193.6**               | 0.81            | 1.241**                 | .05                  |
| as passenger (km)        |             |           |                         |                 |                         |                      |
| Total distance in last   | 66.4        | 68.7      | 52.1**                  | 0.63            | 0.816**                 | .35**                |
| 2 days (trip diary; km)  |             |           |                         |                 |                         |                      |
| Number of trips in       | 5.7         | 5.8       | 2.7**                   | 1.04            | 0.523**                 | .28*                 |
| last 2 days (trip       |             |           |                         |                 |                         |                      |
| diary)                   |             |           |                         |                 |                         |                      |
| Number of work trips in  | 1.9         | 2.8**     | 1.4**                   | 0.74            | 0.903**                 | .58**                |
| last week                |             |           |                         |                 |                         |                      |
| Number of shopping       | 2.7         | 1.9**     | 1.8**                   | 1.22            | 0.842**                 | −.14                 |
| trips in last week       |             |           |                         |                 |                         |                      |
| Frequency of car use on  | 43.7        | 59.9      | 40.8**                  | 1.01            | 0.408**                 | .14                  |
| work trips in last month |             |           |                         |                 |                         |                      |
| (%)                      |             |           |                         |                 |                         |                      |
| Frequency of PT use on   | 26.9        | 13.1*     | 29.4**                  | 0.81            | 0.294**                 | .02                  |
| work trips in last month |             |           |                         |                 |                         |                      |
| (%)                      |             |           |                         |                 |                         |                      |
| Frequency of car use on  | 61.4        | 59.3      | 28.6**                  | 0.98            | 0.286**                 | .41**                |
| weekend leisure trips in |             |           |                         |                 |                         |                      |
| last month (%)           |             |           |                         |                 |                         |                      |
| Frequency of PT use on   | 8.5         | 1.9**     | 7.2**                   | 0.38            | 0.072*                  | .54**                |
| weekend leisure trips in |             |           |                         |                 |                         |                      |
| last month (%)           |             |           |                         |                 |                         |                      |

Note. Two-tailed $t$ tests for paired samples compare male and female means. One-tailed one-sample $t$ tests check whether the absolute mean deviation is larger than 0 (effect sizes refer to these tests) and whether the mean relative deviation is larger than 0.1 (i.e., larger than 10%). Note that effect sizes are also influenced by response variability and may therefore be larger or smaller than the corresponding mean absolute deviations. PT = public transport.

*For travel mode choice, relative deviation equals absolute deviation, as responses were given in percentages.

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

trips at all. These prevalent patterns result in a high correlation of $r = .58$ for the number of work trips. Contrastingly, in few households both partners undertake the same number of shopping trips, yielding a correlation of just $r = −.14$.

Inconsistency of travel mode choice again reflects gender-specific mobility patterns. In the scatterplots on travel mode choice for work trips (Figure O.8),
we observe opposed clusters, depicting households in which either both household members exclusively use the respective travel mode or do not use it at all. These two clusters represent consistent behavior of household members. Both car use and public transport use for work trips tell a similar story: Inconsistent, albeit smaller clusters appear in the plots, where only the male takes the car to his workplace or the female exclusively uses public transport. Although we observe two large clusters of consistent households, the inconsistencies amount to a significant mean absolute deviation and a weak correlation. Couples rather act in concert in their travel mode choice on weekend leisure trips, presumably because they undertake these trips together. Couples mainly rely on the car and hardly use public transport on weekend leisure trips (Figure O.8).

Remarkably, the lack of consistency in mobility behavior appears in variables covering observational periods of an entire year, the previous month, the last week, and the last 2 days. The scatterplots illustrate that consistency within households arises from “extreme” (end of spectrum) behaviors such as full-time employment leading to five regular work trips a week or exclusive car use on work trips.

**Consistency of environmental values.** As in the case of energy conservation behavior, the aggregate measure of the environmental values index yields higher consistency than for the specific items (Table 1). Despite some heterogeneity shown in the scatterplot (Figure O.10), partners’ values correlate with $r = .50$. Women indicate stronger pro-environmental values than do men; this is in line with previous findings (Preisendörfer & Franzen, 1996; Zelezny, Chua, & Aldrich, 2000).

Again, the item-specific scatterplots paint a more nuanced picture: Judging from the item-specific correlations of $r < .20$ (Table 1), couples hardly share specific values. The cluster pattern for selected items in Figure O.10, however, demonstrates that many partners’ value statements differ just marginally. It seems that partners’ shared values become visible when viewed through an aggregated lens of diverse value statements.

**Accuracy of Proxy-Reports**

In this section, we consider the accuracy of proxy-reports by comparing the self-report of one household member with the corresponding proxy-report of the other household member. Therein, we draw on a sample of $n = 168$ paired interviews: 84 self-reports of females that are compared with proxy-reports by males, and vice versa. Table O.2 lists the scatterplots of selected items (all available as online appendix).
Accuracy of energy conservation behavior proxy-reports. For most specific energy conservation behaviors, mean self-reports and mean proxy-reports do not differ significantly (Table 3). Thus, it might seem that respondents can accurately account for their partner’s behavior if averaged over the entire sample. However, we find significant absolute mean deviations within couples. Judging from the correlation coefficients, accuracy is slightly higher for behaviors that are negotiated between the partners (e.g., heating during the cold season, purchasing household appliances) or that are visible to the partner (e.g., turning off the light when leaving the room).

Combining all energy conservation behaviors to an index does not improve the overall accuracy of proxy-reports, yielding correlations in the same range of $r = .40$ as in the specific items (Table 3). The scatterplot reveals a correspondingly scattered distribution (Figure O.3). Comparing index accuracy ($r = .37$ and $r = .41$) with index consistency ($r = .53$, see Table 1) possibly indicates inflation of actual behavior in self-reports for reasons such as social desirability. On one hand, inflated self-reports may weaken accuracy, as the divide between self- and proxy-reports would be even wider; on the other hand, self-inflation bias would overestimate consistency if both partners crowd to the “always” or “often” end of the response scale (as indicated by mean values around 2, Table 1 and Table 3). In that sense, someone’s self-report might be a more precise proxy of his or her partner’s self-report than asking that person to describe his or her partner’s behavior. Still, according to the mean absolute deviations index, accuracy and index consistency hardly diverge (0.4 in accuracy, Table 3; 0.3 in consistency, Table 1). Note though that the energy conservation index suffers from weak reliability (see section “Variables and Operationalization”).

Persons state to turn off the light when leaving the room more often than the according proxy-report suggests; for male self-reports and female proxy-reports, this difference is statistically significant. This might result from inflated self-reports, too. Alternatively, light saving could act as a cognitive representation of energy saving in general, and proxy-respondents downplay their partner’s efforts so that they outdo their partner (Diekmann & Preisendörfer, 1998).

In the scatterplots depicting proxy-report accuracy for turning off the water while soaping (Figure 1) and tilting the window at night (Figure O.3), the “extreme” clusters from the results on consistency (see section “Consistency of Energy Conservation”) reappear. Presumably, if partners jointly engage in these behaviors “always” or “never,” the accuracy of their respective proxy-reports improves.

For most energy conservation behaviors, female proxy-reports are similarly accurate as male proxy-reports. Still, for some behaviors, opposed
### Table 3. Accuracy of Energy Conservation and Environmental Values Proxy-Reports.

| Index of energy conservation behaviors                                                                 | Mean self | Mean proxy | Mean absolute deviation | Effect size $d$ | Spearman correlation |
|-------------------------------------------------------------------------------------------------------|-----------|------------|-------------------------|-----------------|----------------------|
| Female                                                                                                 | 2.1       | 2.2        | 0.4**                   | 1.22            | .37**                |
| Male                                                                                                   | 2.2       | 2.2        | 0.4**                   | 1.05            | .41**                |
| Reducing the room temperature at night during the cold season                                           | 2.4       | 2.3        | 0.7**                   | 0.60            | .67**                |
| Male                                                                                                   | 2.3       | 2.1        | 0.8**                   | 0.56            | .62**                |
| Tilting the window at night during the cold season                                                      | 2.1       | 2.3        | 0.7**                   | 0.65            | .59**                |
| Male                                                                                                   | 2.3       | 2.1        | 0.6**                   | 0.62            | .67**                |
| Keeping the doors between heated and unheated rooms closed                                             | 2.4       | 2.5        | 1.0**                   | 0.81            | .45**                |
| Male                                                                                                   | 2.2       | 2.4        | 1.0**                   | 0.81            | .38**                |
| Reducing room temperature when leaving the dwelling                                                   | 3.2       | 3.2        | 1.3**                   | 0.91            | .36**                |
| Male                                                                                                   | 3.1       | 3.0        | 1.4**                   | 0.96            | .31**                |
| Rather dressing warmer than increasing the room temperature                                            | 2.5       | 2.7        | 1.3**                   | 1.04            | .30**                |
| Male                                                                                                   | 2.7       | 2.5        | 1.3**                   | 1.03            | .31**                |
| Considering energy consumption when purchasing household appliances                                     | 1.5       | 1.7        | 0.6**                   | 0.64            | .44**                |
| Male                                                                                                   | 1.4       | 1.3        | 0.4**                   | 0.62            | .25*                 |
| Hot-washing laundry with 60 °C or less                                                                  | 1.6       | 1.8        | 0.8**                   | 0.67            | .30**                |
| Male                                                                                                   | 1.8       | 1.8        | 0.9**                   | 0.88            | .30                  |
| Using the washing machine even when half-loaded                                                       | 2.1       | 2.2        | 1.2**                   | 1.04            | .13                  |
| Male                                                                                                   | 2.2       | 2.0        | 1.0**                   | 1.25            | .26                  |
| Using the standby mode of PCs or TVs                                                                     | 2.6       | 2.9        | 1.3**                   | 1.04            | .35**                |
| Male                                                                                                   | 2.8       | 2.9        | 1.2**                   | 0.92            | .33**                |
| Putting a lid on the pot when cooking                                                                  | 1.5       | 1.7        | 0.7**                   | 0.78            | .21                  |
| Male                                                                                                   | 1.6       | 1.6        | 0.7**                   | 0.75            | .46**                |
| Turning on the dishwasher only when fully loaded                                                       | 1.4       | 1.5        | 0.6**                   | 0.64            | .26*                 |
| Male                                                                                                   | 1.3       | 1.3        | 0.4**                   | 0.53            | .27*                 |
| Turning off the light when leaving the room                                                            | 1.9       | 2.1        | 0.8**                   | 0.86            | .47**                |
| Male                                                                                                   | 1.5       | 2.1**      | 0.9**                   | 0.78            | .37**                |
| Turning off the water while soaping under the shower                                                  | 3.2       | 3.0        | 1.4**                   | 0.86            | .35**                |
| Male                                                                                                   | 2.9       | 3.0        | 1.1**                   | 0.76            | .54**                |
| Letting the water tap run while brushing teeth                                                        | 1.9       | 2.1        | 1.2**                   | 0.77            | .14                  |
| Male                                                                                                   | 1.9       | 1.9        | 1.0**                   | 0.73            | .28*                 |

(continued)
Table 3. (continued)

|                                | Mean self | Mean proxy | Mean absolute deviation | Effect size $d$ | Spearman correlation |
|--------------------------------|-----------|------------|-------------------------|-----------------|----------------------|
| Number of showers taken per week |           |            |                         |                 |                      |
| Female                         | 6.3       | 6.2        | 1.6**                   | 0.66            | .57**                |
| Male                           | 6.2       | 6.1        | 1.6**                   | 0.59            | .64**                |
| Number of baths taken per week |           |            |                         |                 |                      |
| Female                         | 1.1       | 0.9        | 0.5*                    | 0.31            | .71**                |
| Male                           | 0.5       | 0.7*       | 0.3**                   | 0.48            | .68**                |
| Index of environmental values  |           |            |                         |                 |                      |
| Female                         | 2.0       | 2.2*       | 0.5**                   | 1.04            | .65**                |
| Male                           | 2.2       | 2.2        | 0.5**                   | 1.23            | .41**                |
| I am afraid when I think about environmental conditions for future generations |           |            |                         |                 |                      |
| Female                         | 1.9       | 1.9        | 1.0**                   | 1.04            | .15                  |
| Male                           | 2.1       | 2.1        | 0.9**                   | 1.02            | .26*                 |
| If we continue our current style of living, we are approaching an environmental catastrophe |           |            |                         |                 |                      |
| Female                         | 2.0       | 2.1        | 0.9**                   | 1.04            | .27*                 |
| Male                           | 2.2       | 2.2        | 1.0**                   | 1.20            | .09                  |
| Watching TV or reading in the newspaper about environmental problems, I am often embarrassed and angry |           |            |                         |                 |                      |
| Female                         | 1.9       | 2.2*       | 0.8**                   | 1.06            | .38**                |
| Male                           | 2.3       | 2.2        | 1.0**                   | 1.12            | .25*                 |
| The great majority of Austrian people do not act in an environmentally responsible way |           |            |                         |                 |                      |
| Female                         | 2.2       | 2.1        | 1.0**                   | 1.11            | .12                  |
| Male                           | 2.3       | 2.1        | 1.0**                   | 1.10            | .08                  |
| There are limits of economic growth which the industrialized world has already reached or will reach very soon |           |            |                         |                 |                      |
| Female                         | 1.7       | 1.9        | 0.8**                   | 0.88            | .38**                |
| Male                           | 1.8       | 2.0        | 1.0**                   | 0.92            | .10                  |
| In my opinion, environmental problems are greatly exaggerated by proponents of the environmental movement$^a$ |           |            |                         |                 |                      |
| Female                         | 2.2       | 2.6*       | 1.1**                   | 1.21            | .45**                |
| Male                           | 2.6       | 2.6        | 1.1**                   | 1.16            | .23*                 |
| It is still true that politicians do much too little to protect the environment |           |            |                         |                 |                      |
| Female                         | 1.70      | 1.9        | 0.8**                   | 0.79            | .31**                |
| Male                           | 2.0       | 1.9        | 0.8**                   | 1.02            | .32*                 |
| To protect the environment, we all should be willing to reduce our current standard of living |           |            |                         |                 |                      |
| Female                         | 1.7       | 2.1*       | 0.9**                   | 0.85            | .21                  |
| Male                           | 2.0       | 2.0        | 1.0**                   | 0.94            | .19                  |
| Environmental protection measures should be carried out, even if this reduces the number of jobs in the economy |           |            |                         |                 |                      |
| Female                         | 2.7       | 2.6        | 1.0**                   | 1.17            | .30**                |
| Male                           | 2.7       | 2.8        | 1.1**                   | 1.28            | .09                  |

Note. Five-point response scale, lower values indicate more environmentally friendly behavior (except number of showers/baths) and stronger pro-environmental values. Two-tailed $t$ tests for paired samples compare self- and proxy-means. One-tailed one-sample $t$ tests check whether the absolute mean deviation is larger than 0; effect sizes refer to these tests. Note that effect sizes are also influenced by response variability and may therefore be larger or smaller than the corresponding mean absolute deviations. Mean self-reports: The target person’s own behavior; mean proxy-reports: The partner’s estimate of the target person’s behavior. Female/male rows indicate the respective target person. Mean absolute deviation: Absolute differences between self- and proxy-reports, averaged over all pairs of self- and proxy-reports. $^a$Negative item wording (values given are reverse-coded). $^p < .05. ^{**}p < .01.$
effects point to gender roles attributing technological product choices to men and cooking to women: Regarding the purchase of energy-efficient appliances, female self-reports are fairly well reflected by male proxy-reports ($r = .44$), but male behavior is less transparent to females ($r = .25$). The picture reverses for putting a lid on the pot when cooking, where males struggle to account for their partner’s actions ($r = .21$).

**Accuracy of mobility behavior proxy-reports.** For annual car mileage as a driver or as a passenger, male respondents on average overestimate the self-reported kilometers traveled by women, whereas female respondents underestimate their partner’s mileage (Table 4). Judging from the mean absolute deviations, proxy-reports provided by female respondents are more biased when referring to their partner’s car mileage as a driver. Contrariwise, proxy-reports given by males are more biased when referring to their partner’s mileage as a passenger. In comparison with annual mileage, the distance traveled in the last 2 days as stated in the trip diary is assessed more accurately in proxy-reports. Although there are still statistically significant mean absolute deviations, the correlations of $r = .79$ and $r = .82$ speak of high validity (Table 4); this is also supported by the scatterplots (Figure O.5).

Proxy-reports on the number of work trips in the last week are very accurate in terms of small mean absolute deviations and correlations exceeding $r > .86$ (Table 4). According to the scatterplots, this high accuracy arises from two clusters of accurate proxy- and self-reports where a person either goes to work 5 days a week or not at all (Figure O.7); this reflects the corresponding results on consistency. Proxy-reports are less precise for the number of shopping trips and for the overall number of trips in the last 2 days. These results are in line with findings that proxy-reports often ignore irregular, non-routine and spontaneous trips (Stopher et al., 2004; Wolf, Loechl, Myers, & Arce, 2001).

For travel mode choice, we find high accuracy on work trips but only moderate accuracy on weekend leisure trips (Table 4). Again, similar to the scatterplots on consistency, clusters at the upper or lower end of the diagonal reflect persons who use a certain travel mode exclusively or not at all (Figure O.9).

Overall, proxy-reports on mobility behavior are more precise for travel to the workplace than for shopping or leisure purposes. Still, as in the results on consistency, the good performance of the work mobility measures is closely connected to large clusters of persons with “extreme” behaviors such as full-time versus no employment or exclusive car use. Alternatively, those couples at the “extreme” end might share restricted living conditions that predetermine individual actions so much that the proxy-reporting person may infer his or her partner’s most likely actions just from the lack of alternatives.
Table 4. Accuracy of Mobility Behavior Proxy-Reports.

|                          | Mean self | Mean proxy | Mean absolute deviation | Effect size d | Spearman correlation |
|--------------------------|-----------|------------|-------------------------|----------------|---------------------|
| **Annual car mileage as driver (km)** |           |            |                         |                |                     |
| Female                   | 4,027.5   | 5,173.7*   | 2,925.2**               | 0.77           | .72**               |
| Male                     | 10,958.5  | 7,980.4*** | 6,326.6***              | 1.09           | .51**               |
| **Annual car mileage as passenger (km)** |           |            |                         |                |                     |
| Female                   | 4,705.0   | 6,316.0*   | 4,333.6**               | 0.44           | .39**               |
| Male                     | 2,290.8   | 1,900.5    | 2,081.7**               | 0.60           | .51**               |
| **Total distance in last 2 days (trip diary; km)** |           |            |                         |                |                     |
| Female                   | 67.0      | 63.0       | 15.8**                  | 0.72           | .79**               |
| Male                     | 69.8      | 66.9       | 20.5**                  | 0.73           | .82**               |
| **Number of trips in last 2 days (trip diary)** |           |            |                         |                |                     |
| Female                   | 5.7       | 5.1*       | 1.9**                   | 0.86           | .52**               |
| Male                     | 5.8       | 4.9***     | 1.7**                   | 0.97           | .67**               |
| **Number of work trips in last week** |           |            |                         |                |                     |
| Female                   | 1.9       | 1.8        | 0.3**                   | 0.44           | .96**               |
| Male                     | 2.8       | 2.7        | 0.5**                   | 0.43           | .86**               |
| **Number of shopping trips in last week** |           |            |                         |                |                     |
| Female                   | 2.7       | 2.7        | 1.2**                   | 1.05           | .45**               |
| Male                     | 1.9       | 1.4*       | 1.1**                   | 0.87           | .37**               |
| **Frequency of car use on work trips in last month (%)** |           |            |                         |                |                     |
| Female                   | 43.8      | 45.4       | 9.9**                   | 0.48           | .87**               |
| Male                     | 57.9      | 52.9       | 9.1**                   | 0.53           | .85**               |
| **Frequency of PT use on work trips in last month (%)** |           |            |                         |                |                     |
| Female                   | 27.4      | 25.6       | 10.3**                  | 0.50           | .78**               |
| Male                     | 13.7      | 16.8       | 12.0**                  | 0.57           | .53**               |
| **Frequency of car use on weekend leisure trips in last month (%)** |           |            |                         |                |                     |
| Female                   | 60.0      | 64.7       | 22.4**                  | 0.90           | .60**               |
| Male                     | 59.3      | 60.1       | 28.8**                  | 0.97           | .41**               |
| **Frequency of PT use on weekend leisure trips in last month (%)** |           |            |                         |                |                     |
| Female                   | 9.0       | 4.1*       | 8.5**                   | 0.44           | .45**               |
| Male                     | 1.9       | 6.0*       | 5.5**                   | 0.37           | .49**               |

Note. Two-tailed t tests for paired samples compare self- and proxy-means. One-tailed one-sample t tests check whether the absolute mean deviation is larger than 0; effect sizes refer to these tests. Note that effect sizes are also influenced by response variability and may therefore be larger or smaller than the corresponding mean absolute deviations. Mean self-reports: The target person’s own behavior; mean proxy-reports: The partner’s estimate of the target person’s behavior. Female/male rows indicate the respective target person. Mean absolute deviation: Absolute differences between self- and proxy-reports, averaged over all pairs of self- and proxy-reports. PT = public transport.

*p < .05. **p < .01.
For annual car mileage, male respondents overestimate and female respondents underestimate their partner’s actual behavior. Possibly, both genders take their own mileage as an anchor for estimating their partner’s mileage (see section “Accuracy of Proxy-Reports”). In other words, males drive long distances themselves and hence report longer distances traveled by their partner, and vice versa. However, no evidence for possible anchoring effects is apparent in the other mobility variables.

The results suggest that measures with a temporal perspective on the last 2 days or the last week, which would presumably be more prone to counting strategies, yield more accurate proxy-reports than rather estimation-based measures referring to the last month or the last year.

**Accuracy of environmental values proxy-reports.** For the environmental values index, male respondents tend to attribute weaker pro-environmental values to their female partners than they actually have (Table 3). Apart from that, accuracy is fairly high, as indicated by small mean absolute deviations and a pattern close to the diagonal in the scatterplot (Figure O.11). Still, male respondents tend to report more accurately on their partner than female respondents do. From comparing the environmental values index’s accuracy \( r = .65, r = .41 \) and consistency \( r = .50 \), see Table 1), we may assume that respondents can equally well articulate their partner’s values as their worldviews actually conform to each other.

Again, as observed in the consistency of environmental values (see section “Consistency of Environmental Values”), the discrepancy between self- and proxy-reports regarding specific value items remains small. Despite weak correlations, most clusters appear tightly grouped in the scatterplots with small distances between clusters (Figure O.11).

**Determinants of Consistency and Accuracy**

To conclude our analyses, we explore potential determinants of the level of consistency and accuracy within households using regression models (Table 5). The models use the absolute deviation in the energy conservation behavior and environmental values indices, and in the annual car mileage as driver, as dependent variables. Models on relative deviations (Models 1b and 3b) are discussed in the next section. Sociodemographic variables and indicators of communication within the household serve as predictors. Table O.1 in the online appendix gives descriptive statistics to these predictors.

All three OLS models on consistency show less deviation within older couples (Models 1a, 2, and 3a, \( \beta = -0.16 \) to \( \beta = -0.27 \)). Possibly, age to some extent reflects the duration of the relationship. The longer both partners know each
Table 5. Regression Models of Consistency and Accuracy.

|                   | Consistency (OLS; absolute deviation) | Consistency (logit; relative deviation) | Accuracy (OLS; absolute deviation) |
|-------------------|---------------------------------------|------------------------------------------|----------------------------------|
|                   | 1a                                    | 2                                        | 3a                               | lb                                    | 3b                                    | 4                                    | 5                                    | 6                                    |
| Index of energy conservation behaviors | Annual car mileage as driver           | Index of environmental values            | Index of energy conservation behaviors | Index of environmental values | Index of energy conservation behaviors | Annual car mileage as driver | Index of environmental values |
| Occupationa        |                                       |                                          |                                 |                                       |                                       |                                      |                                      |                                      |
| (Both) retired     | 0.02 (0.13)                           | 0.01 (0.05)                             | 0.24 (1.21)                     | -0.37 (-0.36)                         | 0.08 (0.08)                         | 0.22 (1.75)                          | -0.13 (1.08)                         | 0.18 (1.36)                         |
| (Both) other       | -0.03 (-0.24)                         | 0.08 (0.55)                             | 0.07 (0.56)                     | 0.04 (0.05)                           | 0.10 (0.14)                         | -0.02 (0.23)                         | -0.04 (0.47)                         | 0.03 (0.38)                         |
| Time spent together on week days | -0.01 (-0.04)                         | -0.02 (-0.10)                           | -0.05 (-0.36)                   | -0.02 (-0.27)                         | -0.06 (-0.87)                       | -0.04 (0.31)                         | 0.16 (1.28)                          | -0.03 (0.20)                         |
| Time spent together during the weekend | -0.14 (-1.31)                         | -0.17 (-1.34)                           | 0.07 (0.59)                     | -0.09 (-1.41)                         | 0.04 (0.79)                         | 0.07 (0.66)                          | -0.10 (1.18)                         | 0.05 (0.62)                         |
| Talking about energy saving | -0.01 (-0.05)                         | 0.01 (0.12)                             | 0.11 (0.88)                     | 0.06 (0.66)                           | 0.07 (0.77)                         | 0.02 (0.22)                          | 0.08 (1.19)                          | 0.03 (0.26)                         |
| Age               | -0.16 (-3.50)**                       | -0.18 (-5.42)**                        | -0.27 (-5.71)**                 | 0.00 (0.91)                           | -0.02 (-1.46)                       | 0.02 (0.23)                          | 0.07 (0.64)                          | 0.21 (1.98)                         |
| Educationa        |                                       |                                          |                                 |                                       |                                       |                                      |                                      |                                      |
| (Both) high school | -0.33 (-2.40)*                        | -0.04 (-0.44)                           | 0.06 (0.51)                     | -1.69 (-2.82)**                       | 0.18 (0.30)                         | 0.09 (1.06)                          | 0.04 (0.41)                          | -0.03 (0.35)                        |
| Compulsory school | —                                     | —                                        | —                               | —                                    | —                                    | —                                    | —                                    | —                                    |
| Malea             |                                       |                                          |                                 |                                       |                                       |                                      |                                      |                                      |
| —                 |                                       |                                          |                                 |                                       |                                       |                                      |                                      |                                      |
| Number of cars    | —                                     | 0.46 (4.53)**                           | —                               | —                                    | —                                    | —                                    | 0.30 (3.08)**                       | —                                    |
| n                 | 80                                    | 75                                        | 80                              | 80                                    | 80                                    | 164                                  | 149                                  | 164                                  |
| F(df)/likelihood ratio $\chi^2$(df) | 48.68 (7, 72) | 26.61 (8, 66) | 51.85 (7, 72) | 14.65 (7) | 6.76 (7) | 1.03 (9, 83) | 5.09 (10, 81) | 1.76 (9, 83) |
| Adjusted R$^2$/McFadden’s R$^2$ | 0.09   | 0.17       | 0.06   | 0.15 | 0.07 | 0.01 | 0.20 | 0.07 |

Note. OLS regression (absolute deviation, Models 1a, 2, 3a, 4, 5, and 6), logit regression (relative deviation; 1/0 refer to >10%/≤10% relative deviation between partners, Models 1b and 3b). The table shows standardized regression coefficients (beta values) for the OLS models and unstandardized regression coefficients for the logit models; t-values for OLS models and z values for logit models are given in parentheses. Education: High school refers to the Austrian school-leaving exam required for admission to university studies. Time spent together with the partner was measured in hours on a normal day. Talking about energy saving was measured on a Likert-type scale from 7 = daily to 1 = never. In annual car mileage as driver, seven outliers larger than 26,000 km were excluded from the analysis. Consistency models use household-level predictors; time spent together, talking about energy saving, and age refer to the sum of the answers of both partners. Accuracy models use individual-level predictors of the proxy-reporting person and standard errors clustered on households as the independent units of observation. OLS = ordinary least squares.

*aDummy variables—Reference category for occupation: (both) employed; reference category for education: university level.

*p < .05. **p < .01.
other, the more their everyday practices may have converged. If both partners have a high school educational background, they act more consistently in energy conservation behaviors (Model 1a, $\beta = -0.33$). The more cars are available in the household, the more the partners’ respective mileages as a driver diverge (Model 2, $\beta = -0.46$). A higher number of cars allows for more flexibility in individual mobility options, thus presumably resulting in more heterogeneous travel patterns. All other predictors, most notably those describing the extent of intra-household communication (time spent together, talking about energy saving) do not feature any statistically significant effects on consistency.

Apart from annual car mileage, the models on accuracy do not show any significant effects and explain little variance. Male respondents give less accurate descriptions of their partner’s mileage than do females (Model 5, $\beta = 0.35$); this mimics the effect found in the mean comparisons (see section “Accuracy of Mobility Behavior Proxy-Reports”). A higher number of cars in the household also implies less accurate proxy-reports on mileage (Model 5, $\beta = 0.30$). If partners use separate cars, we may assume that they need less coordination of mobility resources and undertake fewer joint trips, thereby rendering their transport behavior less observable to each other. Again, the predictors on communication within couples are found to be unrelated to accuracy.

Taken together, the determinants available in our study shed little light on the question why some households exhibit higher consistency and accuracy while others do not. Future studies could strive for more detailed indicators of intra-household communication and interaction. Alternatively, approaches for improving consistency and accuracy within households could look whether they achieve varying effects for different household types and deduce relevant determinants from these types’ characteristics.

**Revisiting the Null Hypothesis of Perfect Congruence**

The previous analyses tested the strict null hypothesis that reported behaviors within couples are perfectly congruent, that is, they deviate by 0%. However, there is arguably an expected level of discrepancy as all responses underlie some measurement error. Moreover, some incongruence might be accepted for practical reasons. Therefore, we conducted robustness checks for the consistency analyses, allowing for relative deviations between self-reports of up to 10%. Robustness checks for accuracy are omitted because of limitations in calculating the respective relative deviations (see section “Data Analysis Procedures”).

Tables 1 and 2 report mean relative deviations and the results of one-tailed $t$ tests testing whether the mean relative deviations are significantly higher than 0.1. For almost all items, the statistical tests result in the same conclusion (accepting/rejecting) for the 10% as for the 0% null hypothesis.
To check for robustness in the determinants of consistency, Table 5 gives results of a logit regression explaining whether partners act inconsistently (i.e., deviate by >10%) or not. The logit regression for annual car mileage as a driver is omitted because of insufficient variance, as almost all households deviate by more than 10%. Comparing the models on absolute deviation (Models 1a, 3a) with the models on relative deviation (Models 1b, 3b), we find similarly few statistically significant effects. The effect of age disappears in the models explaining relative deviation, pointing out that age might be a poor indicator of the length of partnership.

Judging from these robustness checks, we are confident in this study’s basic finding of systematic incongruence between household members. However, other studies might be willing to set a threshold of “acceptable” discrepancy higher than 10%. For the index of energy conservation behaviors, Figure O.12 illustrates how the share of households considered congruent rises as we accept an increasing absolute deviation. This plot allows for a “continuous” understanding of consistency and accuracy as opposed to cutoff thresholds required for statistical testing. For example, setting the relaxed assumption that partners may deviate by up to 1.0 scale-points would result in 90% cases considered consistent and accurate in their overall energy conservation behaviors. The steeper the function’s slope, the more critical it is to set a well-founded threshold. Gender-specific bias in proxy-reports is revealed by comparing the functions of males reporting on females versus females reporting on males. Table O.2 lists additional threshold functions for selected items (all available as online appendix).

It is up to every researcher which level of discrepancy to accept within which study context. While we observe little difference between a 0% or 10% threshold, functions as in Figure O.12 may serve as empirical guidance for deciding on a higher threshold. As an alternative to relative thresholds, one step on the five-step rating scale could be seen as an “acceptable” absolute deviation, as this is the smallest resolution in the present operationalization where discrepancies might become visible. However, had the present study used a seven- instead of five-step scale, just selecting another response format would imply a different “acceptable” level. Moreover, the one-step criterion cannot be applied to open-ended measures (e.g., number of baths/showers).

**Limitations**

Our descriptive analysis of the discrepancies between household members is subject to important methodological caveats regarding measurement quality of self-reports and single items, and limitations from the small sample size.
All analyses take the participants’ self-reports as a valid criterion of reference, assuming these self-reports to be unaffected by memory effects, social desirability, impression management, or other forms of response bias. Several studies show that self-reports are imprecise (Kaiser, Frick, & Stoll-Kleemann, 2001; Wolf et al., 2001), even though self-reports tend to be more accurate than proxy-reports (Todorov, 2003). In case of unintentional behaviors (e.g., forgetting to turn off the light upon leaving the room), external observation by a proxy could actually be more precise than self-reports. Social desirability, however, is just moderately interrelated with self-reported pro-environmental behavior ($r = .22$ with general ecological behavior, Schahn & Möllers, 2002; $\beta = .45$ with home-based conservation actions, and $\beta = .04$ to .13 with car use, Bratt, Stern, Matthies, & Nenseth, 2015). Nevertheless, a more reliable assessment of consistency and accuracy within households would require objective behavioral measures such as sub-metering specific electrical appliances or geotracking of everyday mobility. Still, technical sensors require substantial effort in time and money, do not always refer unambiguously to the enacted behaviors and acting persons, and are subject to technical malfunctions. Although self-reports are by their very nature flawed from within-person inaccuracy, they are the prevalent survey method in environmental psychology and as such merit a critical review of how well they reflect the actions of different household members.

The analysis of single items suffers from potential measurement error. Nevertheless, incongruence between partners is observed also in the indices that supposedly feature better reliability, although it is less pronounced as compared with single items. Therefore, it seems plausible to assume that at least some part of the deviations between self- and proxy-reports observed in single items may indeed be attributed to inconsistency and inaccuracy between household members.

The statistical significance of the results underlies some uncertainties: On one hand, the small sample size requires sizable effects to reach statistical significance. Still, power analyses show that our conclusions hold despite the small sample size. On the other hand, the large number of statistical tests introduces cumulative alpha error. However, applying, for example, a Bonferroni correction (Bühner & Ziegler, 2010) would lead to conservative results and a high beta error. Moreover, strictly speaking, the analysis on accuracy does not use 168 independent cases, but clustered data as 84 pairs mutually proxy-reported on each other. Clustered data may underestimate the standard error, which makes statistically significant results more likely. Therefore, we would welcome future studies with larger sample sizes to confirm our findings. Larger samples would also allow conducting group comparisons on how consistency and accuracy vary by length of partnership, living conditions, or other household and person characteristics.
Finally, the employed analysis procedures are subject to some shortcomings. The mean deviations level out the positive or negative direction of the deviation within each pair. Relative deviations allow comparing variables measured on different scales but often exceed 100% and more if the reference value is small. In addition, only households enter the analysis where both partners undertake the specific behavior at least occasionally. For example, half of the surveyed males never operate the household’s washing machine. Still, in the majority of items, this casewise deletion of missing values affects the respective sample sizes only marginally.

Conclusion

Drawing on self- and proxy-reports of 84 male–female couples, this study revealed substantial incongruence between household members. Our data confirm systematic bias in consistency and accuracy between partners for a scope of variables encompassing household energy conservation, mobility behavior, and pro-environmental values. Common methodological standards call for correlations of $r > .40$ with external validity criteria (Bortz & Döring, 2006). Many of the variables reported here fail to achieve this criterion. These discrepancies are even more notable as the surveyed couples share contextual factors that would facilitate consistent action and accurate perceptions: They live in the same situational context in terms of available income, building characteristics, and appliances; if living together for some time, their respective routines and views would have converged at least partially.

In practice, we would hardly expect partners to behave fully consistent and to report perfectly accurate on each other. However, even a robustness check allowing up to 10% deviation between household members yields similar results. Any study that takes an individual’s responses to be representative for the responses of his fellow household members holds the expectation of full consistency and perfect accuracy. It is striking that many studies overlook the substantial and methodological problems arising therefrom such as the following: Individual-level characteristics may poorly explain household-level energy consumption, yielding weak guidance for social marketing campaigns; interventions may have little impact not because they were badly designed but because they reached only part of the household; data collected may be imprecise or biased.

Thus, we strongly caution against employing the responses or actions of an individual person in lieu of the entire household. A household is not a person, but a collective with diverging, sometimes even conflicting interests and behaviors. We give detailed analyses for numerous variables to provide a yardstick for future empirical studies focusing on selected aspects of pro-environmental behavior and values.
Some variables perform better than others. Consistency is higher for couples with “extreme” behaviors (e.g., exclusive car use) if the behaviors are undertaken jointly (e.g., weekend trips) or are negotiated between partners because they directly affect the other’s comfort (e.g., setting the room temperature). Accuracy in proxy-reports is higher for behaviors that follow predictable routines (e.g., work trips) and for behaviors easily observable by the partner (e.g., turning off the light when leaving the room). Indices of energy conservation behavior and pro-environmental values perform better as the aggregation of several items reduces measurement error. If empirical studies cannot survey all household members because of limited resources, we recommend to use primarily variables that are less-biased or to employ indices.

“Extreme,” end-of-spectrum behaviors are considered to be more congruent between partners due to higher observability and predictability. Alternatively, the high overlap in “extreme” behaviors may result from restrictions in living conditions that allow only for very narrow choices that are then emulated by (consistency) and fully transparent to (accuracy) the partner. However, for the “extreme” behaviors found in our study, tilting the window at night and exclusive car use, this alternative interpretation is not supported by the study context: Almost all windows in Austrian buildings can be tilted at will; all respondents live in an urban center with good accessibility to all transport modes. Yet, future research could follow up on the topic how the scope of behavioral options influences the level of concordance within a household.

The present study investigated mainly everyday curtailment behaviors. We would expect higher consistency and accuracy in less habitual behaviors that are performed rarely, such as investing in energy-efficient appliances or building features, as these behaviors are prone to joint discussion and transparency within the household. However, this aspect remains to be elaborated in future studies, as our energy conservation item “considering energy consumption when purchasing household appliances” did not perform substantially better than the other items.

Our results speak not only about discrepancies between household members but also about gender roles within male–female couples. It comes as no surprise that engagement in household chores and use of the family car vary by gender. Still, as couples who live in heterosexual partnerships are the prevalent family situation in many countries, any study on pro-environmental behavior within households will encounter gender-related inconsistencies and inaccuracies. If expanding the research focus from couples to families, we expect that additional discrepancies between parents and their children will emerge (Grønhøj & Thøgersen, 2009). The more people live together in a household, the more difficult it would become that all household members act consistently or that one person can accurately describe the behavior of the entire household.
The evidence that the members of multi-person households pursue energy saving with varying commitment has implications for policy (Munro, 2009). Informative measures, such as energy consulting or energy saving brochures, at least in the Austrian context, usually address the household as a whole or leave it to their contact person to persuade the rest of the family. Instead, these measures should either approach the specific household members undertaking the target behavior or should encourage all household members to agree on a mutual energy saving effort. Our results may provide a guideline of which behaviors are most prone to inconsistency within a household. Addressing these inconsistent behaviors may improve the environmental performance of the entire household if a less pro-environmental person is pulled to the level of energy conservation already shown by more pro-environmental household mates. Future informative measures should consider how members of a household share domestic chores, and in how far they individually feature problem awareness regarding energy saving. Instigating discussions on shared activity schedules and environmental issues within the household could leverage the social fabric between household members for behavioral change. In consequence, joint goal-setting, observational learning, or even reciprocal monitoring, persuasion, and competition between partners may occur.

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Notes

1. The response rate is rather low compared with other social surveys (e.g., 42% of all eligible, reachable households participated in the German ALLBUS survey;
Häder, 2015). Note, however, that the respondents were not offered any incentives for participation. Moreover, to enter the sample, both partners had to agree and to name a joint date for the interview. This made exhausting the sample much more difficult than if needing just the compliance of a single household informant.

2. Further behaviors assessed in the present study but not reported here include environmental activism, additional conservation behaviors (e.g., using CFL bulbs, showering duration, washing the dishes under running water), number and distances of trips for additional purposes (e.g., shopping, escorting a family member), and various indicators that could be derived from the trip diary (e.g., travel mode choice, mobility behavior by specific trip purpose).

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