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Moral Licensing and Rebound Effects in the residential lighting area - an experimental study

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Abstract

Rebound effects reduce the energy demand reduction from energy efficiency increases. Understanding the underlying mechanisms is therefore crucial. A potential driver is moral licensing, a cognitive process by which individuals justify immoral behaviour (e.g., using more and brighter lights) by having previously engaged in moral behaviour (e.g., switching to a more efficient lighting). Since empirical research on this topic is rare, we conducted an experimental study: Participants (n=491) chose between three LEDs, which were all more energy-efficient than their current one. For investigating moral licensing, the perceived environmental behaviour of the participants was manipulated by a previous assessment of their own past environmental behaviour: Treatment *easy (1)* provided the impression of highly environmental behaviours, treatment *difficult (2)* the impression of a less environmentally friendly behaviour. A *control group (3)* focused on leisure time behaviours. Overall, we are able to demonstrate rebound effects in LED choice and find effects of the manipulation on the moral self-perception. However, we do not find significant patterns regarding treatment condition and LED choice. On the contrary, in both treatments, *easy (1)* and *difficult (2)*, individuals tended to show more environmental friendly choices. These results suggest that bringing environmental behaviours to people's mind could contribute to weakening rebound effects in general.

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1 Introduction and research question

More energy-efficient technologies are seen as a solution to reduce global resource consumption. They are regarded as a "win-win" concept because they lead to both economic and environmentally friendly progress (Dahmus, 2014). For example, the transition from a six-litre engine to a three-litre engine enables an enormous reduction in fuel consumption per 100 km driven. However, scientific findings show that more energy-efficient technologies do not necessarily induce lower consumption of resources, but can even increase consumption (Azevedo, 2014). In 1865, Jevons stated that the development of new technologies such as the Stirling engine did not lead to a reduction in coal consumption, but even led to an increase in coal consumption (Azevedo, 2014). This phenomenon resulting from a change in behaviour in response to the use of a more energy-efficient technology is called rebound effect (R) and can be formally defined as follows:

$$R = \frac{PES - AES}{PES} = 1 - \frac{AES}{PES}$$

R denotes the relative gap between potential energy saving (PES) due to an increase in energy efficiency and actual energy saving (AES) (Dütschke, Frondel, Schleich & Vance, 2018). For example, the lower effective demand and therefore lower costs for a light bulb induced by the increase in energy efficiency can lead to an increase in the burning time of the light bulb, the use of more light bulbs or an increase in the brightness of the light bulb (Schleich, Mills & Dütschke, 2014). The fact that rebound effects exist is undisputed in the literature and the political context. However, how to reduce rebound effects is less clear. To address them it is important to understand why they arise. Economic mechanisms based on changes in relative prices as a result of efficiency gains have been widely researched (Santarius & Soland, 2018; Dütschke et al., 2018; Frondel & Vance, 2018). Peters and Dütschke (2016) summarize influencing factors beyond economical ones based on the literature: the degree to which personal needs are already satisfied, norms and attitudes with regard to relevant behaviour and the environment, and a form of mental accounting, also known as moral licensing. Dorner (2018) argues that technological change influences incentives for environmentally friendly behaviour, e.g. a fuel-efficient car reduces the relative environmental benefit of cycling. Midden, Kaiser and McCally (2007) argue that rebound effects arise because for many people energy efficiency is not the primary motivation for consumption, but other non-ecological goals, such as comfort in the automotive sector (Greening, Greene & Difiglio, 2000).

Moral licensing is discussed as a psychological explanation for rebound effects; however, little empirical research has tested the relationship between moral licensing and rebound effects. According to this theory, a past moral act licenses a person to behave immorally or less morally afterwards (Merritt, Effron & Monin, 2010). As stated by Effron and Conway (2015), the moral component of the definition of moral licensing refers to domains such as honesty, prejudice, environmentalism and self-control. Two different approaches are discussed in explaining how moral licensing mechanisms work: moral credits and moral credentials. According to the moral credits model, people try to create a balance in their behaviour. Morally good deeds are stored in a mental bank account and used as credits to offset immoral deeds. In contrast, according to the moral credentials model, past behaviour represents a license by changing the interpretation of future behaviour. An immoral act thus appears as if it is not a violation or transgression. In contrast, the immoral acts in the moral credits model are still immoral, but are outweighed by moral acts (Miller & Effron, 2010). The concept of moral licensing seems to contradict established psychological theories on consistency, meaning that people strive for consistency in their behaviour (Blanken, van de Ven & Zeelenberg, 2015). In 2016, Mullen and Monin examined five moderators for moral licensing versus consistency behaviour in a literature study. They conclude that moral licensing is more likely to occur if concrete (rather than abstract) decisions and actions form the initial behaviour and if the initial action is perceived as progress towards the goal (rather than self-commitment towards the goal). The symmetric effect of moral licensing is called moral cleansing, in moral cleansing, an immoral act is offset by a subsequent moral act (Joosten, van Dijke, Van Hiel & De Cremer, 2014).

Applied to the rebound effect, this means that the investment in a more energy-efficient technology could be perceived as a moral act and the subsequent increased use of the technology as an immoral act. Such an approach presupposes that a moral dimension of energy consumption exists. On the contrary, if financial reasons or a lack of knowledge are the causes of the rebound effect, the moral component is missing. Hence, moral licensing cannot be regarded as the sole cause of the rebound effect. Those who invest in a fuel-efficient car could, subsequently, drive more because the costs per kilometre have fallen (economic reasoning) or because the purchase is perceived as a moral or environmentally friendly act (moral licensing). These two mechanisms have very different policy implications. The cost argument could be countered with a tax on fuel, which does not necessarily address moral licensing (Dütschke et al., 2018).

In contrast to economic mechanisms, psychological mechanisms of the rebound effect have so far rarely been subject to research (Peters and Dütschke, 2016; Santarius, 2012). For this reason, in this paper, we want to contribute to closing this gap in the literature: Does moral licensing contribute to explain the emergence of rebound effects?

1.1 Overview

We chose an experimental design in order to test moral licensing effects in energy consumption, which is also the methodology commonly used in literature for investigating moral licensing in other domains (Mullen & Monin, 2016). In other words, we designed an experiment, which allowed for rebound effects in the area of energy consumption, while applying a moral licensing paradigm. Lighting is chosen as the application case, as it represents a typical everyday decision for almost every person and at the same time enabled us to provide a realistic incentive to the participants, i.e. a light bulb. In the experiment, the participants had to make a choice between a set of more energy-efficient light sources. Previously, participants' perceived level of engaging in environmental behaviours was manipulated in order to create a possibility for moral licensing. The sample consisted of 491 respondents[1] who were representative with regard to age and gender. The required sample size was derived from the medium effect size of moral licensing, which Blanken et al. identified in a metastudy in 2015.[2] The participants were recruited from an online panel of the market research institute Norstat.

1 Of 1,259 persons who called up the questionnaire link, 284 could not participate due to closed quotas, 356 others were screened out. Of these, 21 respondents interrupted the questionnaire, 18 initially refused to consent to the use of their personal data. Why and at what time other test subjects were screened out is explained in the procedure of the experiment. Of the 576 respondents who completed the questionnaire, 85 were removed due to interruption of the questionnaire or too fast processing.

2 Blanken et al. (2015) find a small to medium effect with a Cohen's d of .31. According to their calculations, 165 test subjects per condition are required at a test strength of 80%. After adjusting the data, the treatment group *easy (1)* consists of 156, the treatment group *difficult* (2) of 166 and the *control group (3)* of 169 participants. The treatment group *easy (1)* is therefore slightly smaller than required, due to the reduction of the sample while adjusting the data.

1.2 Experimental Procedure

Initially, sociodemographic data on gender, age and highest educational attainment were collected. The test persons were then asked which lighting technology they are currently using in the most frequently used room at their home and what the electrical power of this light source is. Respondents who did not use a conventional light bulb, an energy-saving lamp or a halogen lamp were screened out. This ensured that an LED is always a suitable replacement that also increases energy efficiency. Test subjects who were unable to provide this information were also screened out, as otherwise, it would not have been possible to estimate the size of the rebound effect. In addition, test persons were screened out, who had an energy-saving lamp with an electrical power consumption of three or less than three watts. It was not possible to develop a suitable LED scenario for these energy-saving lamps. In the next step, respondents were randomly assigned to one of three treatments *easy (1)*, *difficult (2)* or *control group (3)*. Depending on their treatment group, respondents were shown a corresponding list of ten behaviours asking them to indicate, if they performed these behaviours in the last three months. Afterwards they received feedback on how many of the ten behaviours they applied. Next, the participants received a scenario description. Participants were asked to imagine that the light source they were currently using had broken down and that three LEDs were now available to them at the DIY store to replace it. These differed in brightness (darker, similarly bright and brighter than the current one) and thus in electrical power consumption and consequently in energy consumption. The respective electrical power consumption was given in watts.[3] The participants were informed that every tenth test person will receive the selected LED as a thank-you for participating in the survey. Subsequently, the subjects were asked about the motive of their choice followed by a few general questions on light sources. Afterwards the test persons received questions about the

3 The electrical power consumption of the three LEDs displayed is determined as follows: The brightness of the current light source is calculated on the basis of its electrical power consumption. This brightness is then used to calculate the electrical power consumption of the LED, which is similarly bright, which is used to derive the electrical power consumption of the darker and brighter LEDs. In most cases, these values correspond roughly to the LEDs available on the market. Some of the values have been adjusted so that the electrical power consumption of the darker and brighter LEDs differ in the same distance from the similarly bright, so that the test persons are not influenced in their selection if possible.

environmental self Image and the moral self image and had to evaluate the feasibility[4] of the ten behavioural items according to their treatment. Finally, the participants indicated whether they were interested in the draw for the LEDs, and if so, a request of the contact details followed. Figure 1 summarizes the procedure of the experiment.

4 In addition to the two instruments environmental self image and moral self image, it is examined whether the respondents in the treatment *easy (1)* rate more behaviours as easy than the respondents in the treatment *difficult (2)* or whether the respondents in the treatment *easy (1)* rate less behaviours as difficult than in the treatment *difficult (2)*. This allows conclusions whether the priming was effective and whether the chosen division into "easy" and "difficult" corresponds to the assessments of the respondents.

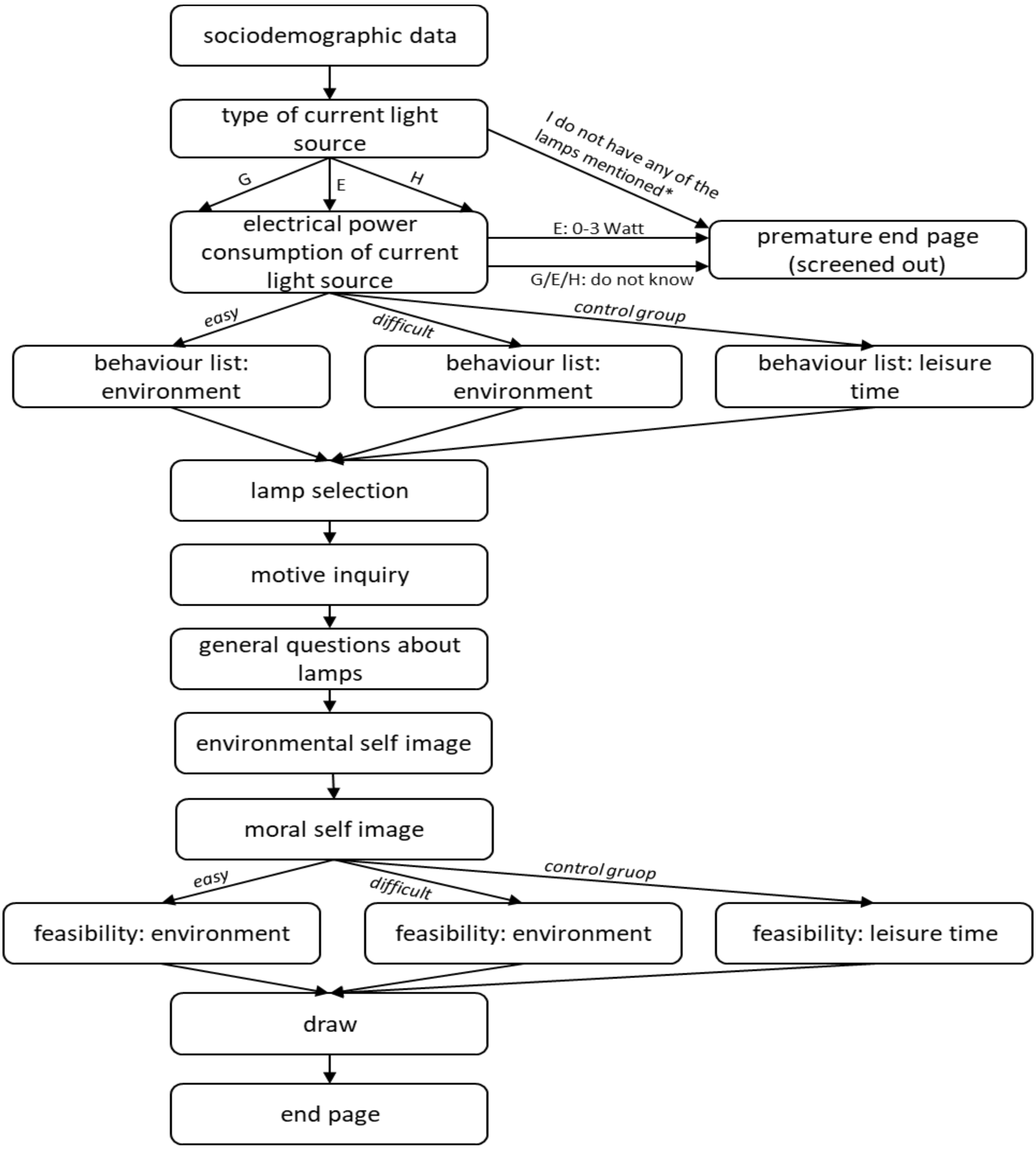

Figure 1: Flowchart of the experiment; Note: G - light bulb, E - energy saving lamp, H - halogen lamp; the arrows are labelled according to the selected response option; treatments and control group are printed in italics.

*Before a test person is screened out, he/she is asked whether he/she uses one of the following lamps: LED, halogen tube, fluorescent tube, I do not know.

1.3 Instruments

Priming. To investigate moral licensing, each treatment included a list of behaviours containing ten items. The subjects were asked which of these behaviours they have implemented in the last three months. Treatment group *easy (1)* received a list of easy to implement environmentally friendly behaviours (e.g. "I separated my waste."), Treatment group *difficult (2)* received a list of difficult to implement environmentally friendly behaviours (e.g. "I only ate vegan.") and the *control group (3)* received a list of leisure activities without any environmental focus (e.g. "I went to the cinema."). The complete item lists can be found in the appendix (5.1). Treatment group *easy (1)* was suggested that they behaved very environmentally friendly, it should get a moral license by answering the behaviour list. Treatment group *difficult (2)* was designed to investigate moral cleansing and to create a strong antithesis to the treatment group *easy (1)*. The items of the two treatments *easy (1)* and *difficult (2)* were partly taken from the General Ecologic Behaviour Scale (GEB) by Kaiser and Wilson (2004) and partly self-designed. In order to better assess the difficulty of the self-designed items, an internal pretest was conducted. The leisure behaviours were also self-designed and, in particular, should have no connection to environmental behaviour. Care was taken to ensure that the behaviour was "showable", i.e. the respondents had the opportunity to implement the behaviour, preferably several times during the specified period (three months), and a specific action. Mullen and Monin (2016) summarize that moral licensing is more likely to occur when concrete (rather than abstract) actions form the initial behaviour.

Manipulation checks. The effect of manipulation is tested using two instruments: environmental self image and moral self image. The environmental self image measures the respondents' environmental self-image, the moral self image the respondents' moral self-image on a 5-point Likert scale between "I do not agree" and "I totally agree". Environmental self image and moral self image in the treatment group *easy (1)* should be significantly higher than in the treatment group *difficult (2)*. The environmental self image contains the three items "I think I am someone who behaves in an environmentally friendly way", "I think the environment is more important to me than to other people" and "I think environmentally friendly behaviour is an important part of me". This compilation is based on van der Werff, Steg and Keizer (2013) and Whitmarsh and O'Neill (2010). The moral self image consists of the four items "I am helpful", "I am compassionate", "I am fair" and "I am honest". These items are based on Aquino and Reed (II 2002) and Khan and Dhar (2006).

1.4 Research hypotheses

The research question as to whether moral licensing can (partially) explain rebound effects is transferred to the following evaluation steps and research hypotheses. First, it is examined whether the sample shows a general rebound effect when the LED is selected. Based on the current literature (Schleich et al., 2014) one would expect a rebound effect, which will manifest itself on the individual level if a participant chooses the brighter LED. We interpret this as rebound as the full potential energy saving will only be realised if an LED of the same brightness is chosen. Contrary, choosing a darker LED is categorised as a spill-over effect. For the whole sample a general rebound effect occurs, if the number of subjects who choose the brighter LED exceeds the number of subjects who choose the darker LED.[5]

In accordance with moral licensing theory, we hypothesize that participants in the treatment group *easy (1)* should choose brighter LEDs than the *control group (3)* as they should be more likely in a state where they feel positive about their morale and level of environmental engagement and therefore be inclined to license a subsequent non-environmentally friendly behaviour. Therefore, the hypothesis is:

H1 (moral licensing): Subjects in the treatment group *easy (1)* choose brighter LEDs with a higher energy consumption compared to the *control group (3)*.

According to the theory of moral cleansing, respondents in the treatment group *difficult (2) s*hould choose darker LEDs than the *control group (3).* This is because they are inclined to believe that they did behave less environmentally friendly in the past and should therefore morally cleanse themselves by picking a more environmentally friendly light bulb:

H2 (moral cleansing): Subjects in the treatment group *difficult (2)* choose darker LEDs with a lower energy consumption than subjects in the *control group (3)*.

5 The rebound effect must be corrected by the number of people who select the darker LED, as they attenuate the aggregated rebound effect.

2 Results

Sample description. The data set contains 251 women (51%) and 240 (49%) men. The average age is 50.2 years (SD = 16.29, range: 18-85). The distribution of age and gender corresponds to the national average in Germany as published by the Federal Statistical Office (DESTATIS Statistisches Bundesamt, 2018c, 2018a).

Rebound effects (H1). Table 1 shows the absolute and relative frequencies of the selected LEDs per treatment. 124 respondents have chosen the brighter LED, thus showing a rebound effect on an individual level. The number of respondents who chose the brighter LED exceeds by far the number of respondents who chose the darker LED: 124 - 23 = 101 >> 0. At an aggregated level participants exhibit a rebound effect.

Table 1: Selection of lamps per treatment: absolute and relative frequencies

	absolute			relative		
Treatment	darker	similar	brighter	darker	similar	brighter
easy (1)	9	111	36	5.8%	71.2%	23.1%
difficult (2)	10	118	38	6.0%	71.1%	22.9%
control group (3)	4	115	50	2.4%	68.1%	29.6%
Total	23	344	124	4.7%	70.1%	25.3%

Excursus to quantify the rebound effect in energy units. Using the data collected in the questionnaire, it is possible to quantify the rebound effect averaged over all respondents, which would result only from the respondents' choice of light sources. At the beginning of the survey, the type and electrical power consumption of the current lamp were surveyed. The interviewees did not give exact values for the electrical power consumption, but selected among given categories. For these categories the mean value was used, partly adjusted according to market shares of predominant values for electrical power consumption. This procedure is based on Schleich et al. (2014), the adaptation used also originates from them. Together with the data of the electrical power consumption of the three LEDs, all data required to calculate the rebound effect are available. Using the formula introduced in 1, the rebound effect per subject *i* can be calculated from the electrical power consumption [watts], not from the consumption units.

$$R_i = (PES_i - AES_i)/PES_i = 1 - AES_i/PES_i$$

The actual energy saving (AES_i) results from the difference between the electrical power consumption of the current lamp ($E_{i,0}$) and the electrical power consumption of the selected LED ($E_{i,g}$). Similarly, the potential energy saving (PES_i) results from the difference between the electrical power consumption of the current light source and the electrical power consumption of the LED, which is similarly bright to the current light source ($E_{i,ä}$).

$$R_i = 1 - \frac{AES_i}{PES_i} = 1 - \frac{E_{i,0} - E_{i,g}}{E_{i,0} - E_{i,ä}}$$

The aggregated rebound effect (R_a) is the sum of the individual rebound effects. N represents the number of respondents.

$$R_a = \sum_{i=1}^{N} 1 - \frac{AES_i}{PES_i} = \sum_{i=1}^{N} 1 - \frac{E_{i,0} - E_{i,g}}{E_{i,0} - E_{i,ä}}$$

If the aggregated rebound is divided by the number of subjects, the average rebound effect (R_g) is obtained. In our study this adds up to 5.2% resulting from only the choice of light source. This figure can be higher if other behavioural changes are induced by switching to LED. The 344 respondents who opted for a similarly bright LED produced an individual rebound effect of 0%. The 23 subjects who chose the darker LED showed sufficiency, i.e. they saved energy. The remaining 124 who chose the brighter LED create an individual ("positive") rebound effect.

Manipulation Check. The prerequisite for the desired effect of the behavioural list is that the respondents in the treatment group *easy (1)* apply significantly more of the environmental behaviours surveyed than the respondents in the treatment group *difficult (2)*. A Kruskal Valais test[6] shows that the average number of behaviours shown differs significantly between the treatment groups ($\chi^2(2, N = 491) = 255.38$; $p < .001$). A post hoc test shows that the mean value in the treatment group *easy (1)* (M = 8.51, SD = 1.60) is significantly higher than the mean value in the treatment group *difficult (2)* (M = 3.61, SD = 1.86) ($p < .001$, $r = .27$). The mean values of the three treatment groups are also shown in Figure 2.

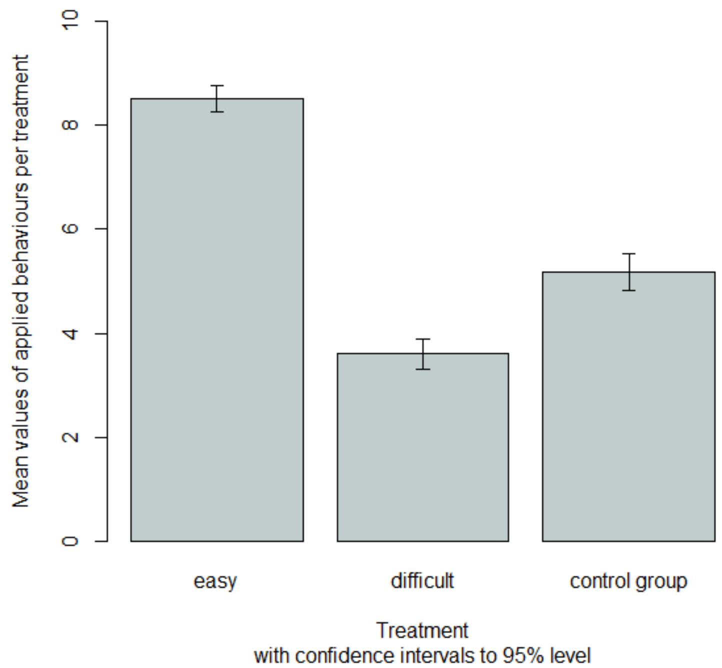

Figure 2: Mean values of applied behaviours per treatment

To test whether presenting participants with easier compared to more difficult environmental behaviour resulted in an increase environmental self-image and an increase moral self-image, we compared the self reports on these two scales. An ANOVA ($F(2, 488) = 7.39$; $p < .001$) followed by a post hoc test shows that the Environmental Self Image in the treatment group *easy (1)* is (M = 3.77, SD = .85) significantly higher than in the treatment group *difficult (2)* (M = 3.42, SD = .81) ($p < .001$, $r = .02$). Similarly, the moral self image in the treatment group *easy (1)*

6 Since the data do not meet the requirement of variance homogeneity, a Kruskal-Valais test is performed instead of an ANOVA test.

(M = 4.42, SD = .53) is significantly higher than in the treatment group *difficult (2)* (M = 4.23, SD = .59) (ANOVA: $F(2, 488) = 4.47$; $p = .01$), (posthoc: $p = .03$, $r = .01$).[7]

Influence of the treatment on the occurrence of a rebound effect. Whether the treatment has an effect on the choice of light source is investigated using an ANOVA. The lamps are coded as following: darker (1), similarly bright (2) and brighter (3). There were no significant differences between treatment groups regarding their lamp selection ($F(2, 488) = 2.23$; $p = .11$). A post-hoc test revealed especially no significant differences between treatment group *easy (1)* (M = 2.17, SD = .51) and the *control group (3)* (M = 2.27, SD = .50; mean difference = .10, $p = .18$) and between treatment group *difficult (2)* (M = 2.17, SD = .51) and the *control group (3)* (mean difference = .10, $p = .15$). As can be seen from Figure 3, contrary to the hypothesis, more respondents from the *control group (3)* (50, 29.6%) than from the treatment group *easy (1)* (36, 23.1%) chose a brighter LED.

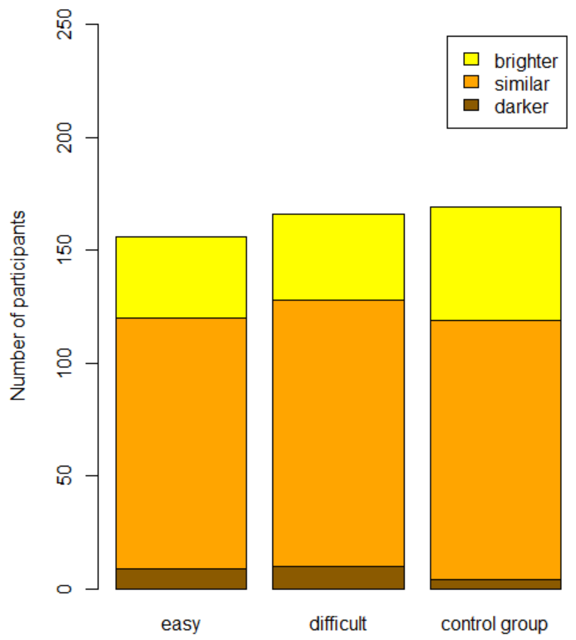

Figure 3: Absolute frequencies of the selected LEDs per treatment

7 ESI: no significant differences between the *control group (3)* and the treatments. MSI: significant difference between the *control group (3)* and treatment group *easy (1)* (p = .03), no significant difference between *control group* (3) and treatment group *difficult (2)*. Strictly speaking it cannot be isolated which behavioural list or both caused the difference in the ESI between the treatment groups.

3 Discussion

The aim of the experiment was to induce moral licensing effects and to investigate their relation to rebound effects. Across all participants, 124 subjects showed individual rebound effects by choosing the brighter LED light bulb, whereas only 23 chose the darker light bulb. Hence, in our experimental scenario, we found a general rebound effect among participants. In order to provoke a moral licensing effect, we manipulated the moral accounts of participants in the treatment groups by reminding them of their comparatively little vs. comprehensive environmental behaviour. This manipulation was successful. Respondents in the treatment group *easy (1)* reported a higher moral self image and a higher environmental self image compared to the treatment group *difficult (2).* However, moral licensing as an explanatory approach for the rebound effect could not be shown by our experimental set-up. Contrary to the research hypothesis, participants did not choose brighter LED bulbs when being reminded of their comprehensive environmental behaviour. Furthermore, we did also not find a significant moral cleansing effect among participants who were reminded of their scarce environmental behaviour.

There may be several reasons why we did not find moral licensing effects in this study. First, other mechanisms are more relevant to explain the rebound effect. Second, there is no moral or environmental dimension of the brightness of the light source. In this case, choosing or not choosing a certain light bulb is no appropriate behaviour to influence individual moral accounts. As the variance of the energy consumption of LEDs is very low in any case, the differences between the options might have looked negligible. Third, moral licensing as a mechanism is relevant, but the experimental design was not suitable to identify it. The priming might have made the environmental attitude salient and thus triggered consistent behaviour instead of licensing behaviour (Mullen & Monin, 2016).

In fact, the data shows some slight support for this alternative explanation: As the descriptive results from the lamp choice (see Figure 3) of treatment *easy (1)* and *difficult (2)* are very similar, we conducted a post-hoc analysis, in which the treatments *easy (1)* and *difficult (2)* were combined into one group and tested against the *control group (3)*. The test shows, that participants in the *control group (3)* chose significantly brighter LEDs than in both treatment groups.[8] This in turn means that participants reminded of their pro-environmental behaviour in the past

8 *control group* ($M = 2.27$, $SD = .50$), treatment groups ($M = 2.17$, $SD = .51$), $t(349.46) = 2.13$, $p = .03$

were more likely to choose darker light bulbs and therefore show a more pro-environmental behaviour. Thus memorizing environmentally friendly behaviour seemed to have a mitigating effect on the rebound effect, regardless of whether the memory strengthens (*easy (1)*) or reduces (*difficult (2)*) the environmental self image. This result is more in line with theories on consistency behaviour (e.g. Blanken et al., 2015; Whitmarsh & O'Neill, 2010) than with the hypothesized moral licensing. However, from our study it is not clear, how this alternative assumption is in line with the moral and environmental self-perceptions that were successfully manipulated. Possibly the LED choice is not a behaviour relevant on a moral dimension and therefore not connected to the moral manipulation. However, our treatment might have had an additional effect on a cognitive level, making environmental and thereby energy demand issues more salient. And this salience lead to a systematic variation in choices. As this finding is not in line with our hypotheses, further research is needed to establish it as a generalizable result.

Another important issue to note in this context is that our participants were forced into a more energy efficient choice by the experiment. This implies that we do not know which choices they would have taken under differing circumstances. Further *limitations* of our study are the following: i) Due to financial reasons, the manipulation was not tested in a pretest. In our case, the manipulation check (moral self image, environmental self image) was included after the LED choice. Thus while answering the manipulation check participants could have been influenced by both, the treatment and the choice of the LED and we are not able to isolate these effects. Ideally, we would have randomised the order of presentation in the questionnaire which was not possible due to limited sample size. ii) Only owners of certain light sources who may differ from the total population (e.g. no early LED adaptors) were able to participate, otherwise the results are transferable. iii) Sending the chosen LED as an incentive to every participant instead of every tenth would have been a stronger incentive.

Regarding individual rebound effects, it is also noteworthy that the majority of our sample did show neither rebound nor a sufficiency behaviour, by choosing the LED that maintains the status quo with regard to brightness. This is in line with findings from a study by Schleich et al. (2014) who found similar distributions regarding rebound, no behavioural change and sufficiency on the individual level. In further post-hoc analysis, we looked into the reasons that respondents provided as an explanation for their LED choice. The majority of respondents who opted for the brighter LED stated that their motivation was "I preferred brighter lighting." (80). This could be an indicator that their need for brightness might not have been sufficiently satisfied and fits in with the findings of Peters and Dütschke (2016), who identified unsatisfied personal needs as a driver for rebound effects. However, touching on need satisfaction leads to a challenging discussion on 'justified' and 'unjustified' needs and whether the desire for more brightness is "excess" (Chatterton et al., 2019) or a justified welfare gain.

Overall, the present study indicates that the development of experimental designs for licensing effects is not trivial as is the discussion around rebound effects in general as hinted in the last paragraph. This also encompasses the question as to the conditions under which rebound effects (choice of a brighter light source) or more consistent behaviour (choice of an equal or lower brightness) are more likely to occur.

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5 Appendix

5.1 Item Lists

<u>Treatment *easy (1)*</u>

Task:

Below you will find a list of environmentally friendly practices. Please indicate whether you have implemented these environmentally friendly practices in the last 3 months.

Please mark "Yes" if you have implemented these actions, if not, mark "No". Please tick "I cannot answer" if a statement does not apply to your current life situation or if you do not wish to evaluate this statement.

Items:

1. I took my waste glass to the collection container for glass.
2. When I left the room, I turned off the light.
3. I did not let the dishwasher run until it was completely full.
4. I cooked with lids on the pots.
5. I let warm food cool down before I put it in the fridge.
6. I used a kettle.
7. I separated my waste.
8. I bought fruit and vegetables according to the season.
9. I showered instead of bathing.
10. I waited with the washing until I had a full laundry drum.

<u>Treatment *difficult (2)*</u>

Task: same as in treatment *easy (1)*

1. I solely ate vegan food.
2. I did not use any disposable items such as paper napkins or kitchen towels.
3. I only bought milk in returnable bottles.
4. I only bought certified organic food.
5. I bought fruit and vegetables according to the season.

6. I had broken clothes repaired or repaired by myself.
7. I have made people aware, if they are acting in an environmentally harmful way.
8. I have obtained books, information leaflets or other materials that deal with environmental problems.
9. I always turned off my computer screen when I took a break of more than 10 minutes.
10. I always took the charger out of the socket after charging the phone.

Control group (3)

Task: Below you will find a list of leisure activities. Please indicate whether you have engaged in these leisure activities in the last 3 months.

Please mark "Yes" if you have implemented these actions, if not, mark "No". Please tick "I cannot answer" if a statement does not apply to your current life situation or if you do not wish to evaluate this statement.

1. I was swimming in an outdoor pool or a lake.
2. I read a novel.
3. I went for a walk in the park.
4. I was at the zoo.
5. I was in a beer garden.
6. I was lying on an air mattress.
7. I ate an ice cream.
8. I was singing in the shower.
9. I was at the cinema.
10. I cooked with friends in the evening.

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