sustainability

MDPI

Article

Validating the Pro-Environmental Behavior Task in a Japanese Sample

Florian Lange [1,*] and Shimpei Iwasaki [2]

1 Behavioral Engineering Research Group, Faculty of Economics and Business, KU Leuven, 3000 Leuven, Belgium
2 Department of Environmental Science, Fukuoka Women's University, Fukuoka 813-8529, Japan; iwasaki@fwu.ac.jp
* Correspondence: florian.lange@kuleuven.be

Received: 22 October 2020; Accepted: 12 November 2020; Published: 16 November 2020

check for updates

Abstract: Controlled experimentation is critical for understanding the causal determinants of pro-environmental behavior. However, the potential of experimental pro-environmental behavior research is limited by the difficulty to observe pro-environmental behavior under controlled conditions. The Pro-Environmental Behavior Task (PEBT) was developed to address this limitation by facilitating the experimental analysis of pro-environmental behavior in the laboratory. Previous studies in Belgian samples have already supported the validity of the PEBT as a procedure for the study of actual pro-environmental behavior. Here, we aimed for a cross-cultural replication of this finding in a sample of N = 103 Japanese college students. Along the lines of previous studies, we found PEBT choice behavior to be sensitive to within-subject manipulations of its behavioral costs and environmental benefits. This implies that participants take these consequences into account when choosing between PEBT options. In addition, we showed, for the first time, that such consequence effects can also be detected in a less powerful between-subjects design. These results support the generality of consequence effects on PEBT choice behavior as well as the validity and utility of the PEBT for use in samples from different cultural backgrounds.

Keywords: pro-environmental behavior; conservation (ecological behavior); validation; consequences; Pro-Environmental Behavior Task

1. Introduction

People make a lot of choices of environmental relevance. They choose between household devices differing in energy efficiency, between modes of transportation differing in CO_2 emissions, and between political parties differing in their support for environmentally friendly policies. They decide what to eat for dinner, where to go on vacation, when to buy a new phone, how to design their garden, and whether to have children. In many of those domains, people tend to choose options that contribute substantially to global environmental deterioration, climate change, and the loss of biodiversity [1–4]. One possible way to address these issues would be to promote pro-environmental behavior (i.e., the choice of options that provide environmental benefits relative to other options [5]). This strategy requires a thorough understanding of the determinants of pro-environmental behavior.

To establish a given factor as a determinant of pro-environmental behavior, one needs to show that independent variation of the factor functionally relates to variation in pro-environmental behavior. Arguably, this can best be done experimentally. However, due to a number of methodological limitations, experimental research on pro-environmental behavior has not realized its full potential yet. Large parts of pro-environmental behavior research rely on the use of self-report items [6], asking participants, for example, how often they eat meat or which mode of transportation they typically use. In addition to the questionable accuracy of such self-reports, they often render the design of experimental studies problematic [7]. These problems are mitigated when studying actual pro-environmental behavior in field experiments, and, eventually, the practical effectiveness of every intervention for promoting pro-environmental behavior has to be demonstrated in the field. The field might, however, not be the ideal place to study the functional determinants of pro-environmental behavior or to develop and fine-tune new intervention techniques. In field experiments, it is often difficult to manipulate a particular factor without affecting other factors, to randomly assign participants to different experimental conditions, or to reliably track participants throughout the course of the study [7]. This lack of experimental control critically limits the possibility to establish functional relationships between pro-environmental behaviors and their determinants in the field.

The typical limitations of field experiments can be addressed by studying pro-environmental behavior in the laboratory. In the laboratory, researchers can precisely control the events to which participants are exposed and they can objectively observe participants' behavior under controlled circumstances. In addition, laboratory studies on pro-environmental behavior may involve more powerful and elaborated study designs (e.g., repeated-measures designs and parametric manipulations), which can help establish functional relationships between pro-environmental behavior and its determinants. Based on the resulting knowledge, novel intervention techniques can then be tested and optimized in the laboratory, where their robustness and side effects can be examined before researchers embark on more costly field trials (see also [8]).

Whether the experimental control characteristic of the lab can be used to further our understanding of pro-environmental behavior depends, of course, on the availability of valid laboratory procedures for the study of pro-environmental behavior. With the Pro-Environmental Behavior Task (PEBT), Lange and colleagues [6] have recently developed a computerized choice procedure to facilitate the laboratory analysis of pro-environmental behavior. The PEBT involves a series of choices between a pro-environmental and an environmentally harmful response option. These options are linked to actual consequences for both the participant and the natural environment. In general, choosing the pro-environmental over the environmentally harmful option increases the time participants have to wait before they can proceed to the next choice. This implies that participants who choose the environmentally harmful option can save actual waiting time (and leave the laboratory earlier) in comparison to participants who choose the pro-environmental option. However, by choosing the environmentally harmful option, participants turn on an additional set of lights and thus waste a small amount of energy. In other words, participants can minimize either the time they spend on the task or the amount of energy that is wasted during their participation. In what follows, we will discuss whether this choice qualifies as an act of actual pro-environmental behavior and thus whether the PEBT allows for the valid study of pro-environmental behavior in the laboratory.

1.1. On the Importance of Consequences

Whether a laboratory choice procedure can yield valid information regarding everyday behaviors depends on the consequences it involves [9–11]. Hypothetical laboratory choices or responses to self-report items might not be very informative in this respect as they do not relate to the same consequences as the everyday behavior of interest [7]. When confronted with the item "I am willing to reduce my car use behavior," for example, participants do not have to incur behavioral costs when choosing "fully agree" over "rather disagree." Assuming that reductions of car use in everyday life involve such costs, it would seem questionable to generalize any results obtained with such an item to everyday car use behavior.

In contrast, choosing the pro-environmental response option on the PEBT involves actual costs for the participants: they have to incur an additional amount of waiting time. These behavioral costs render laboratory PEBT choices potentially informative for the understanding of everyday behaviors (i.e., they are more than "cheap talk"). However, as PEBT waiting time costs are typically in the range of seconds, one may argue that they are too negligible to yield informative results about everyday pro-environmental behaviors. This concern can be addressed empirically by manipulating the waiting time costs (in the range of seconds) and examining whether participants' choice behavior varies accordingly. Empirical tests in Belgian samples have found this to be the case: participants were less likely to choose the pro-environmental option when this involved larger waiting time costs [6,12]. This finding suggests that the PEBT involves non-trivial behavioral costs that render the task potentially informative for the understanding of everyday behaviors. It has, however, not been replicated in non-Belgian samples yet.

Linking PEBT choice behavior to actual behavioral costs is necessary but not sufficient for it to be a meaningful instance of actual pro-environmental behavior. To be considered pro-environmental, behaviors need to relate to a particular type of consequence: environmental benefits. Different definitions of pro-environmental behavior differ in how they specify this relationship between behavior and environmental benefits. In the following, we will analyze whether PEBT choice behavior meets these definitions of pro-environmental behavior by examining its relationship to environmental consequences.

Pro-environmental behavior is typically defined in either impact-oriented or intent-oriented terms [13]. From an impact-oriented perspective, behavior is regarded as pro-environmental whenever it provides any relative benefits for the environment (i.e., when it increases environmental benefits or reduces environmental harm relative to an alternative behavior [5]). Choosing the pro-environmental option on the PEBT clearly meets this criterion: it prevents a series of lights from being illuminated and thus saves energy and the associated CO_2 emissions. These savings may be small in absolute terms, but from an impact-oriented perspective, it only matters that they differ between the available PEBT options. Whether they are large enough to affect participants' behavior becomes relevant when defining pro-environmental behavior in intent-related terms.

From an intent-oriented perspective, behavior is regarded as pro-environmental when it is enacted with the intention to benefit the environment, that is, because of the environmental benefits it produces. Whether PEBT choice behavior is pro-environmental in that sense is an empirical question. It may be addressed by asking participants to report the reason for their behavior, but their ability to do so in a reliable way seems limited (e.g., [14–16]). Alternatively, this question could be addressed by testing if the behavior in question is sensitive to variations of the environmental consequences it produces. If a behavior is shown because of its environmental consequences, it should become less likely to occur when these consequences are devalued. If people, for example, place polystyrene in the recycling bin for environmental reasons, they should stop doing so after learning that this material cannot be recycled (in their area). Similarly, if the pro-environmental PEBT option is chosen because of its environmental benefits (i.e., if it is a pro-environmental behavior according to the intent-oriented view), the likelihood of it to be shown should decrease with its environmental benefits. Previous studies in Belgian samples have tested this possibility by manipulating the number of lights that are illuminated by choosing the environmentally harmful PEBT option. They typically find the likelihood of choosing the pro-environmental option to increase when choosing the environmental harmful option would turn on a larger number of lights [6,12] and thus suggest that PEBT choice behavior is indeed sensitive to its environmental consequences. Yet, replication of this finding outside the Belgian population is still pending.

1.2. The Present Study

The present study was designed to replicate the effects of behavioral costs and environmental benefits on PEBT choice behavior in a Japanese sample. By this mean, we aimed to test the generality of these consequence effects and thus to further probe the validity of the PEBT as a procedure that elicits actual pro-environmental behavior. As in previous studies with Belgian samples, we investigated these effects using within-subject manipulations of (a) the waiting time costs participants have to endure when choosing the pro-environmental PEBT option and (b) the number of lights that are illuminated by choosing the environmentally harmful PEBT option. In addition, we examined whether these effects can also be detected (a) in a between-subjects design and (b) on the level of individual participants. These analyses can reveal the degree to which effects of behavioral costs and environmental benefits can be studied in alternative research designs. Support for the feasibility of such designs will increase the opportunities for future research on the effects of consequences on pro-environmental behavior.

2. Materials and Methods

A total of 103 female students of Fukuoka Women's University participated in the present study. We aimed at the same target sample size as Lange and colleagues (i.e., N = 120 [6]), but had to stop sampling before reaching that target due to a lack of participant availability. Participants' ages ranged between 18 and 23 years. At the time of the study (July to October 2019), all participants were staying at a dormitory at the university. Most participants (n = 54) were in their fourth year at the university (1st year: n = 12; 2nd year: n = 11; 3rd year: n = 24, 5th year: n = 2). The study was approved by the local ethics committee. All participants provided informed consent and received a gift card equivalent to JPY 500 (approx. EUR 4.10 or USD 4.80) for their participation.

Participants completed the study individually in a normally illuminated room on the university campus. They completed the 72-trial PEBT version used in the second study reported by Lange et al. [6], administered in English. The PEBT was implemented in OpenSesame version 3.1.4 [17] and run on a laptop with a 14.1-inch screen. On each trial of the task, participants were asked to make a choice between two transportation options. Pseudowords (labeled "SEST" and "DIFT") were used as labels for these options. Lange and colleagues selected these labels based on a pretest suggesting that these pseudowords do not differ much in the connotations they evoke. The choice of labels was found to be largely irrelevant for observing effects of waiting time costs and environmental benefits on PEBT choice behavior [6].

After indicating their choice (per mouse click), participants had to wait between 5 and 50 s before they were presented with the next choice. The waiting time associated with choosing the DIFT option was either 5, 10, 15, or 20 s. Waiting times associated with choosing the SEST option were either 0, 5, 10, 15, 20, or 30 s longer, resulting in a total of 24 combinations. Each combination was presented three times, in three separate blocks of trials. The order of combinations within each block was randomized for each participant. Whenever participants chose the DIFT option, a series of USB-powered lights was illuminated for the duration of the waiting period. The number of lights to be illuminated (four vs. eight vs. twelve) was varied between blocks and the order of blocks was counterbalanced across participants. On each choice display (see Figure 1, for an example), participants were informed about the waiting times associated with choosing the DIFT and the SEST option, the difference in waiting times (i.e., the waiting time costs related to the choice of the SEST option), the number of lights to be illuminated, and the approximate amount of CO_2 emissions produced by illuminating those lights (3000 vs. 6000 vs. 9000 mg/h). To facilitate the interpretation of CO_2 emissions, we also mentioned whether choosing the DIFT option would consume a "relatively large" (12 lights), "medium" (8 lights), or "relatively small" amount of energy (4 lights). Note that the CO_2 emission information given to participants were rough estimates based on the Belgian electricity generation mix in 2015. Actual DIFT-related emissions in the present study might have deviated from these values. Participants were not informed about any other environmental consequences of their behavior and we cannot exclude that some participants might have reasoned that going through the task quickly would actually save energy (e.g., by reducing the time the lab is running). Such a reasoning could undermine the usefulness of the PEBT as participants would not have to trade off personal and environmental consequences anymore: participants could choose the DIFT option to save time and to save the energy that is required to keep the lab equipment running. However, we did not find any evidence for such a reasoning in the present study (i.e., no participant exclusively chose the DIFT option, see Results section).

Before the first trial, participants were presented with general instructions and an example explaining the task contingencies as described by [6]. After the last PEBT trial, participants completed several Japanese translations of self-report scales for the assessment of psychological constructs related to pro-environmental behavior. Some of these scales were positively related to participants' PEBT choice behavior, but as the psychometric quality of the translated measures seemed insufficient (e.g., internal consistency was $\alpha = 0.69$ for the Environmental Attitudes Inventory and $\alpha = 0.40$ for the New Ecological Paradigm), we decided not to include them in the present analysis.

The proportion of choices of the pro-environmental SEST option (i.e., choices that prevent the illumination of additional lights) served as the outcome measure for this study. It was analyzed as a function of waiting time costs (i.e., the waiting time difference between the SEST and the DIFT option) and the amount of CO_2 emissions produced (i.e., the number of lights to be illuminated) by choosing the DIFT option. All data and analysis scripts as well as the OpenSesame script of the PEBT version used in this study can be found at https://osf.io/vxpmq/.

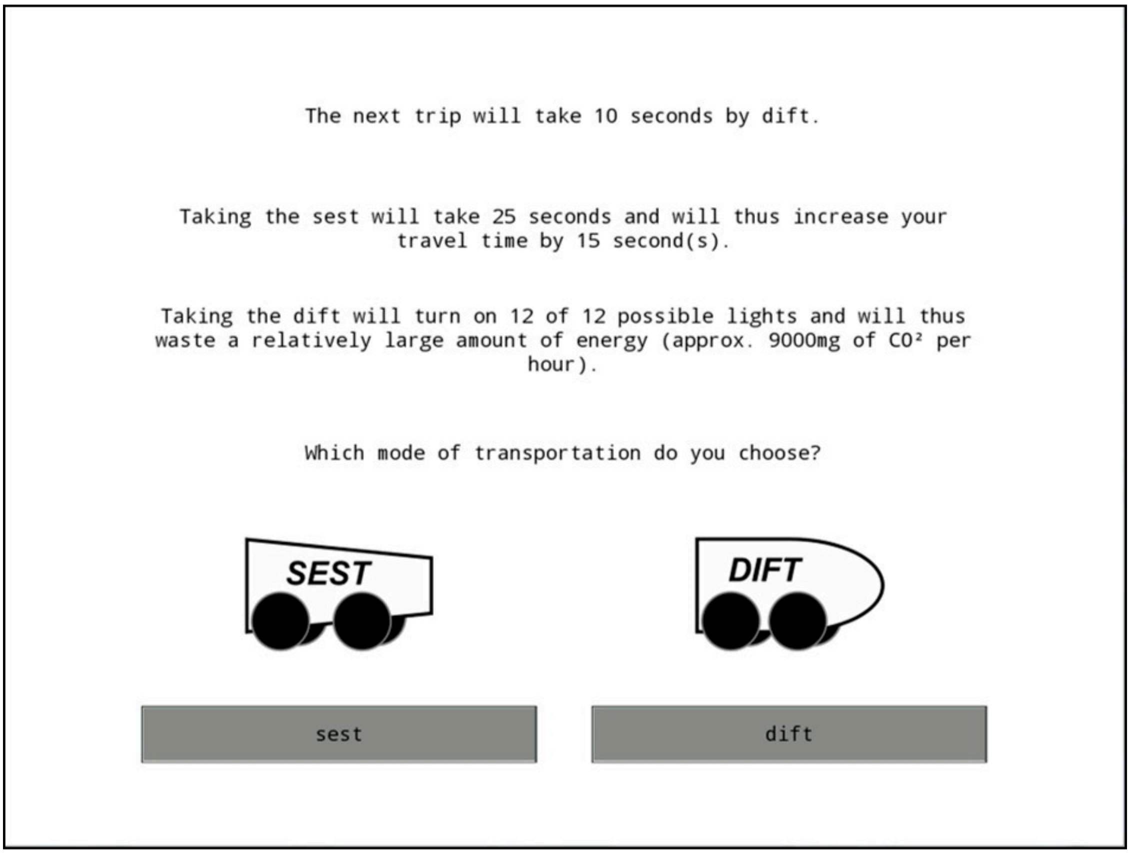

Figure 1. Example of the choices presented in the Pro-Environmental Behavior Task (PEBT).

3. Results

On average, participants chose the pro-environmental SEST option on 66% of the trials (SD = 20%), 95% CI (62%, 70%). The proportion of SEST choices ranged from 15% to 100%: Six participants chose that option on all 72 trials; no participant exclusively chose the environmentally harmful DIFT option. Inspection of the data did not reveal severe deviations from normality (skewness = −0.18, kurtosis = −0.52). Participants' choice behavior across the 72 PEBT trials was highly consistent, as indicated by Cronbach's alpha of $\alpha = 0.96$ and a Spearman–Brown-corrected split-half reliability (across test halves that were matched for waiting time costs and CO_2 emissions) of 0.98. The overall proportion of pro-environmental SEST choices was slightly higher in more senior students, but this relationship was not statistically significant, $r_s = 0.15$, 95% CI (−0.05, 0.33).

To examine the effect of *within-subject variations* of behavioral costs (i.e., added waiting times) and environmental benefits (i.e., saved energy and CO_2 emissions), we first subjected the proportion of pro-environmental SEST choices to two separate repeated-measures ANOVAs (with Greenhouse–Geisser corrected degrees of freedom). The first ANOVA, analyzing the effect of the waiting time difference between the SEST and the DIFT option (0, 5, 10, 15, 20, 30 s), revealed a strong effect of that factor on the proportion of pro-environmental SEST choices, F (5, 237.65) = 183.91, $p < 0.001$, $\eta_p{}^2 = 0.64$, 95% CI (0.60, 0.68). Inspection of Figure 2 reveals a monotonic decrease of the proportion of pro-environmental choices from small to large waiting time costs. The second ANOVA analyzed the effect of the amount of CO_2 emissions (3000, 6000, 9000 mg/h; manipulated via the number of illuminated lights: 4, 8, 12) associated with choosing the DIFT option. This factor exerted a significant effect on the proportion of pro-environmental SEST choices as well, F (2, 191.87) = 27.67, $p < 0.001$, $\eta_p{}^2 = 0.21$, 95% CI (0.12, 0.30). As can be seen in Figure 2, the proportion of pro-environmental choices increased monotonically from small to large amounts of CO_2 emissions.

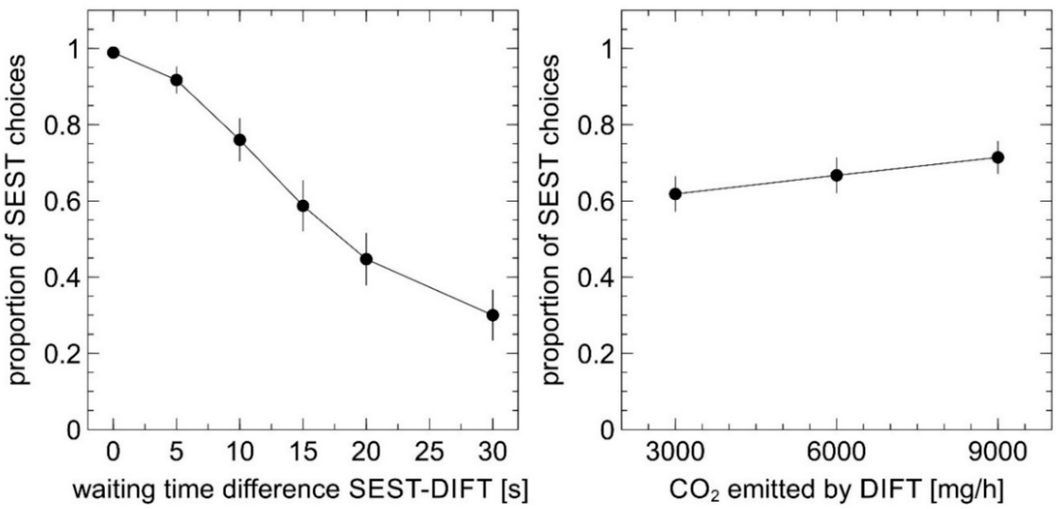

Figure 2. Within-subject effects of behavioral costs and environmental benefits on choice behavior on the Pro-Environmental Behavior Task (PEBT). The proportion of pro-environmental SEST choices is presented as a function of the waiting time difference between the pro-environmental SEST option and the environmentally harmful DIFT option (**left**) and as a function of the amount of CO_2 emissions (manipulated via the number of illuminated lights) associated with the environmentally harmful DIFT option (**right**). Vertical bars indicate 95% confidence intervals.

As a *robustness check*, we repeated these analyses using a logistic regression model with the within-subject factors being waiting time costs (0, 5, 10, 15, 20, 30 s) and number of lights (4, 8, 12). These analyses yielded similar results. The likelihood of choosing the pro-environmental SEST option decreased with increasing waiting time costs, $b = -0.07$, 95% CI (−0.07, −0.06), $\chi^2(1) = 431.67$, and it increased when choosing the DIFT option related to the illumination of a larger number of lights, $b = 0.03$, 95% CI (0.03, 0.04), $\chi^2(1) = 120.48$. These results did not change when trial order was added to the model as another within-subject factor. The effects of waiting time costs, $b = -0.07$, 95% CI (−0.07, −0.06), $\chi^2(1) = 431.40$, and number of lights, $b = 0.03$, 95% CI (0.03, 0.04), $\chi^2(1) = 120.98$, remained substantial, whereas the position of a trial within the 72-trial sequence did not significantly predict participants' choice behavior, $b = 0.00$, 95% CI (0.00, 0.00), $\chi^2(1) = 0.06$ (cf. [18]).

Next, we examined the effects of waiting time costs and number of lights *for each individual participant* using Mantel–Haenszel chi-square tests, a procedure testing for linear trends in proportional data. As for many participants expected counts for many cells were smaller than five, we used an exact version of this test. For the six participants who always chose the SEST option, this test statistic could not be computed (i.e., their choice behavior was constant and thus necessarily independent from variations in waiting time costs and number of lights). Among the remaining 97 participants, the proportion of SEST choices significantly ($p < 0.05$, one-sided) decreased with increasing waiting times for 90 participants. Moreover, the proportion of SEST choices significantly ($p < 0.05$, one-sided) increased when choosing the DIFT option related to the illumination of a larger number of lights in 15 participants. In other words, individual choice behavior was found to be sensitive to waiting time variations in 87% of our participants and to be sensitive to variations in CO_2 emissions in 15% of our participants. Figure 3 reveals that only few individual-level effect sizes were in the opposite direction from the overall consequence effects found in the group-wide within-subject analyses. Only one participant chose the SEST option significantly more often when waiting time costs increased, and no participants showed significant decreases in SEST choices with increasing numbers of illuminated lights.

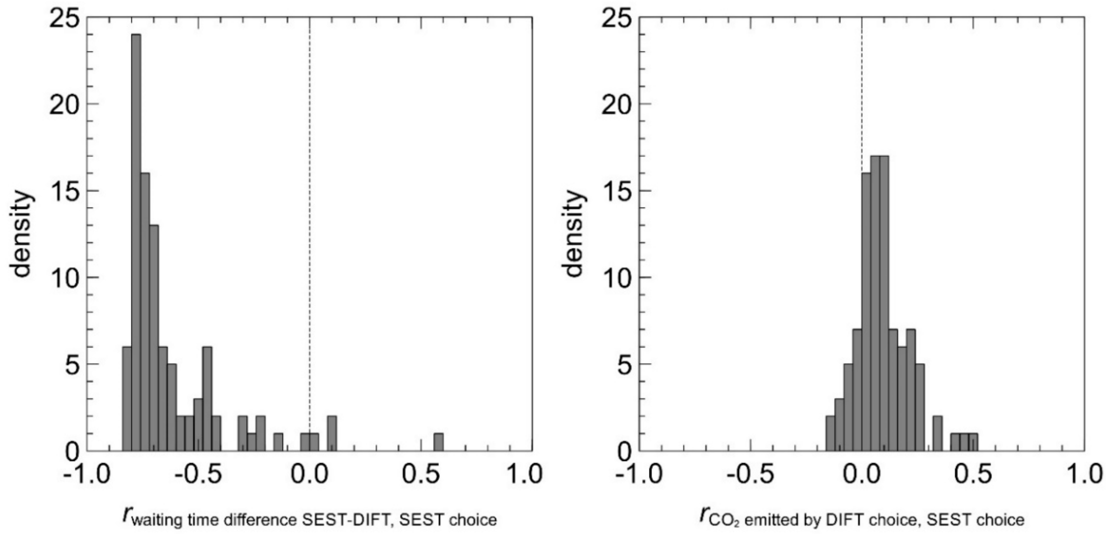

Figure 3. Individual-level effects of behavioral costs and environmental benefits on PEBT choice behavior. The distribution of correlation coefficients (r) as an effect-size measure is displayed for the effect of the waiting time difference between the pro-environmental SEST option and the environmentally harmful DIFT option (**left**) and for the effect of the amount of CO_2 emissions (manipulated via the number of illuminated lights) associated with the environmentally harmful option (**right**). Outcome measure was the choice of the pro-environmental SEST option on the Pro-Environmental Behavior Task (PEBT; 0 = no, 1 = yes).

Finally, we examined the effects of waiting time costs and number of lights in a *between-subjects* design. Because of our randomization procedures, participants encountered a waiting time difference of either 0 (n = 15), 5 (n = 28), 10 (n = 16), 15 (n = 12), 20 (n = 17), or 30 s (n = 15) on the very first trial of the PEBT. Similarly, they started the task with either a 4-light trial (n = 34), an 8-light trial (n = 37), or a 12-light trial (n = 32). By comparing the proportion of SEST choices on the first PEBT trial across these groups (using exact Mantel–Haenszel tests), we were thus able to conduct between-subjects tests of the effects of waiting time costs and number of lights. On the first trial of the task, a smaller proportion of participants chose the pro-environmental SEST option when this trial was randomly assigned to a larger waiting time difference, $Q_{MH} = 12.28$, $p < 0.001$ (one-sided), $r = -0.35$, 95% CI (−0.51, −0.17). Similarly, the more lights that were illuminated by a choice of the DIFT option on the first trial of the task, the higher the proportion of participants who chose the SEST option, $Q_{MH} = 4.34$, $p = 0.025$ (one-sided), $r = 0.21$, 95% CI (0.01, 0.38). Hence, the effect of both consequences on PEBT choice behavior also emerged when tested in a between-subjects design using the information from only the very first PEBT trial (see Figure 4).

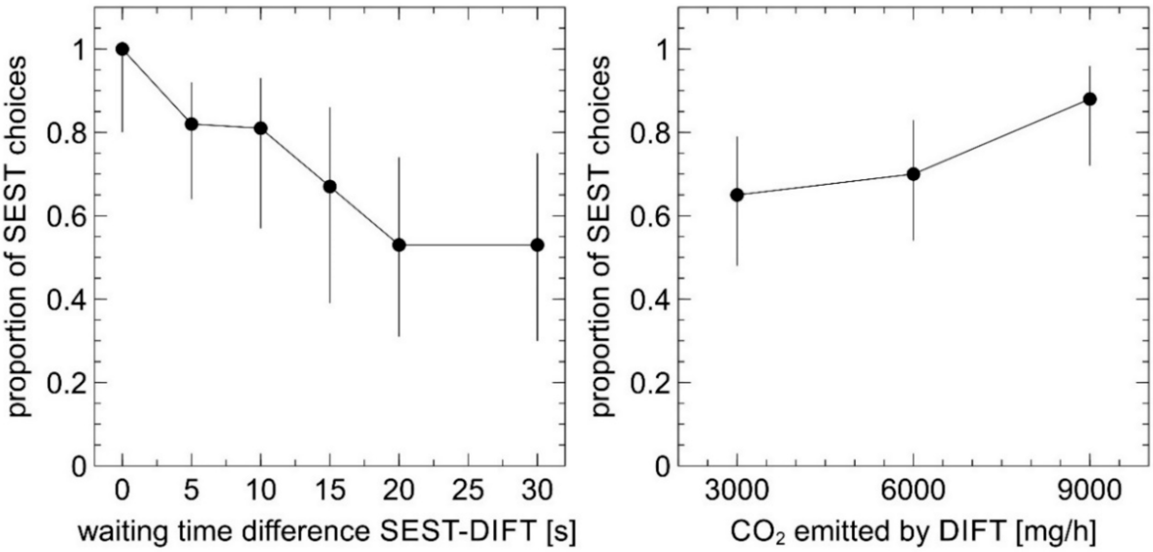

Figure 4. Between-subjects effects of behavioral costs and environmental benefits on choice behavior on the Pro-Environmental Behavior Task (PEBT). The proportion of pro-environmental SEST choices on the first PEBT trial is presented as a function of the waiting time difference between the pro-environmental SEST option and the environmentally harmful DIFT option (**left**) and as a function of the amount of CO_2 emissions (operationalized via the number of illuminated lights) associated with the environmentally harmful option (**right**). Vertical bars indicate 95% confidence intervals.

4. Discussion

In a sample of Japanese college students, we found choice behavior on the recently developed PEBT to be sensitive to its behavioral costs and environmental benefits. Replicating the results of previous studies in Belgian samples, experimental manipulation of these consequences markedly affected PEBT choices when examined in a within-subject design. In addition, we showed, for the first time, that such consequence effects can also be detected in a (statistically less powerful) between-subjects design. These results support the generality of consequence effects on PEBT choice behavior and thus the validity and utility of the PEBT as a procedure for the study of actual pro-environmental behavior.

The finding that the consequences implemented in the PEBT systematically affect participants' choice behavior has several implications. First, observing that pro-environmental PEBT choices become less likely when they relate to larger waiting times implies that the implemented waiting time costs of not more than 30 s function as a meaningful obstacle to pro-environmental behavior. Just like most other pro-environmental behaviors (and in contrast to hypothetical choices), choosing the pro-environmental PEBT option appears to involve non-trivial costs. As a consequence, results obtained using the PEBT are likely to be more informative with regard to the analysis of other costly pro-environmental behaviors than results obtained using hypothetical choices (or other non-consequential measures, e.g., [9,19]).

Second, finding PEBT choice behavior to be affected by its environmental consequences indicates that this behavior is pro-environmental not only according to impact-oriented definitions, but also according to intent-oriented definitions. In general, participants on the PEBT seem to choose for the pro-environmental response option because of the environmental benefits this choice produces. If these benefits are reduced, the pro-environmental PEBT option becomes less likely to be chosen. This result renders the PEBT informative for further analysis of the effects of environmental consequences on pro-environmental behavior. For example, it is often attempted to promote pro-environmental behavior by making its environmental consequences more salient using feedback interventions (e.g., [20,21]). However, based on the available evidence, it is still largely unclear how environmental consequence feedback should be designed and provided in order to be most effective as a behavior change technique. In view of its general sensitivity to environmental consequences, PEBT choice behavior may provide a suitable experimental model for studying the effects of feedback parameters and design features under controlled conditions. Using the PEBT, feedback interventions may first be optimized through a systematic and cumulative analysis in the laboratory before being tested for their practical relevance in field settings.

The present study also makes several contributions to the generality of consequence effects on PEBT choice behavior. First, in line with the call for more cross-cultural research in environmental psychology [22], we showed that consequence effects are replicable in another cultural context. Moreover, the sizes of both the effect of behavioral costs (Belgium: ${\eta_p}^2$ = 0.63, Japan: ${\eta_p}^2$ = 0.64) and the effect of environmental benefits (Belgium: ${\eta_p}^2$ = 0.20, Japan: ${\eta_p}^2$ = 0.21) were very similar across samples. This finding is important as it cannot be taken for granted that the behavior of individuals from different backgrounds is sensitive to the same kind of consequences. As a function of their background, participants may, for example, consider the waiting time costs or energy savings related to PEBT choice behavior negligible. While a single cross-cultural replication does not rule out this possibility in general, it does validate the PEBT as a procedure to study pro-environmental behavior not only in Belgium, but also in female Japanese college students.

Second, we found that PEBT choice behavior was sensitive to these consequences not only in a powerful within-subject design, but also when analyzing behavior between-subjects on the very first trial of the task. Across trials of the PEBT, consequence changes are very salient: the only thing that changes across trials is the number of lights to be illuminated and the waiting time costs associated with the PEBT options. This salience of differences in consequences may facilitate the detection of corresponding differences in participants' behavior. Performance on the first trial of the task may provide more conservative effect-size estimates as consequences may be less salient when they have not yet been observed to vary. The fact that consequence effects can be detected, nonetheless, on the first PEBT trial, provides additional opportunities for researchers interested in these effects and their moderation. It suggests, for example, that the effects of behavioral costs and environmental benefits on pro-environmental behavior can also be tested between-subjects when carry-over effects may render an alternative within-subject design problematic.

Third, future research might also benefit from the demonstrated possibility to study consequence effects on the level of individual participants. The current 72-trial version of the PEBT allowed to detect significant effects of waiting time costs in the majority (87%) of participants. It is likely that this number can be further increased by increasing the number of trials and the range of waiting time costs. This suggests that the PEBT can also be used to study the effect of waiting time consequences in single-subject research designs [23]. In contrast, the effect of environmental consequences reached individual-level statistical significance in fewer participants (Figure 3). This effect might be detected more reliably on the level of individual participants when environmental consequences are varied from trial to trial (as were waiting time consequences in our study) rather that between blocks of trials.

A question that remains unaddressed in the present study is whether the results obtained with the PEBT generalize to other pro-environmental behaviors. This question can be asked in two different ways. First, one may wonder if people who behave pro-environmentally on the PEBT also behave pro-environmentally in other domains (i.e., outside the laboratory). This is essentially a question of construct validity, asking if the PEBT can reliably distinguish participants through measuring a somewhat generalized propensity to behave pro-environmentally (see also [7]). Previous studies in Belgian samples have revealed some support for the construct validity of the task as an indicator of such a propensity. Individual differences in PEBT choice behavior are typically found to be moderately related to individual differences in other pro-environmental behaviors [6,18]. Additional replications and extensions of this finding (also outside of Belgium) would be necessary to further probe the construct validity of the PEBT.

A second way to ask about the generalizability of PEBT results refers to the external (or ecological) validity of experiments conducted with the PEBT as an outcome measure. The external validity of experimental PEBT results depends on the degree to which other choice situations of environmental relevance involve the same contingencies (or "critical theoretical parameters"; [24], p. 432) as the PEBT [12,25]. On the PEBT, choosing the pro-environmental option relates to non-trivial waiting time costs and energy savings. Manipulations that, for example, decrease the aversiveness of waiting (e.g., letting participants watch movies while waiting for the next trial) may promote pro-environmental behavior through modifying PEBT contingencies. If this hypothesis is supported in a laboratory PEBT study, generalization can be expected to other situations that involve similar contingencies and where a similar manipulation would affect contingencies in a similar way (e.g., screening movies on public transport). Generalization cannot be expected, however, when environmentally relevant choices involve other contingencies (i.e., contingencies that are not affected by the manipulation). For example, based on the hypothetical PEBT results sketched above, we would not expect that screening movies in a grocery store would affect the choice between organic and conventional products. A careful analysis of the contingencies involved in the choice to which results are supposed to generalize is thus critical for gauging the external validity of PEBT results. Depending on the choice of interest, the PEBT might also be adapted to reflect the contingencies involved in that choice (e.g., by linking pro-environmental behavior to a different type of costs).

The presented support of the validity of the PEBT in a different cultural setting (i.e., Japan) is limited by the use of a female student sample. Further replication in more diverse or representative samples is desirable. Of particular interest is the analysis of consequence effects in samples of people who report not to care about the environmental consequences of their behavior (or who place less value on time). In addition, it should be noted that, as in previous studies, PEBT instructions were not administered in participants' first language. While we cannot exclude that this design choice affected participants' understanding of the PEBT instructions, we think that participants' behavior on the task is an indication of their insight into task contingencies. It is one of the advantages of the PEBT that participants do not have to rely on their understanding of verbal task instructions. They directly experience the consequences of their behavior, and we found their behavior to be sensitive to these consequences, both in the present experiment and in previous studies. Finally, future PEBT studies may benefit from increasing the parameter range of waiting time costs and environmental benefits to improve the detectability of consequence effects. By this means, it can also be tested whether there is a subset of participants who are entirely insensitive to the PEBT consequences. As in previous studies, we found a small percentage of participants who always chose the pro-environmental PEBT option, irrespective of the associated waiting time costs. A follow-up study involving longer waiting times may reveal if this type of behavior is truly insensitive to consequences (i.e., habitual, [26]) or only across a range of relatively mild consequences.

Author Contributions: Conceptualization, F.L. and S.I.; methodology, F.L.; data curation, S.I. and F.L.; data analysis, F.L.; writing—original draft preparation, F.L.; writing—review and editing, F.L and S.I. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the FWO and European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 665501 and by a FWO postdoctoral fellowship (No 12U1221N, awarded to F.L.).

Acknowledgments: The authors thank Kurumi Goto for collecting the data and Siegfried Dewitte for helpful comments on an earlier version of this manuscript.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. IPCC. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. 2014. Available online: https://www.ipcc.ch/report/ar5/syr/ (accessed on 19 October 2020).
2. Ripple, W.J.; Wolf, C.; Newsome, T.M.; Galetti, M.; Alamgir, M.; Crist, E.; Mahmoud, M.I.; Laurance, W.F.; Coudrain, A.; Catry, T.; et al. World scientists' warning to humanity: A second notice. *BioScience* **2017**, *67*, 1026–1028. [CrossRef]
3. Wilson, E.O. The current state of biological diversity. In *Biodiversity*; Wilson, E.O., Peter, F.M., Eds.; National Academy Press: Washington, DC, USA, 1988; pp. 3–18.
4. Wynes, S.; Nicholas, K.A. The climate mitigation gap: Education and government recommendations miss the most effective individual actions. *Environ. Res. Lett.* **2017**, *12*, 074024. [CrossRef]
5. Steg, L.; Vlek, C. Encouraging pro-environmental behaviour: An integrative review and research agenda. *J. Environ. Psychol.* **2009**, *29*, 309–317. [CrossRef]
6. Lange, F.; Steinke, A.; Dewitte, S. The Pro-Environmental Behavior Task: A laboratory measure of actual pro-environmental behavior. *J. Environ. Psychol.* **2018**, *56*, 46–54. [CrossRef]
7. Lange, F.; Dewitte, S. Measuring pro-environmental behavior: Review and recommendations. *J. Environ. Psychol.* **2019**, *63*, 92–100. [CrossRef]
8. IJzerman, H.; Lewis, N.A.; Przybylski, A.K.; Weinstein, N.; DeBruine, L.; Ritchie, S.J.; Vazire, S.; Forscher, P.S.; Morey, R.D.; Ivory, J.D.L.; et al. Use caution when applying behavioural science to policy. *Nat. Hum. Behav.* **2020**, *4*, 1092–1094. [CrossRef]
9. Klein, S.A.; Hilbig, B.E. On the lack of real consequences in consumer choice research: And its consequences. *Exp. Psychol.* **2019**, *66*, 68–76. [CrossRef] [PubMed]
10. Lewandowski, G.W., Jr.; Strohmetz, D.B. Actions can speak as loud as words: Measuring behavior in psychological science. *Soc. Pers. Psychol. Compass* **2009**, *3*, 992–1002. [CrossRef]
11. Morales, A.C.; Amir, O.; Lee, L. Keeping it real in experimental research—Understanding when, where, and how to enhance realism and measure consumer behavior. *J. Consum. Res.* **2017**, *44*, 465–476. [CrossRef]
12. Lange, F.; Brick, C.; Dewitte, S. Green when seen? No support for an effect of observability on environmental conservation in the laboratory: A registered report. *R. Soc. Open Sci.* **2020**, *7*, 190189. [CrossRef]
13. Stern, P.C. New environmental theories: Toward a coherent theory of environmentally significant behavior. *J. Soc. Issues* **2000**, *56*, 407–424. [CrossRef]
14. Goddard, M.J. On certain similarities between mainstream psychology and the writings of B.F. Skinner. *Psychol. Rec.* **2012**, *62*, 563–576. [CrossRef]
15. Nisbett, R.E.; Wilson, T.D. Telling more than we can know: Verbal reports on mental processes. *Psychol. Rev.* **1977**, *84*, 231–259. [CrossRef]
16. Skinner, B.F. Whatever happened to psychology as the science of behavior? *Am. Psychol.* **1987**, *42*, 780–786. [CrossRef]
17. Mathôt, S.; Schreij, D.; Theeuwes, J. OpenSesame: An open-source, graphical experiment builder for the social sciences. *Behav. Res. Methods* **2012**, *44*, 314–324. [CrossRef] [PubMed]
18. Lange, F.; Dewitte, S. Cognitive flexibility and pro-environmental behaviour: A multimethod approach. *Eur. J. Pers.* **2019**, *33*, 488–505. [CrossRef]
19. Herziger, A.; Hoelzl, E. Underestimated Habits: Hypothetical Choice Design in Consumer Research. *J. Assoc. Consum. Res.* **2017**, *2*, 359–370. [CrossRef]
20. Karlin, B.; Zinger, J.F.; Ford, R. The effects of feedback on energy conservation: A meta-analysis. *Psychol. Bull.* **2015**, *141*, 1205–1227. [CrossRef]
21. Tiefenbeck, V.; Goette, L.; Degen, K.; Tasic, V.; Fleisch, E.; Lalive, R.; Staake, T. Overcoming salience bias: How real-time feedback fosters resource conservation. *Manag. Sci.* **2018**, *64*, 1458–1476. [CrossRef]
22. Tam, K.-P.; Milfont, T.L. Towards cross-cultural environmental psychology: A state-of-the-art review and recommendations. *J. Environ. Psychol.* **2020**, *71*, 101474. [CrossRef]
23. Kratochwill, T.R. *Single Subject Research: Strategies for Evaluating Change*; Academic Press: New York, NY, USA, 1978.
24. Schmuckler, M.A. What is ecological validity? A dimensional analysis. *Infancy* **2001**, *2*, 419–436. [CrossRef]

25. Lange, F.; Dewitte, S. Positive Affect and Pro-environmental Behavior: A preregistered experiment. *J. Econ. Psychol.* **2020**, *80*, 102291. [CrossRef]
26. Wood, W.; Rünger, D. Psychology of habit. *Annu. Rev. Psychol.* **2016**, *67*, 289–314. [CrossRef] [PubMed]

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.