Spillover of pro-environmental consumer behavior

Lieke Dreijerink

Propositions

- 1 Saving money by behaving pro-environmentally often leads to expenses that reduce the positive environmental impact of the original behavior. (this thesis)

- 2 People behave pro-environmentally when their motivation is strong enough for the behavior to feel easy. (this thesis)

- 3 Social psychologists should be involved more in testing the impact of policies on behavior.

- 4 Social changes require both system change and individual change.

- 5 Transferring insights from science to practice takes as much time and effort as doing the research itself.

- 6 Academic publishers should be non-profit organizations to balance the effort and revenues for researchers and the public.

- 7 If the Dutch government wants to encourage research by external PhD researchers (‘buitenpromovendi), it should provide childcare benefit to those with children.

Propositions belonging to the thesis, entitled.

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Thesis

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Chapter 1:
General introduction

Humanity's current way of living has a major impact on life on earth. The actual state of "system earth" seems to be deteriorating at a rapid pace. Climate change causes global temperature to rise and in combination with the loss of biodiversity the whole biospheric system is under pressure (e.g., Rockström et al., 2009; Steffen et al., 2015). To avoid the grim consequences of a system collapse, plans and solutions are being developed. For example, in order to limit climate change it is necessary to reduce the global emission of greenhouse gases (GhGs). Current efforts are focused on limiting global warming to 1.5 degrees above pre-industrial levels (IPCC, 2021). It seems clear that, since about 60% of global emission can be attributed to consumer behavior (Ivanova et al., 2016; Ivanova et al., 2020), consumption patterns need to change. Consumption patterns consist of different behaviors in various domains, such as mobility, leisure, housing, food, and goods. These behaviors may be performed one-time, e.g., investing in a specific technology, or repeated, e.g., buying specific foods. A change in consumption patterns is especially relevant for people in higher-income countries. For example, a Dutch consumer contributes on average to around 8.7 tonnes (or 8,700 kg) of GhG emissions per year (Our World in Data, 2022) because of, among other things, driving a fossil-fueled car, going on holiday by airplane, heating one's home with natural gas, consuming meat and buying new goods such as electronics or clothing. In comparison, on average each person on earth contributes to about 4.5 tonnes of GhGs, with a resident of Malawi contributing to 0.2 tonnes and a US resident contributing to 17.1 tonnes. To stay below the 1.5 degrees limit, the average per person emission—the so-called individual carbon footprint—would need to be around 2.1 tonnes by 2030 (UNEP, 2020). This implies that overconsumption from high emitters needs to be reduced (Nicholas, 2021).

Consumption patterns can be changed into more pro-environmental patterns by several means, among others by improving the products offered by producers and companies, sometimes referred to as changing the system, or by changing the choices of individual consumers. In this dissertation I focus on the second means. People can reduce their carbon footprint by adopting more pro-environmental consumption patterns, thereby performing pro-environmental behaviors (PEBs) in various domains. Since one behavior can affect what happens next, it is important to study the sequence of these types of behaviors (Dolan & Galizzi, 2015). On the one hand, acting pro environmentally in one situation can encourage people to behave more pro-environmentally elsewhere (e.g., Juhl et al., 2017; Lanzini & Thøgersen, 2014; Margetts & Kashima, 2017). However, on the other hand, people do not consistently behave pro-environmentally (e.g., Steg & Vlek, 2009; Barr et al., 2011) and performing one PEB can adversely affect the performance of another. In this dissertation I therefore focus on how the performance of different PEBs is related. To be able to encourage people to adopt more pro-environmental consumption patterns, it is important to learn more about why in one situation performance of one PEB leads to another PEB, while in a different situation people act environmentally unfriendly following a previous PEB. More specifically, this dissertation is focused on behavioral spillover; a concept used in psychology to refer to the process between consecutive behaviors.

With regard to PEBs, a behavioral spillover implies that acting in a pro-environmental way changes a person's likelihood or extent of performing other PEBs (Lanzini & Thøgersen, 2014). Behavioral spillover can be positive when the performance of a first PEB (PEB1) is found to increase a person's inclination to engage in a different, subsequent PEB

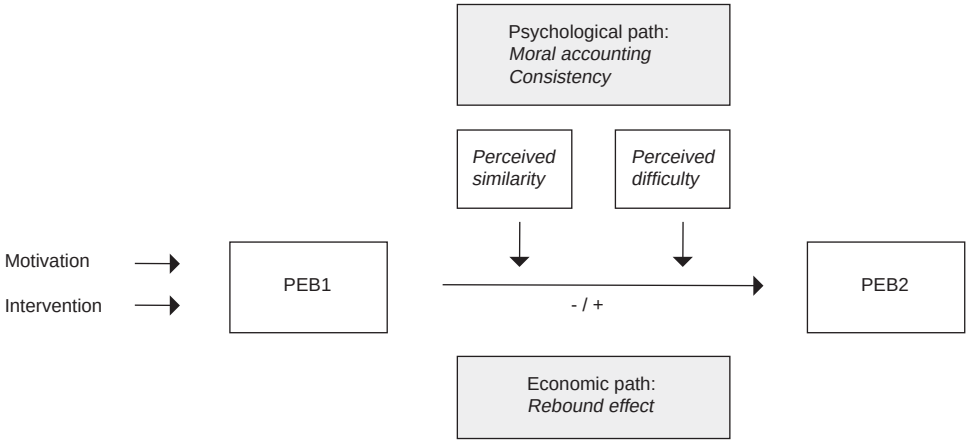
(PEB2). However, spillover can also be negative, in which case the reverse effect is observed: after adopting a PEB1, the probability of an individual adopting a PEB2 declines (Thøgersen & Crompton, 2009). According to some definitions of behavioral spillover, the performance of a PEB1 must be the result of an intervention or a targeted effort (e.g., Galizzi & Whitmarsh, 2019; Truelove et al., 2014), while in other definitions spillover can also occur between behaviors without the presence of an intervention initiating PEB1 (e.g., Nash et al., 2017; Nilsson et al., 2017 Thøgersen, 1999). In this dissertation the latter definition is assumed, that is, when people engage in a certain PEB1 (due to any reason) this may affect subsequent behavior.

Apparently, both positive and negative behavioral spillovers occur. Meta-analyses of spillover studies show that, overall, positive spillover appears to occur from PEB1s to behavioral intentions, and negative or no spillover appears to occur between behaviors (Geiger et al., 2021; Maki et al., 2019)[1]. Generally, spillover effects are small. However, a number of moderators have been identified that positively or negatively affect the occurrence of behavioral spillover, implying that under certain circumstances the spillover effect may be larger (Carrico, 2021; Maki et al., 2019; Nilsson et al., 2017; Truelove et al., 2014). These moderators include the frame of the intervention, e.g., focus on identity (Baca-Motes et al., 2013) or a monetary versus environmental focus (Lanzini & Thøgersen, 2014; Steinhorst et al., 2015), a person's political ideology (Truelove et al., 2016; Lacasse, 2015), and the perception of the PEBs; including the degree of similarity of PEBs (Thøgersen, 2004), and the perceived difficulty of PEBs (Fujii, 2006; Gneezy et al., 2012). Finally, Carrico (2021) described that average effect sizes are larger and more negative when behavior is observed versus self-reported. However, until now few spillover studies observed actual behavior and instead rely on measures of intended or self-reported PEB2.

■ 1) The meta-analysis by Maki et al. (2019) included 22 studies, and the meta-analysis by Geiger et al. (2021) included 37 studies.

This dissertation is focused on increasing the understanding the behavioral spillover process. First, the processes of why positive or negative spillovers occur from a PEB1 to a PEB2 are investigated. We argue there are two pathways guiding the process: a psychological and an economic path (see Figure 1.1). Within both pathways, we study several relevant concepts, which we elaborate on in Section 1.1. Second, we examine the role of different moderators in the spillover process. In particular, we focus on how people perceive similarity and difficulty of PEBs. These moderators are further described in Section 1.2. Finally, in Section 1.3 we summarize our research goals and provide an overview of the chapters included in this dissertation.

Figure 1.1
Process of positive and negative behavioral spillover via economic and psychological pathways, from a first pro-environmental behavior (PEB1) induced by motivation or an intervention to a subsequent behavior (PEB2), with perceived difficulty and similarity of PEB1 and PEB2 as moderators



1.1 Why does behavioral spillover occur?

1.1.1 The psychological pathway

Acting pro-environmentally is often regarded as a type of moral or ethical behavior (Stern, 2000; Truelove et al., 2014; Van der Linden, 2015). Different theories address the way people consider making subsequent moral choices. According to the moral balance model (Nisan, 1985) moral decisions are affected by evaluations of a person's moral self that is based on recent moral decisions and actions. People seek to keep a balance of good and bad deeds (Nisan, 1991). Similarly, Gneezy et al. (2012) describe a construct called conscience accounting in which debits accumulated from misdeeds can be offset by credits gained by good deeds, and vice versa. Offsetting occurs within, but also across domains: misdeeds in one moral domain can be offset by credits in a completely unrelated domain. For instance, after receiving feedback on reckless driving, people experienced a stronger desire to engage in community service (Steele, 1998). Key concepts within accounting for morality are moral licensing, which describes the phenomenon that people may feel allowed to act immorally after an initial moral act (Miller & Effron, 2010), and moral cleansing, which is the phenomenon that people may choose behaviors aimed at restoring moral self-worth in response to past transgressions (West & Zhong, 2015).

Moral accounting has been researched with respect to behavioral spillover, and appears especially relevant for negative spillover. Negative spillover is often attributed to moral licensing (Galizzi & Whitmarsh, 2019; Maki et al., 2019). There is some empirical evidence for moral licensing of PEBs. For example, Thøgersen (1999) showed that recycling had a negative impact on the felt obligation to avoid excessive packaging waste when shopping,

and Klöckner et al. (2013) found that electric car owners felt less moral obligation to drive less compared to owners of conventional cars. Furthermore, Truelove et al. (2016) showed that people who recycled were less supportive of a green fund compared to a people in a control condition. Licensing was first introduced in relation to moral issues, but has also been studied in the context of consumer, health and eating behavior—under the name of self-licensing. It is unclear if processes of moral and self-licensing take place unconsciously or consciously. Khan and Dhar (2006) showed that consumers may be unaware of how their prior decisions influence their subsequent choices, and therefore that the process underlying the moral licensing effect may be largely unconscious. However, others describe licensing as a deliberate justification strategy to excuse morally questionable behaviors which includes active engagement in using and searching for available justifications (Blanken et al., 2015; De Witt Huberts et al., 2014). Meta-analyses by Blanken et al. (2015) and Simbrunner and Schlegelmilch (2017) show evidence of small moral licensing effects; although there are also still concerns about the replicability of moral licensing effects (Kuper & Bott, 2019).

Moral accounting is also relevant for positive spillover, as it is expected that perception of one's moral self or identity, which is the foundation of one's moral balance, plays an important role. As Carrico (2021) describes, the performance of a PEB1 may either prime a pre-existing sense of self, or trigger a revised sense of self, that includes pro-environmental values and action. Positive spillover of a PEB1 to a PEB2 is thought to be driven by motivations for consistency and coherence, such as self-perception theory (Bem, 1972) which posits that people infer their attitudes from past behavior, or the theory of cognitive dissonance (Festinger, 1962), which states that the discomfort that people experience when they behave in a way that is inconsistent with their self-concept will motivate them to reduce this dissonance (for instance, by acting in accordance with their self-concept). Van der Werff et al. (2013) found, for example, that people who had been reminded of their previous performance on a range of PEBs were more likely to make green product decisions, as compared to people who were reminded of environmentally-unfriendly actions. This positive spillover was mediated by people's environmental identity (that is, the degree to which individuals see themselves as environmentally friendly): reminding people of previous PEBs strengthened their identity which led people to choose green products and make more pro-environmental judgments. The relationship between environmental identity and the adoption of PEBs is indeed well-established (Whitmarsh & O'Neill, 2010). It is therefore expected that interventions that foster or renew a pro-environmental identity have potential to stimulate a range of PEBs over time and across domains (Carrico, 2021). However, in their meta-analysis on spillover Maki et al. (2019) found no support for interventions targeting environmental identity causing more positive spillover compared to interventions that do not target identity.

All in all, from a psychological perspective, behavioral spillover is explained by moral and self-perception processes. However, results of previous studies still raise questions about how big a role these processes play. This lack of clarity is probably related to the mixed results and the small effects of spillovers in general. In addition to the processes within the psychological pathway, the field of economics may provide additional explanations for the occurrence of behavioral spillover.

1.1.2 The economic pathway

The rebound effect is an economic explanation for negative spillover, and focuses on energy consumption. The rebound effect is commonly used as an umbrella term for a number of mechanisms which reduce the size of energy savings achieved from improvements in energy efficiency (Sorrell, 2012). In other words, due to rebound effects the energy savings that result from taking an efficiency measure are smaller than they could have been. The literature distinguishes three types of rebound effects: the direct rebound effect, the indirect rebound effect and economy-wide effects (e.g., Aydin et al., 2017; Greening et al., 2000; Sorrell et al., 2009).

In case of the direct rebound effect, an energy efficiency improvement for a particular energy service reduces the cost of this service and thus leads to a higher consumption of this energy service (Aydin et al., 2017; Verboven & Vanherck, 2016). This increase in consumption is the result of a combination of the income effect and the substitution effect. The income effect reflects the increase in purchasing power due to a lower cost of the service. According to the substitution effect the lower cost of a service may shift consumption patterns to an increased purchase of this service instead of other goods. For example, insulating one's home makes heating cheaper, thereby encouraging people to heat larger parts of the house to higher levels over longer periods of time (e.g., Chitnis et al., 2013). Since heating has become cheaper, people can afford to use heat more often as they have more money to spend (income effect) and heating is attractive since it is so cheap (substitution effect). Box 1.1 explains these two effects in more detail. The direct rebound effect is acknowledged and quantified by a wide range of economists (e.g., Berkhout et al., 2000; Binswanger, 2001; Gillingham et al., 2013; Greening et al., 2000; Khazzoom, 1980). However, the size of the effect varies between studies, among other things due to differences in definitions, boundaries, and ways of quantification. In a meta-analysis on the rebound effect in various consumption domains, Ehrhardt-Martinez and Laitner (2010) estimated that the direct rebound effect negates at most about one-third of the benefits of efficiency upgrades (with the magnitude of the effect being around 10 to 30%). However, some studies claim higher proportions: for example, 42% for tenants in the residential setting (Aydin, 2016), and 57 to 62% in travel (Frondel et al., 2012).

In case of the indirect rebound effect, the reduction of the cost of the energy service leads to changes in demand for other goods and services that also require energy or resources (Aydin et al., 2017; Verboven et al., 2016). In other words, indirect rebound is about how one spends the money one saves, on other goods or services (Jenkins et al., 2011). For example, money savings from more energy efficient heating may be put towards an overseas holiday or a new phone. The indirect rebound effect is also explained by the income and substitution effect (see Box 1.1.). With regard to the size of the indirect rebound effect there is substantial uncertainty (Jenkins et al., 2011; Nadel, 2012). The indirect effect occurs in many different shapes and is therefore more complex to investigate (Jenkins et al., 2011; Sorrell, 2012; Verboven & Vanherck, 2016). That is, the saved money can be spent on a very broad variety of goods. Moreover, the size of the indirect rebound effect varies widely from one household to another (Chitnis et al., 2014). For instance, as low-income households spend a greater proportion of their money savings on carbon intensive necessities such as

food and drink, the indirect effect is generally larger for this group. Chitnis et al. (2014) describe that the indirect rebound effect may frequently be of comparable magnitude as the direct effect, namely around 10 to 30% of energy savings is negated.

Finally, the economy-wide rebound effect involves macro-economic effects, such as US policy affecting global oil prices leading to consumption shifts in other countries, or macro-economic growth effects, for example innovations in materials for fuel-efficient cars leading to better airplanes and thereby boosting the aviation sector and its related energy use (Gillingham et al., 2013). Economy-wide effects are beyond the scope of this dissertation.

Box 1.1. Substitution and income effects

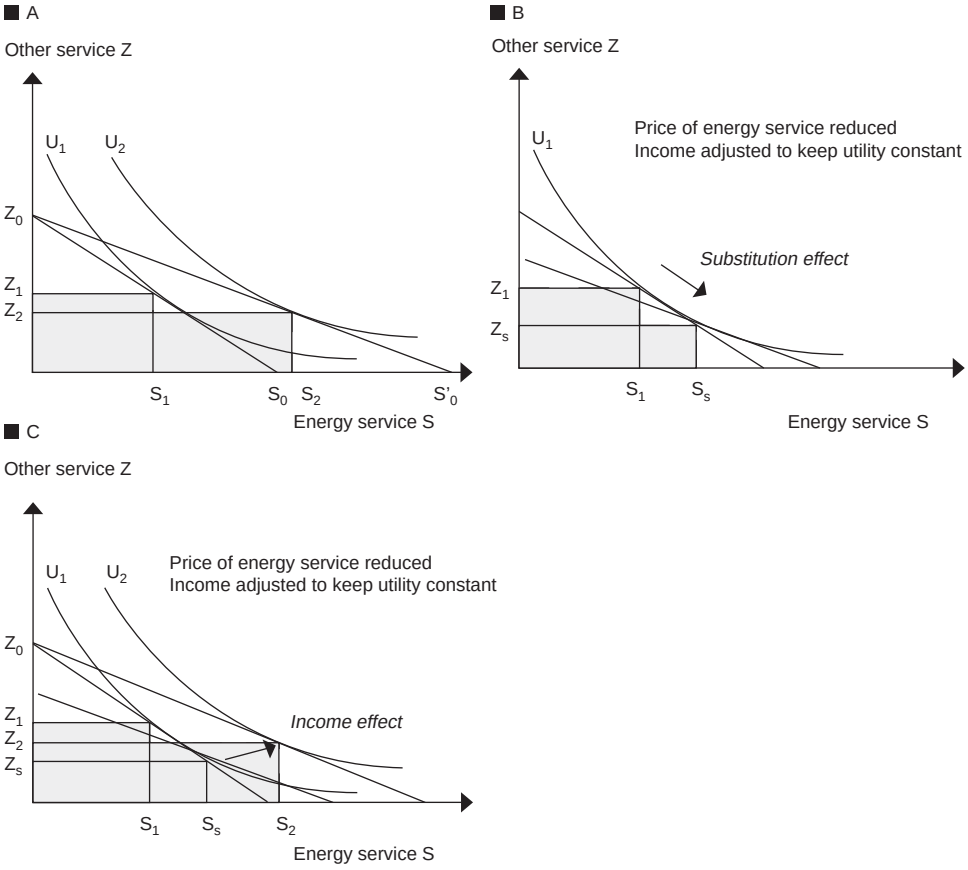
Figure 1.2 displays the substitution and income effect for both the direct and indirect rebound effect. The units of consumption of energy service S (for instance heat) are on the x-axis and the consumption of all other goods and services Z are on the y-axis.

Panel A describes the direct rebound effect that might occur after, for example, installing insulation. Line S0 represents the household budget. S0 represents the household budget when the cost of heating decreases—in our example after insulation. The lines U are the indifference curves before (U1) and after (U2) the cost decrease. Figure 1.2 shows on the x-axis the amount of energy service S the household consumes before the cost decrease at S1 and after at S2. This difference is caused by both the income and substitution effect. The substitution effect is equal to the change in consumption of S holding real income constant. In Figure 1.2 (panel B) this means that the new budget line is drawn next to the optimal choice line U1. The point on the x axis where the new budget line crosses U1 is called Ss. The difference between S1 and Ss is the substitution effect. In Figure 1.2 (panel C) the difference between Ss and S2 is the income effect. Since the income and substitution effects for any individual good or service may be either positive or negative, the sum of the two may be either positive or negative (Chitnis et al., 2013).

The indirect rebound effect is also explained by the income and substitution effect. The y-axis on consumption of another good or service Z in Figure 1.2 displays the indirect income (Zs–Z2) and substitution effect (Zs–Z1). Note that, the substitution (SS–S1) and income (S2–SS) effects for energy service S have the same sign and hence reinforce one another, while the substitution (Zs >Z1), and income (Z2>ZS) effects for the other service Z have different signs and hence offset one another.

Figure 1.2

Illustration of the direct and indirect rebound effect (panel A), explaining the substitution effect (panel B) and income effect (panel C). Source: Chitnis et al., 2013.



The rebound effect is an economic effect that assumes that consumers take cost effects of an energy-efficiency improvement into account and consequently increase their consumption of goods and services. However, people are often not rational in their financial decisions; for example, due to bounded rationality (Simon, 1955) people do not evaluate all available options when making a decision and do not carry out a full cost-benefit analysis of the possible options. Instead of choosing the best option, people often satisfice, by choosing an option that is good enough, rather than optimal. In addition, the rebound effect does not acknowledge that people may implement energy-efficiency measures out of, for example, pro-environmental motivations, but it implies that people would be driven solely by financial motivations. Therefore, we argue that, in addition to economic considerations, psychological factors related to spillover explain part of why intended energy savings are limited by subsequent behavioral responses. Since the rebound effect and psychological factors are rarely studied together (e.g., Reimers et al., 2021), combining both pathways could provide a more complete picture.

1.2 Moderators of behavioral spillover

As we described in the beginning of this chapter, spillover effects generally appear to be small but they may be larger under certain circumstances. Previous studies identify several factors that moderate the spillover process. In general, these moderators receive less attention in spillover studies, while they are of equal importance as other elements of the process. More attention for these moderators would help to bring some coherence to the literature (Carrico, 2021). Here we focus on two moderators that are related to PEB1 and PEB2: perceived similarity of the behaviors, and perceived effort associated with the performance of the behaviors.

1.2.1 Similarity of behaviors

The degree of *similarity of behaviors* is described as an important moderator of spillover (Bratt, 1999; Thøgersen, 2004; Truelove et al., 2014). In the literature that explicitly focuses on spillover and similarity, most studies assess the similarity of subsequent behaviors according to domains such as energy, recycling, or food-related behaviors (Juhl et al., 2017; Nash et al., 2019). Gatersleben et al. (2002) showed that people tend to be more likely to co-perform behaviors in similar domains. In other words, when behaviors are perceived as more similar positive spillover might be more likely (Margetts & Kashima, 2017; Thøgersen, 2004). Meta-analysis by Maki et al. (2019) indeed showed that PEBs that were assessed as highly similar (based on the goal of the behaviors and the similarity of the actions) led to more positive spillover compared with behaviors assessed as being of medium or low similarity. Negative spillover has more often been found between domains, or when behaviors are dissimilar (e.g., Tiefenbeck et al., 2013; Werfel, 2017). For example, Geng et al. (2016) found that after a green purchasing task, respondents were less inclined to save water. There are several explanations for these findings.

Striving for consistency

One explanation is that people strive for consistency between behaviors and beliefs, and choose to behave consistently when they assess behaviors to be similar. When people do not perceive behaviors as similar, they might not see inconsistency (Thøgersen, 2004). Therefore, in that case consistency and a desire to prevent dissonance are both absent and there is no incentive to perform the subsequent PEB2.

Mental accounting

Mental accounting may provide an additional explanation of why similarity is important. The mental accounting hypothesis states that people use psychological accounts to organize, evaluate, and keep track of their financial activities (Thaler, 1999). Expenditures are mentally grouped into categories (for example, housing, food, leisure, etc.) and spending can be constrained by implicit or explicit budgets. Studies show that people indeed apply mental accounting to their finances (e.g., Abeler & Marklein, 2017; Antonides et al., 2011;

Shefrin & Thaler, 1988). For example, Tversky and Kahneman (1981) found that a loss occurring inside an account is perceived differently than a loss occurring outside an account. When people imagined losing a 10-dollar theatre ticket, they were less likely to buy a new ticket than when they imagined losing the same amount in bills. Mental accounts are believed to have several functions, including simplifying decision making and applying self-control to keep individual or household finances under control (Antonides & Ranyard, 2017; Zhang & Sussman, 2018). Additionally, the mental accounting processes of integration and segregation may have hedonic functions, such as buffering the pain of payment (by integrating expenses or losses) or distributing positive experiences (gains) in an enjoyable way (Thaler & Johnson, 1990). These principles are part of the hedonic editing hypothesis. Mental accounts have been described as categories that are organized around active goals (Paul et al., 2018). Pursuing a goal requires protecting it from competing goals, which can be accomplished by committing resources (e.g., money, attention, effort) to that goal rather than to others (Brendl et al., 1998). People would, therefore, be more inclined to subsequently spend these resources within the same category than in a different category. Applying mental accounting principles to spillover would imply that positive spillover is more likely within accounts and negative spillover is more likely between accounts.

Knowledge

Finally, perceived similarity of PEBs may be related to people's level of knowledge about the environmental impact of behaviors. It is expected that people with much environmental knowledge recognize that certain behaviors are related (and are thus similar) and might therefore be more likely to engage in positive spillover rather than negative spillover (Truelove et al., 2014). On the other hand, people with little knowledge might be more likely to engage in negative spillover because they do not see a relation between a previous PEB and their follow-up behavior. This possible effect of knowledge raises the question of how people perceive similarity and whether perception of similarity may be more complex than using domains. Moreover, although there is evidence that similarity is related to positive spillover and dissimilarity to negative spillover, there are also contradicting studies that show positive spillover between categories and thus people engaging in dissimilar behaviors (e.g., Lanzini & Thøgersen, 2014; Thøgersen & Ölander, 2003; Xu et al., 2018) or that suggest negative spillover within categories (e.g., Chatelain et al., 2018; Truelove et al., 2014; Weber, 1997). In addition, meta-studies on licensing find that moral licensing is not domain-specific and licensing effects occur equally within and between domains (Blanken et al. 2015; Miller & Effron, 2010). For example, behaving morally does not only license subsequent immoral behavior, but other type of behaviors as well, such as unhealthy food choices (Adriaanse & Prinsen, 2017). All in all, there remain several questions to be answered.

1.2.2 Perceived difficulty and effort

Next to perceived similarity, the perceived level of difficulty or effort associated with PEBs is described as an important moderator of spillover (Truelove et al., 2014). Difficulty and effort are closely related concepts. In psychological studies, *effort* has been defined as

the mental or physical activity to meet some goal (Inzlicht et al., 2018). It is generally assumed that effort is costly and that people avoid it to spare their resources; i.e., the principle of least effort (Zipf, 1949). Within studies on effort the *perceived difficulty* of a behavior is a key concept. Perceived difficulty enables individuals to avoid wasting effort as it provides information about the resources required for task success (Richter et al., 2016). In other words, when people know the difficulty of a behavior they can estimate how much effort they have to invest to complete the task.

In general, PEBs that are easier to perform and therefore require less effort are more likely to be adopted, and vice versa: when PEBs are more difficult and require more effort, people are less likely to perform them (Attari et al., 2011; Urban & Ščasný, 2016). Furthermore, it is known that current choices are often evaluated with the knowledge of the outcomes which have preceded them (Thaler & Johnson, 1990), and several studies indeed suggest that the difficulty of one behavior affects the likelihood of the uptake of another (e.g., Truelove et al., 2016). For example, Lanzini and Thøgersen (2014) revealed a positive spillover from purchasing ecological products to other low-cost PEBs. In a recent meta-analysis, Maki et al. (2019) show that (contrary to their expectation that difficult PEB1s would lead to more positive spillover than easy PEB1s) easy PEB1s led to more negative spillover on PEB2 compared to moderately difficult PEB1s that produced no spillover on behavior. In line with these findings, but in a different domain, Gneezy et al. (2012) showed that costless (in monetary terms) prosocial acts led to less subsequent prosocial behavior; a negative spillover. Consistent with what Maki et al. (2019) expected but did not find, Gneezy et al. (2012) showed that costly first prosocial behaviors led to more subsequent prosocial behavior; a positive spillover. An explanation would be that the performance of a difficult PEB1 strengthens one's environmental identity and thus leads to more positive spillover than performance of an easy PEB1 (Maki et al., 2019). In both studies, the difficulty of PEB2s was, however, not clearly specified while this seems relevant. In these current times when there is a need for more ambitious behavior changes, especially the effect on the performance of difficult PEB2s should receive attention. Lauren et al. (2016) did study the spillover effect from self-reported easy and difficult water-related PEB1s to a difficult water-related PEB2. They found that the performance of easy behaviors was not related to the performance of more difficult behaviors, while the performance of subsequent difficult behaviors was related: after performing a difficult PEB1 people more often performed another difficult PEB2. However, in an experimental study on sustainable choices Penz et al. (2019) showed that difficulty of PEB2 did not seem to matter: they found a positive spillover of equal size between an easy PEB1 and an easy PEB2, and between the easy PEB1 and a more difficult PEB2. In other words, the literature on difficulty and spillover between two behaviors generally shows mixed results and further study is needed.

1.3 Research goals and overview of chapters

As this introduction shows, behavioral spillover has been investigated in several studies, but there are still numerous gaps in knowledge on its exact workings. Although spillover between one behavior and another does occur (especially negative spillover), this is not always the case, and we do not know why it occurs in one situation and not in another.

This uncertainty is possibly related to remaining questions with regard to the existence and working of underlying psychological processes of balancing morality (compensating good and bad deeds) and identity. In addition, behavioral spillover appears to be a small effect, but certain circumstances may increase the probability of its occurrence; that is, when behaviors are perceived as similar, or when the difficulty of the behaviors in some way is aligned. For both moderators, it is necessary to provide more insight into exactly what they mean. For instance, when and why are behaviors perceived as similar (Chapter 4) or as easy or difficult (Chapter 5)? Next to these psychological processes, the economic path of the rebound effect may provide an explanation of spillover (Chapter 3). The overall aim of this dissertation is to increase insight in this mechanism of behavioral spillover, including its moderators. This dissertation therefore consists of four studies that focus on different elements of the spillover process.

I started our research with a series of interviews (n = 26) to gather ideas and insights about how people think and talk about concepts related to PEB, behavioral spillover and rebound effect in their daily life. Chapter 2 describes this qualitative study that includes both the psychological and the economic pathway leading to behavioral spillover, in particular negative spillover. We want to gain insight into people's motivations and arguments to behave environmentally-unfriendly and explore people's level of awareness of both pathways. Our main questions are whether people are aware of processes such as *moral licensing* and the *rebound effect*, and if they acknowledge their occurrence. Moreover, we investigate *perceived difficulty* by asking participants how they perceive the effort of several PEBs and to motivate their assessment. We find that although some people can imagine that moral licensing and rebound effect may occur and provide examples from their own lives, most people assess these concepts as not rational. People seem unaware of the relation between PEB1 and PEB2, and therefore inconsistencies in behavior go unnoticed. As people are good at rationalizing why they do not perform specific PEBs, they in general feel satisfied with their own pro-environmental actions. Furthermore, results indicate that when people perceive behaviors as more effortful they increasingly seem to use arguments to motivate and rationalize why performing the behavior is difficult or impossible. Based on these qualitative results, we developed our follow-up studies.

Since behavioral spillover implies a causal relation between an initial and subsequent PEB, it is important to study causality between behaviors and the psychological processes underlying these relations (e.g., Nilsson et al., 2017). Chapter 3 therefore focuses on spillover in an experimental setting. More specifically, we investigate negative spillover and the indirect rebound effect, thereby combining economic (*income effect*) and psychological (*moral licensing, consistency*) explanations. In addition, we study how people's knowledge of the environmental impact of goods affects these processes. On the basis of a pre-study and a pilot we develop an online experiment that revolves around performing a task (behavior 1), earning money, and subsequently spending this money on a reward (behavior 2). By means of this experiment we test whether participants (n = 725) are prone to the indirect rebound effect. Furthermore, we investigate if an *environmental motivation* or a *financial motivation* to perform the task in combination with providing i*nformation on environmental impact of the reward* affect the size of the rebound effect. We find evidence that people are prone to the indirect rebound effect. However, when their knowledge on the environmental impact of the

rewards improves because they receive information, they choose more pro-environmentally and thus both the rebound effect and negative spillover decline. Furthermore, when people receive information and have the idea that they perform behavior 1 from an environmental motivation (instead of a financial motivation) they are most eager to choose pro-environmentally. We argue that psychological processes related to consistency and identity are the main drivers of this result. In our study the evidence for moral processes affecting the choice of rewards is less clear.

Chapter 4 focuses on the moderator *perceived similarity*. Although many studies assume and indicate that people assess similarity of subsequent behaviors by whether they are in the same domain, it is important to acknowledge that the degree to which two behaviors are similar in one person's mind may differ from the way they are perceived as similar in another's mind (Thøgersen, 2004). Next to using domains as a way to cluster behaviors, people also appear to categorize behaviors using, for example, environmental impact, frequency, difficulty and location (Gabe-Thomas et al., 2016; Kneebone et al., 2018; Seebauer, 2022; Truelove & Gillis, 2018). In this study we therefore investigate how people cluster a variety of 17 PEBs. We use a sample of the Dutch public (n = 1,536) to perform an online clustering task. We analyze how people cluster the PEBs and why. We find that people mainly cluster behaviors according to domains (such as energy, mobility), but they also apply other categorization types. Moreover, we explore potential spillover between people's current behaviors and their desired behaviors, and how clustering affects this behavior–desire spillover. Positive spillover from actual to desired behavior occurs both within domains and between domains. Moreover, clustering behaviors into different categories is related to having a relatively strong overall desire to behave pro-environmentally.

Chapter 5 focuses on the moderator *perceived difficulty.* Particularly, using the same sample of the Dutch public as in Chapter 4 (n = 1,536), we investigate how a combination of *personal motivation*, and the *difficulty* and t*he perceived effort of a PEB*, predict the performance of PEBs in various domains. By means of Rasch analysis we identify the difficulty of 17 PEBs and estimate respondents' pro-environmental motivations. In addition, we investigate if performance of certain PEBs increases the probability of performing other PEBs. This way we identify for each level of motivation which PEBs respondents are (probably) performing and which PEBs they do not yet perform, but will be the easiest-to-perform, new behaviors. Furthermore, using a non-recursive structural equation model (SEM) we investigate the relations between perceived effort, PEB performance, motivation, underlying traits, and demographics. Results show a feedback loop between motivation and perceived effort: when respondents are motivated, they perceive behaviors as less effortful and in addition lower perception of effort is related to higher motivation. Our results imply that people mainly perform PEBs that fit their level of pro-environmental motivation and that they are inclined to do the things of which they can justify the effort they need to invest. This amount of effort seems quite similar for people: no one wants to invest too much effort, but people differ considerably in how effortful they assess different behaviors. Our study thus indicates that rationalizations play a key role.

Finally, Chapter 6 integrates the obtained results and draws general conclusions based on the studies of separate elements in the different chapters. In addition, we discuss the scientific relevance and practical implications of our main findings.

Chapter 2:

Rationalizing inconsistent consumer behavior

Understanding pathways that lead to negative spillover of pro-environmental behaviors in daily life

This chapter is based on: Dreijerink, L., Handgraaf, M., & Antonides, G. (2021). Rationalizing inconsistent consumer behavior. Understanding pathways that lead to negative spillover of pro-environmental behaviors in daily life. Frontiers in Psychology, 12, 583596.

Abstract

Ideally, pro-environmental consumer behavior leads to a lower impact on the environment. However, due to negative behavioral spillovers environmentally-friendly behavior could lead to an overall higher environmental impact if subsequent environmentally-unfriendly behavior occurs. In this exploratory interview study, we focused on two pathways leading to negative spillover: a psychological path (perceived effort, moral licensing) and an economic path (rebound effects). We wanted to gain insight into people's motivations to behave environmentally-unfriendly and to explore people's level of awareness of both pathways. Our results indicate that pro-environmental behaviors that are associated with higher effort are performed less frequently, and that when people do not perform these behaviors they associate them with higher effort levels. When people perceive behaviors as more effortful, they increasingly seem to use arguments to motivate and rationalize why performing the behavior is difficult or impossible. Moreover, we found that although some people can imagine that moral licensing and rebound effects could occur and can provide examples from their own lives, most people assess these concepts as not rational. People seem unaware of the relation between a first pro-environmental behavior and a subsequent behavior, and therefore inconsistencies in behavior go unnoticed. As people are good at rationalizing why they do not perform specific PEBs, they in general feel satisfied with their own pro-environmental actions. In order to discourage negative spillovers, we describe a number of approaches and research ideas aimed at taking away the grounds for rationalization.

2.1 Introduction

Pro-environmental behavior (PEB) takes many forms, such as insulating one's home, eating less meat, recycling empty glass bottles, or using a bicycle. Studies show that people do not behave pro-environmentally consistently. For instance, people can recycle their waste but at the same time make environmentally-unfriendly mobility choices (Steg & Vlek, 2009), and saving energy at home does not mean that people save energy while on holidays (Barr et al., 2010). Other studies, however, show that most people do desire to behave consistently (Thøgersen, 2004). Van der Werff and Steg (2018), for example, describe that when people realize they engaged in PEB, their environmental self-identity is likely to be strengthened, thus increasing the likelihood of performing other PEBs. In this case the first behavior leads to the second behavior. This sequence of behaviors is characteristic of behavioral spillover. Originally, Thøgersen (1999) defined spillover in terms of a change in attitude and/or behavior concerning a specific activity produced by a targeted effort at one time that may spill over into related areas at another time. As spillovers can also occur when the first PEB is not caused by a targeted effort (or intervention) and behaviors can also spill over to unrelated areas, we accept a broader definition as a starting point: acting in a pro-environmental way changes a person's likelihood or extent of performing other PEBs (Lanzini & Thøgersen, 2014). Behavioral spillover can be positive when the adoption of a particular PEB is found to increase a person's inclination to engage in another PEB. Conversely, spillover can be negative, in which case the reverse effect is observed: after adopting a particular PEB, the probability of an individual adopting another PEB declines (Thøgersen & Cromp-

ton, 2009). Studies show that both negative and positive spillovers occur (Galizzi & Whitmarsh, 2019; Maki et al., 2019), but why one or the other occurs remains largely unclear and calls for more research. In this study we focus on the occurrence of negative spillovers. In the literature several examples of negative spillover are described, for instance, people who purchased more green products subsequently consumed greater amounts of water compared to people who purchased less green products (Geng et al., 2016), and people who committed to doing something good for the environment, subsequently donated less to an environmental program (Clot et al., 2016). Spillovers thus imply a correlation between behaviors (e.g., Thøgersen, 2004); only when this correlation is significant the term behavioral spillover is applicable[2]. When there is no correlation between PEBs, behaviors apparently are unrelated activities. If people behave inconsistently with regard to their PEBs, this may therefore be caused either by negative spillover or because behaviors are not perceived as being related. In the latter case people may not experience any inconsistency when performing one behavior and not the other.

2) In addition to behavioral spillover, Nilsson et al. (2017) describe the existence of temporal and contextual spillovers. In this paper we focus on behavioral spillover.

Various psychological traits have been identified to explain the occurrence of both types of behavioral spillover, including environmental concern, values (e.g., Carrico et al., 2018; Van der Werff et al., 2014), or preference for consistency (Cialdini et al., 1995). Environmental identity (i.e., the degree to which individuals see themselves as environmentally friendly) in particular has been suggested to play an important role. Sticking to negative spillovers, Truelove et al. (2014) for example suggested that among people with a weak or lacking pro-environmental identity negative spillover may be more likely when behaviors are similar. In addition, Gneezy et al. (2012) showed that the cost of prosocial behaviors serves as a signal of identity and subsequently people behave in line with that self-perception. When initial behaviors are perceived as relatively easy or costless, a person would not perceive him or herself as a prosocial person, and negative spillover is more likely to occur. Truelove et al. (2014) therefore stated that participants' perceptions of the costs of behaviors are of primary importance to predicting whether or not negative spillover will occur. In line with this recommendation, we investigate the perceived effort of various PEBs in this study. In addition to the role of identity, Gneezy et al. (2012) described licensing as an explanation for the negative spillover observed in their study. A moral license allows people to act without fearing that they will morally discredit themselves (Miller & Effron, 2010). By applying moral licensing people feel free to act immorally after an initial moral act. Negative spillover is often attributed to moral licensing (Galizzi & Whitmarsh, 2019; Maki et al., 2019), which is therefore an important concept in our study of negative spillovers. We will elaborate on this phenomenon in the theoretical framework below.

In economics spillovers at the individual behavioral level also have been studied, albeit using a different terminology[3]. The rebound effect is a well-known example and is particularly relevant to our study as it describes a negative spillover. The rebound effect has been studied widely (e.g., Ehrhardt-Martinez & Laitner, 2010; Ruzzenenti et al., 2019) and concerns how consumers react to a lower price of an energy service by consuming more (for instance lighting) after they took an energy efficiency measure (for instance, buy

3) In economics the spillover effect is also often used to describe macro effects of events occurring in one nation or region having an effect on the economies of other nations or regions (e.g., Baicker, 2005), which is different from the type of spillover behaviors in our study.

energy-efficient light bulbs). Because of the lower price, the so-called budget line for a particular energy service shifts and as a result consumer behavior changes: consumers will buy more of the energy service (such as light) than before, as the service has become cheaper. The type of economic decision making as described by the rebound effect only includes economic factors that affect consumption of the particular energy service. However, Santarius et al. (2018) pointed out that over the years the rebound effect has evolved from being considered from a neoclassical economic perspective only, to including several other social scientific disciplines such as psychology and sociology. Nonetheless, research on psychological effects related to rebound effects is still limited. To our knowledge there are no studies into how people perceive rebound effects and if people are aware of the occurrence of rebound effects.

Here, we especially focus on two pathways leading to negative spillovers: a psychological path (perceived effort, moral licensing) and an economic path (rebound effects). Our overall aim is to gain insight into people's motivation to act environmentally-unfriendly. Moreover, we explore people's level of consciousness of both the psychological and the economic pathway. We define the following research questions: 1. What is the role of perceived effort of PEBs within motivation to act environmentally-unfriendly? 2. Are people aware of moral licensing and does it apply to them? 3. Are people aware of rebound effects and do they apply to them? For further exploration, we add a final question: 4. Does perceived environmental impact (such as carbon emission) affect people's motivation to act environmentally-unfriendly? We expect that people use different motivations to explain their environmental decisions, and that effort expended on PEBs plays an important role in these motivations. In addition, we expect that people do apply moral licensing and justification strategies but as these processes are not fully deliberative, we explore how people describe them. Finally, we expect that people are unaware of how they spend the money they save by behaving pro-environmentally. Since we want to investigate people's opinions, views, and use of these concepts in the context of their everyday life, we decided to use a qualitative approach.

2.1.1 Theoretical framework

Perceived effort of PEBs

The concept of effort is studied across various fields, but proves hard to define. Steele (2020) makes a distinction between actual effort (objective effort), and the perception of that effort (subjective effort). Perceived effort thus builds on actual effort. As we are interested in how people perceive the effort of PEBs and the role of perceived effort within their environmental motivations, in the following we only discuss perceived effort.

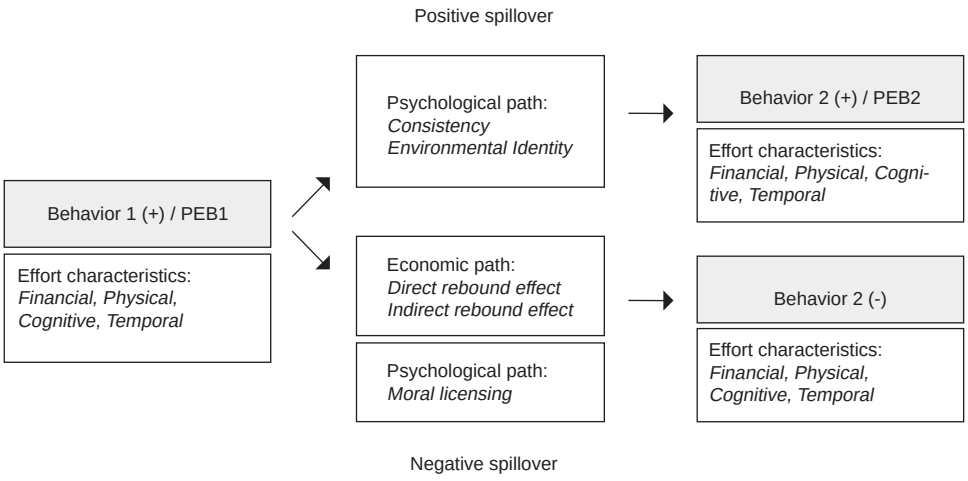
A behavior that is perceived as easier to perform is more likely to be adopted, and vice versa: when behaviors are more difficult and require more effort to carry out people are less likely to perform them (Attari et al., 2011; Osbaldiston & Schott, 2012; Urban & Ščasný, 2016). Moreover, among people who are concerned about the environment, the strength of that concern diminishes as behaviors become more difficult or costly (Diekmann & Preisendörfer, 2003). Attari et al. (2011) identified four barriers that affect the ease of behavioral

uptake, namely financial, physical, cognitive, and temporal barriers. The level of perceived effort of a PEB may therefore be determined by any combination of the perceived effort on these four barriers. For instance, a PEB may be perceived as effortful as one person may associate it with taking up much time and investing physical exertion, while another perceives it as effortful since he or she first has to dive into learning more about it.

Insight into how people perceive the difficulty of various PEBs is of importance to predicting spillovers (Truelove et al., 2014). There is reason to believe that the sequence of behaviors and their perceived difficulty or effort levels matter for spillover: an easy PEB followed by a difficult PEB may have a different behavioral outcome than the reverse order. The evidence for positive spillover between PEBs of comparable ease, for example, seems strong (Thøgersen & Crompton, 2009), but overall the current state of research paints an incomplete picture. In their meta-analysis Maki et al. (2019) showed that easy first PEBs led to both more positive and more negative spillovers compared to moderately difficult PEBs. Unfortunately, no previous studies tested the effect of a difficult or effortful first PEB on a subsequent PEB, and therefore the meta-analysis could not provide insight into this issue. With regard to prosocial behavior Gneezy et al. (2012) found that costly (in monetary terms) first prosocial behaviors subsequently led to more prosocial behavior, while costless prosocial acts led to less subsequent prosocial behavior. The costs of the subsequent behaviors were not the focal point of the study and were not clearly specified, but we would argue that the subsequent behaviors were costly. In that case their outcome seems in line with findings by Maki et al. (2019) stating that, when the subsequent PEB is difficult, more negative spillovers occur. All in all, in order to explain or predict the occurrence of both negative and positive spillovers, it is necessary to include and consider the perceived difficulty or effort level of the first and subsequent PEBs. Figure 2.1 describes both the psychological and economic pathways of negative spillover, to be considered next.

Figure 2.1

Economic and psychological pathways in positive and negative behavioral spillovers from an initial pro-environmental behavior (PEB1) to a subsequent Behavior 2



Psychological pathway: moral licensing

As described, by applying moral licensing people feel free to act immorally after an initial moral act. For instance, after investing in an energy-efficiency measure, a person may feel morally permitted to be less frugal with energy. The licensing phenomenon was first introduced in relation to moral issues but has also been studied in the context of consumer behavior, health and eating behavior—under the name of self-licensing. Adriaanse and Prinsen (2017) described that licensing effects are not domain-specific. Behaving morally does not only license subsequent immoral behavior, but unhealthy food choices as well. Consumer behavior studies have found similar cross-domain effects, by demonstrating that respondents were more likely to choose luxury over necessary goods when they just had committed to a charitable act (e.g., Khan & Dhar, 2006). Negative spillover is often attributed to moral licensing (Galizzi & Whitmarsh, 2019; Maki et al., 2019). Additionally, moral licensing is used as a psychological explanation for the rebound effect (Friedrichsmeier & Matthies, 2015).

It is unclear if processes of moral licensing and self-licensing take place unconsciously or consciously. Khan and Dhar (2006) showed that consumers may be unaware of how their prior decisions influence their subsequent choices, and therefore that the process underlying the moral licensing effect may be largely unconscious. Blanken et al. (2015) also state that people may not consciously feel that after displaying certain good behavior "A" they can now engage in undesirable behavior "B." However, perhaps people who deliberate on a dilemma in which they would like to engage in undesirable behavior "B" (e.g., driving their car for a short distance) are more likely to find a reason why that is acceptable after having just performed a good action (e.g., separating their plastic waste). In that case moral licensing would be a deliberate justification strategy to excuse morally questionable behaviors. This process fits the self-licensing definition of De Witt Huberts et al. (2014, p. 121): "the act of making excuses for one's discrepant behavior before actual enactment, such that the prospective failure is made acceptable for oneself." De Witt Huberts et al. (2014) state that self-licensing is not only about being more likely to give in to temptation in response to feelings of deservingness after having behaved responsibly, but also encompasses active engagement in using and searching for available justifications. We therefore hypothesize that people do not take into account prior pro-environmental decisions in a fully deliberate way and we expect that people let these prior decisions influence their subsequent choice. Finding justifications for one's environmentally-unfriendly choices is part of this process. As De Witt Huberts et al. (2014) described, there need to be impulsive motivations that interfere with long-term goals, otherwise justification processes are unnecessary. A justification functions as some kind of credential that then serves as a license to choose an option that would otherwise create negative attributions for the self, such as acting against one's intentions. Anything can act as a justification and the number of justifications can be infinite, as long as it is generated during a self-regulation dilemma, and as long as it forms an allowance that acts against achieving one's long-term goal. In the present study we aim at exploring licensing and justifications by asking people a number of questions in personal in-depth interviews. This approach implies that we mainly collect information on rational and conscious attributes and not so much on the undeliberate aspects of licensing.

Economic pathway: rebound effects

The rebound effect is an economic explanation of a negative spillover (see Figure 2.1). The rebound effect is commonly used in economics as an umbrella term for a number of mechanisms reducing the impact of energy savings achieved from improvements in energy efficiency (Sorrell, 2012). The economic literature identifies three types of rebound effects that encompass both micro- and macroeconomic perspectives: the direct rebound effect, the indirect rebound effect, and economy-wide effects (e.g., Aydin et al., 2017; Greening et al., 2000; Sorrell et al., 2009).

The direct rebound effect occurs when an energy efficiency improvement for a particular energy service reduces the price of this service (Aydin et al., 2017; Verboven & Vanherck, 2016). As a result of a combination of the income effect and the substitution effect the consumption of the same energy service increases. The income effect reflects the increase in purchasing power due to a lower price of the service. The substitution effect describes that the lower price of a service may shift consumption patterns to an increased purchase of this service instead of more expensive alternatives. For example, energy-efficient light bulbs make lighting cheaper, thereby encouraging people to illuminate larger areas to higher levels over longer periods of time (Chitnis et al., 2013). Since lighting is cheaper, people can afford to use these light bulbs more often as they have more money to spend (income effect) and this type of lighting is attractive since it is cheaper than other types of lighting (substitution effect). In Figure 2.1 the direct rebound effect is depicted at the bottom, economic pathway. Using the previous example, the first behavior (PEB1) is a person buying energy-efficient light bulbs, and subsequently this person performs Behavior (2) that has a negative environmental effect: illuminating larger areas to higher levels over longer periods of time. Note that within this sequence of behaviors associated with the rebound effect there is also a PEB0 that is similar to Behavior 2, namely light consumption.

The indirect rebound effect occurs when the reduction of the cost of the energy service leads to changes in demand for other goods and services that also require energy or resources (Aydin et al., 2017; Verboven et al., 2016). In other words, the indirect rebound is about how one spends the money one saves, on other goods or services (Jenkins et al., 2011). For example, cost savings from more energy efficient lighting may be spent on an overseas holiday (Chitnis et al., 2013). The indirect rebound effect can also be explained by income and substitution effects. The economy-wide rebound effect represents the sum of the direct and indirect effects (Sorrell, 2007). In Figure 2.1 the indirect rebound effect is also depicted at the bottom, economic pathway. In this case the first behavior (PEB1) is, for example, again a person buying energy-efficient light bulbs, and subsequently this person performs Behavior 2 that has a negative environmental effect: saving up for an overseas holiday. Note that in this case there also is a PEB0 (light consumption) but this behavior is dissimilar to Behavior 2.

2.2 Materials and method

2.2.1 Participants

From December 2017 until the beginning of October 2018 we conducted 26 semi-structured face-to-face interviews. Respondents were recruited via family, colleagues, Facebook, and community websites (such as Nextdoor). All interviews were conducted by one researcher, in the Dutch language. We aimed for a mixed group of participants that varied in income level (high, medium, low), gender (male, female), and age (under 30, 30-40, 40-55, over 55), of in total 24 respondents. In practice, when organizing the interviews, some cells were filled easily and more frequently, while others were not. The final group of 26 participants was a good mix: respondents varied in age (M = 45.5; SD = 18), gender (12 males, 14 females), income level (10 above the Dutch modal income[4], 10 approximately modal income, and six below the modal income) and place of residence (from cities to smaller towns, all in the central part of the Netherlands). Participants that were recruited via public channels were offered a reward for their participation: a gift voucher or a donation to charity (value 30 euro). People who were acquainted with the interviewer through family were not offered a reward (n=6), since people participated as a favor. Interviews took on average about 45 minutes, with a minimum of 25 minutes and a maximum of 1 hour and 15 minutes. The interviews took place at Wageningen University (n=4), at people's homes (n=15), at their place of work (n=1) or in a cafe (n=6). All interviews were recorded (after the participant's consent) and anonymously transcribed by a student-assistant. Quotes in this paper were translated as literally as possible from Dutch into English.

4) The Dutch modal income is the household income before taxes. In 2017 the annual modal income was €36,500 (monthly €2,816).

2.1.2 Materials and procedure

Interview

During the interview we asked the respondents to answer 15 questions and to complete one task concerning PEBs and effort (the interview scheme is added in Appendix 2.1). The first set of questions was about gaining insight into motivations related to environmental decision making in daily life. First of all, we asked people to provide examples of their environmentally-friendly behaviors (Question 1) and environmentally-unfriendly behaviors (Q2), in order to learn what kind of behaviors respondents performed and what behaviors were associated with both concepts. Next, we asked them to assess the overall picture of the examples they provided with respect to environmental friendliness (Q3), in order to get insight into how respondents weighed different behaviors and to determine their satisfaction with their own behaviors and choices. In addition, to learn if information about carbon emissions or environmental impact would motivate respondents, we asked if they ever thought about the effect (impact) of their behavior on the environment (Q4).

Furthermore, the next set of questions was about rebound effects, as we wanted to know how aware respondents were about the occurrence of this phenomenon and how they would assess it. First, respondents were asked to think of an example in which be-

having pro-environmentally led to financial savings (Q5). Second, we asked what respondents thought about saving money by acting pro-environmentally and subsequently spending these savings in an environmentally-unfriendly way (Q6). Third, we asked if people ever thought about how to spend money they saved by behaving pro-environmentally (Q7).

After the effort scoring task (see next section) we asked respondents questions about moral licensing, in order to gain insight into how aware respondents were about moral licensing, what their thoughts were on the concept and whether or not they would apply it. We asked respondents whether they agreed or disagreed with each of two statements on moral licensing (Q9, Q10; e.g., "When I do something pro-environmentally that takes a lot of effort, I feel I can behave less pro-environmentally for a while").

Finally, we asked respondents whether they agreed or disagreed with three statements on having an environmental effort budget (Q11, Q12, Q13; e.g., "I have the feeling I have a limit or budget for behaving pro-environmentally. Some things take too much effort and therefore I do not do them"). With these questions we wanted to gain insight into respondents' thoughts about having this kind of budget (not reported here).

Effort scoring task

Halfway during the interview, we used an effort scoring task (Q8 in Appendix 2.1) to assess the amount of effort participants associated with 18 PEBs. By means of this task we wanted to learn how much effort respondents associated with each PEB and how this affected their motivation to perform these PEBs. Moreover, we wanted to gain more in-depth insight into how respondents substantiate their effort assessments for each of the PEBs.

In order to accomplish a full view of environmental behavior a broad set of PEBs was needed. We therefore selected 18 behaviors from the General Ecological Behavior (GEB) scale version, as described by Arnold et al. (2017) that were suitable for the Dutch situation. We selected the 18 PEBs to represent six consumption domains: housing, mobility, food, leisure, work, clothing, and goods. Moreover, we selected PEBs to represent different levels of environmental impact, including low impact behaviors that would lead to avoiding small amounts of greenhouse gas emissions (such as reading or recycling) and high impact behaviors that would lead to avoiding much larger amounts of emissions (for instance not going on holiday by airplane or insulating one's home). Participants indicated on a 10-point scale whether they thought a PEB would cost them very little (score 1) to very much effort (score 10). They were handed an A3 sheet with the 10-point scale printed on it and 18 pieces of paper with the names of the PEBs. In addition to scoring the PEBs participants were asked to explain the scores they attributed to each of the PEBs.

Analysis

We analyzed the transcriptions using Atlas.ti, Qualitative Data analysis software, version 8. In total 121 codes were used to code the transcriptions. Codes were defined at the start of the coding process, since we knew specific topics would certainly be discussed (e.g., indirect rebound, or effort). We also added codes to the list during the coding process, often comprising more detailed topics (e.g., compensation, guilty feelings, or footprint). We

used both content analysis (What concepts are mentioned?) and domain analysis (Who says what?). Since Atlas.ti provided reports for each code, an overview could be obtained directly. Moreover, we looked at co-occurrence of different labels: for example, if people who indicated driving a car also went on holiday by airplane. The co-occurrence tool and the network options in Atlas.ti were used for this purpose.

In addition, we developed an SPSS dataset in which we quantified the main variables: effort per PEB, overall effort score per person, licensing (awareness and occurrence), and the rebound effect (awareness and occurrence). For each respondent we related the effort scores per PEB to whether or not they performed the PEB, resulting in an effort score per respondent for behaviors they did perform and for behaviors they did not perform. We calculated an overall effort balance by subtracting the effort for PEBs they did not perform from the PEBs they did perform.

Following the definition of effort by Attari et al. (2011) we labeled the arguments respondents used to explain the effort score for each PEB being financial, physical, cognitive, and/or temporal. In other words, if a respondent described a PEB as being effortful because it took a lot of time, physical exertion and was expensive, we coded their response with the labels temporal, physical, and financial, respectively. Next to the four types of effort we added three labels for behaviors being habitual (always do things a certain way) or being affected by the physical surroundings or social context. These three types of arguments were defined during the coding process as the four effort types appeared insufficient to cover all arguments. We analyzed if respondents who did perform or did not perform the PEB used different arguments, and if respondents with different effort balances used different arguments.

Net environmental impact (NEI)

At the start of the interview, we asked respondents to provide examples of their environmental behaviors. For each of these behaviors we made estimations of the average amount of CO2 emission in kilograms per year, using internet sources. We relied mainly on the Dutch website of Milieu Centraal (www.milieucentraal.nl) that provides thorough information for the public on environmental impacts based on lifecycle assessments (LCA). For the PEBs we estimated the avoided CO2 emissions, while for the environmentally-unfriendly behaviors we estimated the realized CO2 emission. Since behaviors were not specified with respect to frequency or duration, we were unable to calculate the actual impacts, so we categorized them roughly into low, medium, and large effect behaviors. We then made an assessment per respondent of whether the Net Environmental Impact (or the sum of their examples) was negative, neutral, or positive. We asked two researchers with expertise in calculating environmental impacts (including LCA) to assess our estimations of the net environmental impact (NEI) of each respondent's examples. We incorporated their comments into the final NEI estimates.

2.3 Results

2.3.1 Effort to behave pro-environmentally (effort scoring task)

We analyzed the results of the effort scoring task in multiple ways. First, we investigated the effort respondents associated with each PEB and discriminated between whether respondents actually performed the PEB or not. In addition, we looked at the arguments respondents used to explain the effort scores. Furthermore, we analyzed how effort scores differed between respondents by means of calculating an effort balance, and in addition investigated the arguments respondents used to explain the effort scores.

Effort of performing the PEBs

Of the 18 PEBs, cleaning up after a picnic (M = 1.1, SD = 0.3) and bringing empty glass bottles to the bottle bank (M = 1.3, SD = 0.5) were assessed as least effortful overall (see Table 2.1). For all 26 respondents this behavior took no effort, and all respondents stated they actually performed these two behaviors. In the selection of the PEBs for this study, these two behaviors were labeled as low impact behaviors (leading to avoiding small amounts of greenhouse gas emissions).

On the other end, being vegetarian (M = 6.4, SD = 2.8) and not buying from non-ecological companies (M = 6.5, SD = 2.1) were associated with the most effort. Being vegetarian was associated with little effort by the four respondents who were vegetarian (M = 1.5, SD = 1.0). Eating this way was habitual for them. Some indicated there was some effort related to the social context, for example making sure there would be a vegetarian or vegan option when having dinner with friends at their place or in a restaurant. Being vegetarian was however associated with high effort by the respondents who were not vegetarian (M = 7.3, SD = 2.0). They enjoyed and valued the taste of meat and fish and would miss it. Taking the time to learn new recipes and buying other products were put forward as additional reasons why this behavior would be effortful for them. Not buying from non-ecological companies was associated with the highest level of effort, also among the respondents performing the PEB (M = 3.5, SD = 1.9)—although for this latter group all effort scores are low. They mentioned the time needed to read about companies and products and about visiting specific shops. With regard to greenhouse gas emission the latter two PEBs are effective in avoiding emissions (but others have an even larger impact).

The results show that respondents reported the performance of the 18 PEBs more often (total of 261, M = 10.0 per person) than non-performance (total of 178, M = 6.8 per person). The PEBs that are generally perceived as less effortful are performed by many, while the PEBs that are perceived as more effortful are performed by fewer respondents. Moreover, respondents associated the PEBs they actually performed with a lower level of effort (M = 2.2, SD = 1.3) and the PEBs they did not perform with a higher level of effort (M = 6.5, SD = 2.1).

Table 2.1

Mean effort scores and standard deviations for the 18 PEBs with a subdivision of scores when respondents did and did not perform the PEB

PEB	Total effort score		Effort score when performing the PEB			Effort score when not performing the PEB		
	M	*SD*	*M*	*SD*	*N*	*M*	*SD*	*N*
Clean up after a picnic	1.1	0.3	1.1	0.3	26			0
Bring empty glass bottles to the bottle bank	1.3	0.5	1.3	0.5	26			0
Do not have towels changed daily when staying in a hotel	2.1	2.0	1.5	0.6	22	8.0	2.8	2[a]
Use public transport or my bike	2.7	2.1	1.8	1.2	21	6.3	1.5	5
Turn off computer screen at work/school when leaving for 10 minutes	2.8	2.1	1.7	1.1	14	4.7	2.1	9[a]
Wear a sweater at home when it's cold	2.8	2.7	1.7	1.0	22	8.5	1.0	4
Behave pro-environmental at work/school	3.2	2.0	2.5	1.5	17	4.6	2.1	4[a]
Use public transport or my bike to get to work/school	3.3	2.9	1.8	1.2	17	8.2	1.0	6[a]
Buy seasonal fruits and vegetables	3.6	2.0	2.5	1.6	15	5.1	1.7	11
Read about environmental issues	3.7	2.7	2.9	2.1	20	6.5	2.5	6
Insulate home to keep it warm	4.0	3.0	3.2	2.8	14	5.1	3.1	9
Install solar panels on roof	4.8	3.4	1.3	0.6	3	5.3	3.3	19[a]
Carpool to work/school	4.8	3.4			0	4.8	3.4	18[a]
Repair goods or clothes that break	5.0	2.8	3.2	1.5	15	7.6	2.0	11
Avoid to buy new goods	5.2	2.9	2.2	1.0	10	7.2	1.7	15[a]
Not go on holiday by airplane	5.8	2.9	3.3	2.3	11	7.1	2.4	15
Be a vegetarian	6.4	2.8	1.5	1.0	4	7.3	2.0	22
Do not buy products from un-ecological companies	6.5	2.1	3.5	1.9	4	7.1	1.5	22
Total	3.8	2.3	2.2	1.3	261	6.5	2.1	178

[a] When the sum of Ns did not add up to 26 this was due to respondents stating that the performance of a PEB was not applicable to them

Next, we analyzed the arguments respondents provided of why the PEBs were effortful. We categorized the arguments about why the behaviors were effortful into financial, physical exertion, cognitive, temporal, habitual, or being affected by the physical surroundings or social context. Respondents who did not perform the PEBs provided more arguments concerning why PEBs were effortful (total of 208) than those who performed the PEBs, see Table 2.2. Dividing the number of arguments by the total numbers of PEBs

that were either performed (261) or not (178), showed that when respondents performed the PEBs they on average named 0.23 arguments, whereas for PEBs they did not perform they named on average 1.17 arguments. Cognitive effort and limitations in the physical surroundings were most frequently used as arguments. Financial arguments were also used, but least often. Respondents who did not perform the PEBs seemed to give the argument of being used to a different behavior (habits) as a reason not to perform the PEB more often, for instance: "We always do our groceries at the local supermarket and never look at environmental aspects" (R19) and "I am just not used to using public transport or my bike. [...] A car is more convenient." (R17). Although the number of respondents to our study was limited, the total number of arguments respondents provided on why the PEBs were effortful was quite large (269). We therefore explored if there might be differences in the type of arguments respondents used when they either performed a PEB or not. By means of a chi-square test we found no difference in the distribution of the number of arguments between the two groups, $X^2(6,N = 269) = 5.718$, $p = 0.456$. The type of effort arguments did not seem to differ between respondents who did or did not perform the PEBs, although the results should be considered with some caution.

Table 2.2

Sum of type of explanations of why the PEBs were effortful, subdivided by respondents performing or not performing the PEBs

Explanation type	Performing the PEBs		Not performing the PEBs		Total (*n*=26)	
	Count	%	Count	%	Count	%
Financial	2	3	11	5	13	5
Physical exertion	10	16	32	15	42	16
Cognitive	18	30	54	26	72	27
Temporal	7	12	19	9	26	10
Habitual	2	3	28	14	30	11
Physical surroundings	17	28	49	24	66	25
Social context	5	8	15	7	20	7
Total	61	100	208	100	269	100

Effort balance

Participants varied with regard to their effort balance (i.e., the effort associated with PEBs they did perform minus the effort associated with PEBs they did not perform) with a mean score of -23 (SD = 24; see Table 2.3). For most respondents the effort balance was negative (n = 21); only five respondents had a positive balance. The most positive balance was 14 (R5) while the most negative balance was -73 (R19). Again, the results show that when respondents did perform the PEBs they associated the PEBs with less effort and when they did not perform the PEBs they associated the PEBs with more effort.

Moreover, we calculated the correlations between effort balance and argument types. As the number of respondents was limited, we want to emphasize that these results are mainly indicative. It showed that when the effort balance of respondents became more ne-

gative they provided more arguments overall (r(24) = -.71, p = .000). Furthermore, the more negative the effort balance the more arguments were provided related to physical exertion (r(24) = -.45, p = .022), habits (r(24) = -.69, p = .000) and the physical surroundings (r(24) = -.61, p = .001). Respondents with a more negative effort balance, for example, mentioned it needed to be nice and comfortable at home without wearing sweater (R17), or being accustomed to eating meat for a lifetime and loving the taste (R19), or enjoying exploring the world and therefore needing to fly by airplane (R6). The correlations with regard to the other types were not significant: financial (r(24) = -.17, p = .416), cognitive (r(24) = .21, p = .315), temporal (r(24) = -.30, p = .131), social context (r(24) = -.10, p = .634), but as most types had a negative correlation coefficient, except for cognitive arguments, this implies that these types were also used more often when the effort balance was increasingly negative. Of the four previously identified barriers that affect the ease of behavioral uptake, cognitive effort seemed the odd one out. When combining the three other effort barriers (physical exertion, financial, temporal) and correlating this with the effort balance we again saw a negative relation (r(24) = -.60, p = .001). It could be that cognitive arguments were used more frequently by respondents with a more positive effort balance, as these respondents are more concerned with environmental behavior and accordingly think more about it.

Table 2.3
Overall results (mean, SD, minimum value, maximum value) of effort balance, effort score when performing, and effort score when not performing the PEBs

Effort score	*Mean*	*SD*	Min	Max
Effort balance	-22	24	-73	14
Effort sum score of performed PEBs	21	6	10	36
Effort sum score of not performed PEBs	44	21	11	92

2.3.2 Awareness and occurrence of moral licensing

Furthermore, we asked if respondents felt allowed to act less pro-environmentally after they did one large effortful PEB, or multiple smaller PEBs that cost little effort. These were two separate questions, but respondents responded similarly to these questions: They disagreed with both. There were a few exceptions of respondents who agreed (n = 4). One student stated that because of her study in consumer science she believed in permitting herself unconsciously: "It could be that it works like this" (R3). Another respondent stated that he did not behave very pro-environmentally and therefore would not know how he would react. One other respondent first indicated that he disagreed, but on second thought he recognized that he sometimes, after five days of eating vegetarian, felt allowed making a stir-fry with chicken. Regarding eating meat, another respondent mentioned that he took some extra meat when eating meat after a vegetarian day.

Although most respondents indicated they disagreed with the suggestion that they would apply moral licensing or compensate for good behavior, we did hear some moral licensing examples at different points during the interviews (see Table 2.4). Strikingly, most

examples were about eating vegetarian or vegan. For instance, one woman described that she recalled feeling OK with throwing away some plastic bags in the regular bin because she ate vegetarian. Another respondent felt that buying a new and not very energy-efficient car was OK because she and her partner decided to become vegetarians. Another respondent described going on a daytrip to Germany by car because he did something pro-environmentally just before (what exactly he couldn't remember). Furthermore, one respondent recalled that he once participated in a study for which he was not allowed to eat dairy products and then started eating more eggs. We would assess all these initial behaviors (PEB1) as effortful, as respondents refrained from eating meat or dairy products while they were used to eating meat or dairy. When we focus on the Behaviors 2, respondents mentioned both easy behaviors (such as recycling the plastic bags after all) and effortful behaviors (for instance switch to a daytrip by another mode of transport). In other words, moral licensing seemed to apply to situations including an effortful PEB1, followed by both easy and difficult subsequent behaviors. The effort balance levels of the respondents who provided licensing examples varied (see Table 2.4). However, none of these respondents had a positive effort balance and none of the respondents were at the extreme negative end of the balance level.

Next to the moral licensing examples we heard a number of striking justifications of why respondents made environmentally-unfriendly choices. For example, one respondent mentioned that not having children sometimes came up in discussions with her husband about behaving pro-environmentally: for instance, that she felt that they could go on a holiday by airplane because they did not have children. She added that this was a bit of a joke but at the same time it had some truth to it. Two other respondents described that they, because of other things in life not going well (due to health reasons), felt allowed to go on a holiday by airplane or eat meat or out of season fruits ("Because of my diet [...] I'm only allowed to eat strawberries, so I need those in the winter too" (R11)). Additionally, the statement that life is about joy and happiness was used as an argument for not wanting to act too frugal.

In sum, our results showed a number of examples of moral licensing, but these processes seemed not to be deliberate: most respondents denied moral licensing would apply to them.

Table 2.4

Examples of moral licensing, in relation to respondents' effort balance

Resp. no	PEB 1	Behavior 2	Effort balance
R1	Not eating dairy products	Eat more eggs	-42
R10	Being a vegetarian	Buy a less energy efficient car	-12
R15	Eating vegetarian five days in row	Eat chicken on day six	-11
R23	Being a vegetarian	Put plastic bags in regular bin	-21
R24	Eating vegetarian on day one	Eat some extra meat the next day	-32

2.3.3 Awareness and occurrence of the rebound effect

Next, we asked two questions related to the direct and indirect rebound effect. First, respondents provided examples of their PEBs that had saved them money. These included home curtailment behaviors (turning down the heat, turning off the lights when not in use, shorter showers), in-home investments (solar panels, new boiler), and decision making about doing something or doing something differently (using bicycle instead of car, buying second-hand). However, six respondents mentioned PEBs being more expensive, for instance buying ecological products or meat substitutes instead of cheaper regular products, solar panels being not that profitable, or that traveling by train being more expensive than by car. This would imply that for these respondents a first PEB would not lead to money saving or a possible rebound effect. An additional six respondents described that behaving pro-environmentally could both be more costly and save money, depending on the behavior.

Second, we asked respondents what they thought of the idea of spending money in an environmentally-unfriendly way while they saved this money because of acting pro-environmentally. Many respondents thought this reasoning was not rational: when they did something for the environment then they would not want to cancel it out afterwards. "Either it doesn't interest you or you are a bit stupid" (R15). But others thought that when (other) people behave pro-environmentally purely from a financial motivation it would make sense; this did however not apply to themselves. Some respondents (n = 7) could imagine that in practice people (including themselves) would act like this, but that they were unaware of it. One respondent for example stated: "Yes I think it is true. Because we do not own a car, we save money monthly; I think this really adds up. And we use our money to go on holidays. I went to Rome in January and to Cuba a couple of weeks ago, and in the fall we will go on holiday by plane again" (R22).

When respondents were reminded of the examples they gave previously, they indicated that this money stayed in their bank account and that they did not really have an idea of how they spent it. "I am not very concerned with balancing my money" (R24), and "Suppose you have a monthly budget and there is some money left, then you divide this proportionally over the total budget. It will not create a new category in my budget" (R26). The comparison with smoking was made a number of times. Respondents mentioned that when they quit smoking the money they saved just "disappeared." All in all, respondents thought that the topic of spending the money they saved by behaving pro-environmentally was a quite difficult one and in general they had not considered this issue before. Only six respondents indicated they thought of this before.

2.3.4 Balancing environmental behaviors (Interview)

At the start of the interview we asked respondents to list a number of examples of their own PEBs. As a first top-of-mind example they often initially mentioned separating their waste (nine times) and eating vegetarian or eating less meat (five times). Curtailment behaviors regarding water use (seven times), heating or electricity (eleven times) were mentioned frequently, but more often as a second or third example. Also, mobility choices, such as not owning a car (five times), using a bicycle or public transport (six times) were menti-

oned as second or third examples. Co-occurrence of behaviors was limited: using one's bike and using public transport were mentioned together by some respondents (mobility domain), as were saving on electricity and saving on heat (in-home domain).

Next, respondents were asked to give examples of their environmentally-unfriendly behavior. They especially mentioned using their car as an example of their environmentally-unfriendly behavior (fourteen times), often as a first top-of-mind example (eleven times). Going on holiday by airplane, not separating waste or eating meat were also mentioned (six times). Respondents were less able to name two or three examples of their environmentally-unfriendly behavior; sometimes they could not think of a second or third example. Again, respondents mentioned a range of different behaviors and therefore we did not see strong co-occurrence between behaviors: using one's car and eating meat, and using one's car and going on holiday by plane were mentioned together by a small number of respondents (three and two times, respectively). Finally, we investigated co-occurrence between the PEBs and environmentally-unfriendly behaviors but we found none. In other words, performing a certain PEB was not related to a specific environmentally-unfriendly behavior and vice versa.

When asked about the total picture of all of their environmentally friendly and unfriendly behavior examples, a majority (n=18) seemed satisfied and only some acknowledged that they could do more (n=6). One respondent indicated that she felt bad about her behavior. She was disappointed that she did not behave more pro-environmentally. Furthermore, respondents were asked if they thought about the environmental impact of their behaviors, for example, in terms of carbon footprint or CO2 emissions. Five respondents indicated that they did not think about the impact of their behaviors at all. The others stated that they thought about their impact, but they did not use a clear definition. These respondents did not exactly know what the impact of their behaviors was, but they mentioned they had an idea of the order of magnitude. One respondent, for example, called the way he estimated the environmental impact of his behaviors a "reasoned feeling" (R22). For only a small number of people, thinking about the actual environmental impact played a role in their daily or weekly life.

Our estimations of the net environmental impact (NEI) of the provided examples showed that for twelve respondents the NEI was positive (their pro-environmental examples more than compensated for their environmentally-unfriendly examples, in sum reducing their footprint), for nine respondents the NEI was negative (their environmentally-unfriendly examples surpassed their pro-environmental actions) and for five respondents the NEI was somewhat neutral (all pro-environmental examples seemed to be neutralized by the environmentally-unfriendly examples). These results show that for about half of the respondents the impact of their pro-environmental examples was negated to quite some extent by their environmentally-unfriendly examples: many described low impact PEBs (for instance waste separation or using LED lights) on the pro-environmental side, but high impact examples (for instance go on holiday by plane or frequent use of their car) on the negative side. These results indicate that participants do various pro-environmental things (large and small) and at the same time do other things that (partially) negate the positive environmental effects of their pro-environmental actions. As we do not know the sequence of these behaviors, it is not to say whether positive or negative spillovers occurred between behaviors.

2.4 Discussion

In this study we investigated people's motivations to act environmentally-unfriendly. In line with previous studies we found that people prefer performing easy PEBs over effortful ones and that PEBs that are associated with higher effort are performed less. Moreover, people who do not perform the behaviors associate these behaviors with higher effort levels compared to people who do perform the PEBs. Possibly, people overestimate the effort associated with a behavior they do not perform as they do not know this behavior very well. In contrast, people who do perform the behavior may adjust their effort assessment downward because of possible cognitive dissonance between behaving in a certain way and claiming it to be effortful. Another explanation could be that performing specific PEBs may become habitual and therefore is assessed as less effortful. Furthermore, our results indicate that the more effort people associate with PEBs the more arguments they use to substantiate or justify their behavior. Although the described barriers to act may of course be real and legitimate, the large difference in number of arguments people use when not performing a behavior compared to when they do perform the behaviors seems to imply that people actively engage in searching for available justifications, as other studies also describe (De Witt Huberts et al., 2014; Schütte & Gregory-Smith, 2015). The type of arguments why behaviors are effortful are similar when people perform or do not perform the PEBs: cognitive effort and limitations in the physical surroundings were most frequently used. Moral or financial explanations were hardly used. Because of the limited number of respondents in our study these results should however be viewed with some caution.

Most people rejected the idea of allowing oneself to act in an environmentally-unfriendly way after doing something pro-environmental. But we did find a number of moral licensing examples. These examples were all related to a difficult first PEB, followed by an easy or difficult second behavior. This is not in line with previous findings or ideas that performing a difficult first behavior would lead to more positive spillover as it would trigger a person's environmental identity (Gneezy et al., 2018; Truelove et al., 2014). Our results, however, indicate that the people providing the licensing examples were not the ones who acted the most or the least pro-environmentally, but the ones in between. It might be that especially people that have room to improve their environmental behavior, but do not associate these behaviors with too much effort, can reflect on their own inconsistencies. For people who act pro-environmentally often and by conscious choice, the use of licensing as a deliberate justification might not fit their perceived environmental identity. As Lanzini and Thøgersen (2014) describe, if a person holds moral environmental norms of some strength, behavioral inconsistency threatens the individual's self-perception as a morally reliable person. While on the other hand for people who act less pro-environmentally, who hold weaker moral (environmental) norms and associate PEBs with high effort levels, acting inconsistently is less of an issue: they have no need to find a morally based justification.

Furthermore, as we had expected, people seemed unaware of the occurrence of rebound effects. People acknowledge that the money they save by pro-environmental behavior ends up being spent, but are unaware of how they spend and whether a rebound effect would occur. The rebound effect was perceived by many as not rational. People indicated that when they do something for environmental reasons and accordingly saved money, they

would not want to spend that money on something with a highly negative environmental impact. When reflecting on their own daily life and expenses, people did not have an idea how they spend saved money: it mostly stays in their bank account and is spent 'at some point'. This lack of awareness fits current knowledge that individuals regularly are neither fully informed nor act fully rationally in the economic sense (e.g., Friedrichsmeier & Matthies, 2015; Thaler, 1980). Frederick et al. (2012) for example showed that the assumption that consumers consider the opportunity costs of a purchase and therefore actively think about alternatives that this purchase would displace is incorrect. People often fail to do so. This could be similar for rebound effects: that people do not think about all possible ways to spend the money they saved.

Finally, in general, people were satisfied with how they balanced pro-environmental and environmentally-unfriendly behaviors, also when the balance seemed negative. Low-impact PEBs like waste separation or recycling came readily to mind for many people, similar to findings by Reynolds (2010) and Roy et al. (2015). People could more easily name examples of PEBs than of environmentally-unfriendly behaviors. This is striking since most daily-life behaviors do in fact have a negative environmental impact. By focusing on performing PEBs instead of avoiding environmentally-unfriendly behaviors, people seemed to overestimate their environment-friendliness. In addition, we found a large variation of examples of both pro-environmental and environmentally-unfriendly behaviors and almost no co-occurrence between behaviors. This might imply that there are no clear combinations or orders of behaviors. When people do not perceive behaviors as in some way related, acting consistently is not an issue. Moreover, people seemed to quite intuitively assess the environmental impact of their behaviors, but there is reason to believe that especially for high impact activities people's assessments are flawed (Attari et al., 2010). In that case people underestimate the actual negative impact of their behaviors. The overestimation of environment-friendliness, the lack of co-occurrence, the underestimation of the negative impact and the use of different types of justification may explain people's optimistic view of their own behavior.

2.4.1 Limitations, implications and future research

People's perceptions of the costs of behaviors are important in predicting whether or not negative spillover will occur. Our study provides insight into the associated effort of 18 PEBs. On average we could distinguish between low and high effort behaviors, but people differed widely in the level of effort they associated with the various PEBs. This was related to the performance of the behaviors. Studies into positive and negative behavioral spillover should take into account the perceived effort levels of both PEB1 and PEB2 or Behavior2, and elaborate on the definition of effort. Furthermore, these studies should consider the difference when people already perform a behavior compared to when this behavior is new to them.

Since people prefer easy and simple behaviors, it would be fruitful to see if there are PEBs that are perceived as low or medium effort and are effective in reducing environmental impact. For instance buying seasonal fruits and vegetables, and insulating one's home to keep it warm are associated with a medium effort level by people who do not perform them

and are in fact quite effective. By zooming in on the reasons why behaviors are perceived as difficult, intervention designers could try and make PEBs easier. For example, the cognitive barrier of having to read and learn which fruits and vegetables are seasonal could be reduced by offering the products in a specific part of a shop or market. Taking away the barriers that affect the ease of behavioral uptake (for example, making a behavior less time consuming or providing infrastructure) would additionally reduce the number of available justification options.

This qualitative study was most suitable for our exploratory purpose. At the same time there are disadvantages to using face-to-face interviews. Social desirability could have led to people being less eager to share environmentally-unfriendly examples. However, respondents did not seem to hold back and many of them did mention environmentally-unfriendly behaviors, such as going on holiday by plane or eating "lots of meat". Another limitation of interviews is that we mainly collected information on rational and conscious attributes and not so much on less deliberate aspects of moral licensing and the rebound effect, while we knew these concepts are also of a non-deliberate or unconscious nature. Some respondents struggled with these questions and found them difficult to think through and answer. It could be that our questions were not clear or that we were asking about things that are hard to put into words or realize one would do at all. By asking people to focus on these issues, it is also possible that their answers are biased due to the focusing illusion (Kahneman et al., 2006; Schkade & Kahneman, 1998), explaining why they usually are not aware of certain issues, except when explicitly asked to pay attention. Instead of a picking a focus on the rational side of moral licensing and rebound effects, future studies could combine conscious and unconscious factors, for instance, by doing experiments in which awareness or conscious processes are manipulated, with participant interviews afterwards.

Moral licensing and justifications influence daily environmental behaviors, but these concepts need more research. A taxonomy of justification or rationalization strategies seems to be missing (Chatzidakis et al., 2006). In addition, it is unclear how often and when people apply it (Sörqvist & Langeborg, 2019), when and why people can resist and when they indulge (De Witt Huberts et al., 2014), and what exactly drives justifications. What most potential explanatory mechanisms have in common is that they seemingly allow a person to cross their own lines while minimizing the psychological harm normally associated with such discrepant behavior (De Witt Huberts et al., 2014). Studies on ethical decision making show a similar mechanism: using minor lies allows people to simultaneously benefit financially while keeping up a self-image of an honest person (Shalvi et al., 2011). Future studies could explore whether these personal boundaries or the definition of one's self-image could be moved towards more environmentally-friendliness and if this is also applicable when people hold weaker environmental norms. Furthermore, previous studies show that when justifications are more available people are more inclined to behave unethically. Reducing the number of justifications, by taking away the barriers that affect the ease of behavioral uptake could be a step forward.

Finally, we noticed that people have different associations with environmental impact: it is about recycling waste and avoiding plastics, but also about biodiversity, the use of chemicals, and buying ecological products. Our carbon impact approach does not necessarily do justice to people's perceptions of what environmental behavior is. Furthermore, we

did not make a full overview of people's behaviors, and it could be that people did not mention specific behaviors that are either environmentally-unfriendly or pro-environmental and we were therefore unable to estimate their total impact. The NEI estimations were a small sidestep we included during our analysis, but to do it more accurately it would be better to ask people more in detail. Furthermore, it would be interesting look into people's satisfaction with their environmental behavior in relation with their actual and more accurate environmental impact.

2.3.2 Conclusion

In this exploratory study we wanted to gain insight into people's motivations to behave environmentally-unfriendly and to explore people's level of awareness of both a psychological and economic pathway leading to negative spillover. Our study shows that people are good at rationalizing why they do not perform specific PEBs. There seems to be no issue, as in general people feel satisfied with their own actions and effort related to acting pro-environmentally. Previous studies describe that people prefer to be consistent. If people would indeed behave consistently pro-environmentally this would substantially add to reducing greenhouse gas emissions. Lanzini and Thøgersen (2014) describe that only for people with strong moral norms the desire to avoid cognitive dissonance creates a drive to behave consistently. For people who have no or only weak moral norms for pro-environmental behaviors it matters little to be inconsistent. We would add that the consistent behavior that most people prefer seems to be more about rationalizing their behavior to keep up their self-image of being a pro-environmental person and less aimed at actual greenhouse gas reduction.

Furthermore, based on our findings we argue that people are unaware of the relation between a first pro-environmental behavior and a subsequent behavior. This also prevents people from realizing that their behavior is inconsistent. Although some people can imagine that moral licensing and rebound effects could occur and can provide examples from their own lives, most people assess these concepts as not rational. We think that for many people this indeed is the case: moral licensing and rebound effects do occur but people are unaware or claim to be unaware. The reporting of both phenomena is consistent with the negative environmental impact and greenhouse gas emissions due to environmentally-unfriendly consumer behavior.

Thus, in order to substantially reduce individuals' environmental impact, focusing on consistency might not be the best approach for a large part of the population. Instead, and in order to discourage negative spillovers, we propose to focus on taking away the grounds for rationalization by, for example, making pro-environmental behaviors easier (e.g., less time consuming or providing better infrastructure), or providing insight into which PEBs are most impactful and effective to undertake.

Appendix 2.1 Interview questions

Q1. Can you give some examples of environmentally-friendly behavior that you do?
Q2. Can you give some examples of environmentally unfriendly behavior that you do?
Q3. How do you view the relationship between your environmentally friendly and environmentally unfriendly behavior?
Q4. Do you ever think about the effect of your behavior on the environment?
Q5. Can you think of an example of your own environmentally-friendly behavior that has saved you money?
Q6. If someone behaves in an environmentally friendly way, for example insulating his house or taking the bicycle instead of the car, he will save energy or fuel and also money. This money can be spent on other things, for instance on things that are not good for the environment. What do you think about this?
Q7. For this interview, have you ever thought about spending money that you save through environmentally friendly behavior?
Q8. We assume that some forms of environmentally friendly behavior take more effort than others. For the following 18 examples of behavior, can you indicate how much effort it costs you on a scale from 1 (no effort at all) to 10 (very much effort) and explain why.

PEB	Description
A	Use public transport or my bike to get to work/school
B	Turn off computer screen at work/school when leaving for 10 minutes
C	Behave pro-environmentally at work/school
D	Install solar panels on my roof
E	Bring empty glass bottles to the bottle bank
F	Carpool to work/school
G	Clean up after a picnic
H	Buy seasonal fruits and vegetables
I	Use public transport or my bike
J	Do not have towels changed daily when staying in a hotel
K	Be a vegetarian
L	Do not buy products from un-ecological companies
M	Read about environmental issues
N	Not go on holiday by airplane
O	Avoid to buy new goods
P	Insulate home to keep it warm

Only for those who indicated at Q4 to think about the impact of their behavior on the environment.

Q9. You just indicated that you are thinking about the effect of your behavior on the environment. If you think about the effort you want to put into behaving pro-environmentally, is the environmental impact important?

Can you tell to what extent you agree or disagree with the following four statements:
Q10. If I do something pro-environmental and this costs me a lot of effort, afterwards I behave not pro-environmental for a while.
Q11. If I do a number of smaller, pro-environmental things in succession that, independently of each other, do not take that much effort, afterwards I behave not pro-environmental for a while.
Q12. I feel like I have a limit or budget for the amount of effort I want to put into pro-environmental behavior. At a certain moment I did enough.
Q13. I feel like I have a limit or budget for the amount of effort I want to put into pro-environmental behavior. Some things cost me too much effort and I therefore do not do them.
Q14. Can you imagine that people in general would have a budget or limit for pro-environmental behavior?
Q15. Before this interview, did you ever think about having a budget for pro-environmental behavior?

Chapter 3:

How people spend money they earned through pro-environmental behavior

This chapter is based on: Dreijerink, L., Handgraaf, M., & Antonides, G. (in preparation). How people spend money they earned through pro-environmental behavior.

Abstract

The positive environmental effect of pro-environmental behaviors (PEBs) and measures is often partly negated because of the rebound effect. In other words, when an initial behavior or measure saves people money they can subsequently spend this money on goods and services that have a negative impact on the environment. Economists mainly study the rebound effect as a cost effect, while psychologists argue there are also moral and social factors that affect subsequent choice. While economists talk of the rebound effect, psychologists call the phenomenon of the declining likelihood of performing a PEB after an initial PEB a negative spillover. In this study we investigate the occurrence of the indirect rebound effect and negative spillover in an experimental setting. An indirect rebound effect occurs when people spend the money they saved on goods and services that are unrelated to the initial behavior or measure. In addition, we study how people's knowledge on environmental impact affects these processes. On the basis of a pre-study and a Pilot we developed an online experiment that revolved around performing a task (Behavior 1), earning money, and subsequently spending this money on a reward (Behavior 2). We tested whether participants (n = 725) were prone to the indirect rebound effect. In addition, we investigated if an environmental motivation or a financial motivation to perform the task affected the size of the rebound effect. Moreover, we tested if providing information on environmental impact of the reward affected the size of the effect. We found evidence that people are prone to the rebound effect: after performing a PEB they used the money they earned to buy rewards that reduced the positive environmental impact of their initial behavior. They don't seem to realize that this effect takes place. However, when their knowledge on the environmental impact of the rewards improved because they received information, they chose more pro-environmentally and thus the rebound effect (and negative spillover) reduced. Furthermore, when people received information and had the idea that they performed the initial behavior because of an environmental motivation (instead of a financial motivation) they were most eager to choose pro-environmentally. We argue that psychological processes related to consistency and identity are the main drivers of this result. In our study the evidence for moral processes affecting the choice of rewards is less clear. Based on our results we suggest that adding information on the environmental impact of goods and services will encourage people to make more pro-environmental decisions and decrease the potential indirect rebound effect and negative spillover.

3.1 Introduction

People may perform different kinds of pro-environmental behaviors (PEBs) to reduce their environmental impact. For example, they insulate their homes to save energy, use electric vehicles instead of gasoline cars, or install solar panels to produce their own renewable electricity. However, the intended environmental impact reduction is often not fully reached: people may heat more rooms in their homes after insulation (e.g., Hertwich, 2005; Wallenborn, 2013), increase their mileage when they drive electric (e.g., Holtsmark & Skonhoft, 2014), and use more electricity after they install solar panels (e.g., Deng & Newton, 2017; Qiu et al., 2019). In economics, the rebound effect explains the phenomenon that an

energy-efficiency measure does not lead to the predicted energy savings. The rebound effect revolves around the cost reduction of energy use, leading to higher energy consumption. However, in addition to changes in costs, other factors may affect energy-efficiency measures not leading up to predicted energy savings. Psychologists use the term negative behavioral spillover for the phenomenon of a declining likelihood to perform a PEB after performing an initial PEB (Thøgersen & Crompton, 2009). Explanations for negative spillover include that people may feel allowed to behave less pro-environmentally because their previous behavior provides them a license to refrain from performing another PEB (i.e., moral licensing; Khan & Dhar, 2006) or because others are also responsible to behave pro-environmentally (i.e., diffusion of responsibility; Darley & Latané, 1968). However, there is still much uncertainty about the occurrence of negative spillover (e.g., Geiger et al., 2021; Maki et al., 2019). Furthermore, the rebound effect and psychological factors are rarely studied together (e.g., Reimers et al., 2021). Therefore, in this study we combine economic and psychological explanations of pro-environmental decision making to investigate the existence of the rebound effect and negative spillover. In addition, we focus on the role of knowledge about the environmental impact of behaviors as a potential moderator of negative spillover: when people are not familiar with the impact of their actions and the relation between their actions, they might be more prone to negative spillover (Truelove et al., 2014). By improving people's knowledge on the environmental impact of choices, people may therefore be better able to make a subsequent pro-environmental choice, thus reducing negative spillover and the rebound effect.

3.1.1 Rebound effect

In the domain of energy conservation, the rebound effect is commonly used as an umbrella term for a number of mechanisms that may reduce the size of the energy savings achieved from improvements in energy-efficiency (Sorrell, 2012). The literature distinguishes three types of rebound effects: the direct rebound effect, the indirect rebound effect and economy-wide effects (e.g., Aydin et al., 2017; Greening et al., 2000; Sorrell et al., 2009). In case of the direct rebound effect, an energy-efficiency improvement for a particular energy service reduces the cost of this service—for example, after purchasing a more fuel-efficient car it becomes cheaper to drive—and thus leads to a higher consumption of this energy service (Aydin et al., 2017; Verboven & Vanherck, 2016). This increase in consumption is the result of a combination of the income effect and the substitution effect. The income effect reflects the increase in purchasing power due to a lower cost of the service. For example, if driving a car has become cheaper because of the more fuel-efficient car, people have more money to spend and can therefore afford to drive more often. The substitution effect implies that the lower cost of a service may shift consumption patterns to an increased purchase of this service instead of other goods. For example, after purchasing a more fuel-efficient car driving is more attractive than other services (such as using public transport) since it became cheaper. In case of the indirect rebound effect, the reduction of the cost of the energy service leads to changes in demand for other goods and services that also require energy or resources (Aydin et al., 2017; Verboven & Vanherck, 2016). In other words, indirect rebound is about how one spends the money one saves, on other goods or services (Jenkins et al.,

2011). For example, money saved because of the more fuel-efficient car may be spent on an overseas holiday or a new phone. In case of indirect rebound the increase in income (income effect) because of, for example, buying a more fuel-efficient car is spent on the alternative good or service. At the same time, the substitution effect limits indirect rebound as the initial energy service—in our example, driving a car—becomes more attractive. Indirect rebound effects are mostly driven by income effects (e.g., Chitnis & Sorrell, 2015), although other studies also indicate a role of the substitution effect (Reimers et al., 2021). The economy-wide rebound effect involves macro-economic effects, such as US policy affecting global oil prices leading to consumption shifts in other countries (Gillingham et al., 2013). In this study we focus on the indirect rebound effect.

Contrary to the direct rebound effect that is acknowledged and quantified by many economists (e.g., Berkhout et al., 2000; Binswanger, 2001; Gillingham et al., 2013; Greening et al., 2000; Khazzoom, 1980), the quantification of the indirect rebound effect appears more complex (Jenkins et al., 2011; Sorrell, 2012; Verboven & Vanherck, 2016), mainly because the indirect rebound effect occurs in many different shapes, as the money saved can be spent on a wide variety of goods. Moreover, the size of the indirect rebound effect varies widely from one household to another (Chitnis et al., 2014); for instance, as low-income households spend a greater proportion of their savings on necessities such as food and drink associated with carbon-intensive production, indirect effects are generally larger for this group. Therefore there is substantial uncertainty about the size of the indirect rebound effect (Jenkins et al., 2011; Nadel, 2012). According to Chitnis et al. (2014) the indirect rebound effect negates at most about one-third of the benefits of efficiency upgrades (with the magnitude of the effect being around 10 to 30%).

The indirect rebound effect entails that consumers take cost effects of an energy-efficiency improvement into account and as a consequence increase their consumption of alternative goods and services. The rebound effect does not acknowledge that people may implement energy-efficiency measures out of, for example, pro-environmental motivations, but implies that people would be driven solely by financial motivations. It indeed shows that people are often not rational in their financial decisions; for example, due to bounded rationality (Simon, 1955) people do not evaluate all the available options when making a decision and do not carry out a full cost-benefit analysis of the possible options. Instead of choosing the best option, people often choose a good enough option. With regard to the rebound effect, Dreijerink et al. (2021) showed that people seem unaware of the rebound effect occurring in their daily life and even label the rebound effect as not rational. Therefore, we argue that, in addition to economic explanations, psychological factors may explain part of why intended energy savings are limited by subsequent behavioral responses.

3.1.2 Behavioral spillover

There are several psychological explanations of why energy-efficiency improvements do not lead to predicted energy savings (e.g., Friedrichsmeier & Matthies, 2015; Girod & De Haan, 2009; Santarius & Soland, 2018). As described, psychologists use the term negative behavioral spillover for the phenomenon that the likelihood of performing a second PEB declines if people already performed a first PEB (Thøgersen & Crompton, 2009).

Behavioral spillover is not limited to energy efficiency but includes various domains, such as recycling, mobility, or food-related behaviors. Since PEBs are often described as moral behaviors and are about doing the "right" thing (e.g., Bolderdijk et al., 2013; Van der Linden, 2015), explanations of behavioral spillover are sought in morality. Negative behavioral spillover is often attributed to moral licensing (Galizzi & Whitmarsh, 2019; Maki et al., 2019), and moral licensing is indeed also used as a psychological explanation for the rebound effect (Friedrichsmeier & Matthies, 2015). A moral license allows people to act without fearing that they will morally discredit themselves (Miller & Effron, 2010). By moral licensing people feel freer to act immorally after an initial moral act. For instance, after investing in an energy-efficiency measure, a person may feel permitted to be less frugal with energy. In moral licensing processes an individual's previous actions are used as one's reference point, but people may also use actions of others, such as other citizens or politicians, as a reference point (Santarius & Soland, 2018). A person's belief that other actors are potentially responsible may decrease feelings of personal responsibility, a concept known as diffusion of responsibility (Darley & Latané, 1968). It can provide the feeling that someone has "played one's part" and that it is now up to others to do the same.

In contrast, positive behavioral spillover may also occur (e.g., Maki et al., 2019). Positive spillover implies that the adoption of a particular PEB increases a person's inclination to engage in another PEB (Thøgersen & Crompton, 2009). A commonly used explanation is that people act because they dislike inconsistency and want to prevent dissonance associated with inconsistent behaviors. In addition, it is expected that people prefer to act in line with their environmental self-identity; that is, the degree to which individuals see themselves as environmentally friendly (Van der Werff et al., 2013). Environmental self-identity is rooted in the values that people endorse, particularly biospheric values (Van der Werff et al., 2013). It is expected that performance of an initial PEB would strengthen one's environmental self-identity and would thus positively spill over to other PEBs. Support for this expectation is, however, mixed (Maki et al., 2019; Van der Werff et al., 2013). Overall, results on the occurrence of positive and negative behavioral spillovers show a mixed picture (e.g., Geiger et al., 2021; Maki et al., 2019) and further research on the reasons for the occurrence of either spillover type is needed.

Environmental knowledge

As described above, the level of knowledge about environmental issues may affect behavioral spillover, as knowledgeable people would recognize the behaviors as being related and might therefore be more likely to engage in positive spillover rather than negative spillover (Truelove et al., 2014). On the other hand, people with little knowledge might be more likely to engage in negative spillover because they do not see a relation between a previous PEB and their follow-up behavior. Therefore, people's capability to assess the environmental impact (in terms of energy use or carbon emissions) of energy-efficiency investment and other PEBs is relevant in situations of successive PEBs. If people would know the impact of their actions, this might affect what they do after an energy-efficiency investment. However, people generally do not know or are not able to accurately estimate the positive and negative impacts of their environmental and energy-related behavior (Attari et al., 2010;

Bilharz & Schmitt, 2011; Wynes et al., 2020). Improving people's carbon numeracy, that is one's ability to approximate a correct value of one's environmental impact (or carbon footprint) without resorting to an explicit calculation, is believed to be essential for individuals to make sustainable choices (Grinstein et al., 2018; Wynes et al., 2020). Carbon numeracy can be improved by providing people with information on the environmental impact of their actions. Penz et al. (2019), for example, found that providing people with information about harmful effects of CO2 emission, led to more CO2 reducing behavior.

3.1.3 Research goals

In this study we investigate the occurrence of the indirect rebound effect and negative spillover, by means of simulating the performance an initial PEB that leads to an income effect and subsequently to a follow-up purchase. As the rebound effect and spillover are inherently causal processes regarding the effect of one initial behavior on a subsequent behavior, they are best studied by means of an experimental design (Carrico et al., 2018). A lab experiment is most suitable since we focus on actual behavior but want to limit the number of confounding factors that surround decision making in real life. With this study we expand the limited literature on experiments on behavior and the rebound effect (an exception is Dorner, 2019). In our experimental study we focus on the indirect rebound effect as we are interested in relationships among a broad spectrum of PEBs, including energy use, mobility choices and food consumption. More specifically, we investigate the income effect as this appears the main driver of the indirect rebound effect. In addition to the income aspect we investigate the role of several psychological factors and environmental knowledge.

First, we want to know if people are subject to the indirect rebound effect. We develop an experiment to mimic the basics of the indirect rebound process consisting of two steps. In the first step participants perform a pro-environmental behavior (Behavior 1, B1) which leads to an income effect: participants receive credits for performing B1. In this experiment we leave the substitution effect aside (we will explain this in more detail in the method section). In the second step participants can use their earned income to purchase rewards (Behavior 2, B2) that may reduce the positive environmental impact of the initial behavior. We expect that when performing B2 after B1 an indirect rebound effect occurs (H1).

Second, we want to know whether increasing knowledge, instigated by providing people with information on the environmental impact of B2, will affect their choice of rewards (B2). We expect that providing information on the environmental impact will lead to a more pro-environmental choice of rewards, and therefore reduces the size of the rebound effect as compared with a condition in which no information is provided (H2).

Third, we want to know if motivation (either environmentally or financially) for performing B1 will affect the subsequent choice B2. We expect that a potential rebound effect will be smaller for people who perform B1 for environmental reasons than for people who perform B1 for financial reasons (H3). The main explanation would be that the psychological factor of consistency drives people who performed B1 for environmental reasons to purchase more pro-environmentally than people who performed B1 for financial reasons.

Fourth, we expect that people who are environmentally motivated to perform B1 will be more affected by information on impact of B2 than people who are financially motivated

to perform B1. Or, in other words, we expect an interaction between task focus and information: the impact of information on the pro-environmental purchase will be stronger in the environmental task focus conditions than in the financial task focus conditions (H4).

We preregistered our study at the OSF platform (osf.io/zjtv7). The main reason to preregister was to make our research process transparent and clearly define our hypotheses beforehand. After a first run of the study we concluded that some adjustments were needed. We, therefore, carried out a Pilot in which we further tested the materials. Since the combined initial study and the Pilot led to an improved version of the experiment, we decided to view them as one development-and-testing phase. We describe the method, results, and conclusions of this phase in the first part of the paper. Based on the results we were able to perform the study in an improved way. The final Study 2 was again preregistered as at OSF (osf.io/rwf83). This second preregistration included a description of the improved materials and methods. The hypotheses remained similar.

Finally, as part of this study we explored the concept of an environmental effort budget. This part was not pre-registered. It is known that current choices are often evaluated with the knowledge of the outcomes which have preceded them (Thaler & Johnson, 1990), and that people balance their moral behaviors (e.g., Nisan, 1991). Based on the mental accounting hypothesis—i.e., people use psychological accounts to organize, evaluate, and keep track of their financial activities (Thaler, 1999)—we wanted to explore if people also keep track of the effort they invested in PEBs and the amount of carbon emission they had caused.

3.2 Developing and testing the materials

3.2.1 Study 1

Method

Participants and design

Participants were randomly assigned to a 2 (task focus: environmental vs. financial) × 2 (information: yes/no) between-subjects factorial design. Using G*Power[5], we calculated that a sample size of 231 participants would be sufficient to detect medium effect sizes generally described in the literature (e.g., Ehrhardt-Martinez & Laitner, 2010) with regard to the rebound effect (f = .25), given 5% significance and 90% power. At the end of 2018 we recruited participants on US Amazon's MTurk, aged between 20 and 30 years that were a US High School Graduate or had a US Bachelor's Degree. They received MTurk points ($2) for participating. 242 People (M_{age} = 27.9 years, $SDage$ = 2.6; 55% female) completed the questionnaire. Most participants had a four-year college degree (45%), but levels differed from high school (10%) to a doctoral degree (0.5%).

5) G*Power is freely available software from the Heinrich-Heine University Düsseldorf (see, Faul et al., 2009).

Procedure

Participants completed an online questionnaire; the full questionnaire can be found at the OSF Platform[6]. After a short introduction participants were asked for their informed consent.

6) https://osf.io/fphj3/?view_only=c565cc04899845b8ba13b83f809cfc2a

We checked if they had read the introduction by a question on the purpose of the study. After answering questions on different traits (see Measures), they were presented with the first part of the experiment, in which they either performed an environmental or financial B1 task (see Manipulations, task focus). As a reward they received six lottery tickets they could use in the second part of the experiment. In the second part participants were asked to spend their lottery tickets on 13 different rewards. Participants were either informed about the environmental impact of these rewards or not (see Manipulations, impact information). After dividing the tickets (B2), participants were asked why they chose the specific reward. Moreover, we asked if people considered the environmental impact and to explain why (not). The questionnaire ended with questions on moral licensing and on demographics (age, gender, level of education and income). Finally, participants were debriefed about research purposes.

Manipulations

Task focus. The first manipulation mimicked the performance of a PEB leading to an income effect. We created a cover story on taking part in a research project aimed at improving cycling in European and North-American studies. We developed a task that required some time and effort from participants in order for it to feel as an effortful behavior. Participants were asked to read an instruction and then assess six different cycling situations in cities. We consider assessing these situations as a PEB since we told participants that by performing this task they contribute to improving cycling infrastructure which could lead to more cycling and less car travel. Next to their role as consumers, people may also perform PEBs in other roles (e.g., Nielsen et al., 2021; Stern, 2000). Assessing cycling situations is an example of a PEB that people perform in their role as citizens (see OSF for full instructions). Participants were divided into an environmental or a financial task focus condition, in which they would either perform B1 out of a pro-environmental or a financial motivation (see below). In both conditions they were presented with pictures of six traffic situations in cities in Europe and the US and were asked to give their opinions on these situations and in particular on the safety of cycling. For each of the traffic situations participants were asked: "Imagine cycling here. How would this make you feel? If possible provide a solution how this situation could be improved for cyclists." In the environmental task focus condition participants were asked to think about these situations from an environmental perspective: "Assessing these situations will help improving cycling circumstances. […] People switching from their car to a bike can save a huge amount of fossil fuel and make a big difference." Next to these societal benefits, we described personal environmental benefits: "Besides this, making the use of bicycles safer around the world can in the end also benefit you. It can for example result in reducing your environmental impact and your own carbon footprint due to using your car less." In the financial task focus condition, the perspective was about society saving money when traffic is safer for cyclists because of less congestion and delays: "Assessing these situations will help improving cycling circumstances. […] People switching from their car to a bike can save a huge amount of money and make a big difference." Next to these societal benefits, we described personal financial benefits: "Besides this, making the use of bicycles safer around the

world can in the end also benefit you. It can, for example, result in saving money by using your car less."

The task itself did not directly lead to an increase in income for participants. As we study the effect of earning money after doing something pro-environmental on subsequent behavior, we rewarded participants for performing this task. To emphasize that participants would earn something by performing the task we announced beforehand that they would be rewarded with credits that they could use in a lottery later on. After completing the cycling safety task we provided the following instruction: "One in every twenty participants of this study will be randomly chosen and will actually receive the reward of their choice. Here is how that will work: You have just received 6 credits for completing 6 assessments. You can divide those credits over the 13 rewards you can choose from. Each credit represents a lottery ticket. By dividing your lottery tickets you will be able to determine which reward you will actually receive if you are one of the lucky participants. We ask you to divide the 6 credits in such a way that you give the most credits to the reward you prefer the most. For each credit you invest in a particular reward, you will have a 1 in 6 chance of actually receiving that reward. The rewards will be ordered online and delivered to you. […]." Next, participants were invited to spend their tickets in part 2 of the experiment.

Impact information. In part 2 participants were offered a choice of 13 rewards in various categories (including food, clothing, biking) and with different environmental impacts (see Table 3.1)[7]. Participants were divided into a condition with and a condition without information about the environmental impact of the rewards. In both conditions participants saw a picture of each reward with descriptive information on price, size and a review (number of stars) on Amazon. The price of the rewards ($13) and number of stars (4.5) was similar for all rewards. The value of the rewards was determined by available financial resources for our study. In addition, participants in the impact information conditions received information on the absolute CO2 emission of production and an environmental impact score (high/medium/low) of each reward. For each reward category we included a high and low impact reward; for instance, a CD (high impact) or an MP3 gift card (low impact), and a dried sausage (high impact) or coffee beans (low impact).

7) Data on environmental impact was retrieved from the Dutch website Milieu Centraal (www.milieucentraal.nl) that offers environmental information for the public.

Table 3.1

Environmental impact (CO_2 emission of production, impact score, and dichotomous impact) per reward

Reward category	Reward	Absolute CO_2 impact (kg)	Environmental impact score	Dichotomous impact (0 = low, 1 = high [b)]
Food	Coffee	1.7	Low	0
Food	Cheese	4	Medium	1
Food	Sausage	8	High	1
Clothing	T-shirt	2.55	Low	0
Clothing	Flip flops	10	High	1
Leisure	E-book	0.1	Low	0
Leisure	Book	7.5	High	1
Electronics	USB stick	3.9	Medium	1
Leisure	CD	1.1	Low	0
Leisure	Mp3	0.1	Low	0
High impact gift	Flowers	8.7	High	1
Mobility	Ponchos	1.4	Medium [a]	0
Mobility	Tail light	0.7	Low	0

[a] CO_2 impact is not that large, but it's a disposable product so environmental impact set at medium

[b] Average CO_2 impact is 3.8 kg. All below-average impact was coded as low, all above average was coded as high

Measures

The start of the questionnaire included questions on several personal traits and preferences. Unless otherwise indicated, participants scored all measures on 7-point Likert-type items (e.g., 1 = strongly disagree/ not at all concerned, 7 = strongly agree/ very concerned). Most measures were included for our confirmatory analyses, but we also added a number of questions for exploratory reasons.

Concern on major threats. A three-item scale was adapted from major threat questions by Pew Research Center (2017), and was added for exploratory reasons. It included concern about global climate change as well as concern about global economic instability and the Islamic militant group in Iraq and Syria known as ISIS.

Preference for consistency. The short preference for consistency scale by Cialdini et al. (1995) was included for exploration purposes. The scale consisted of nine items (e.g., "I make an effort to appear consistent to others," and "I typically prefer to do things the same way"). The item "It doesn't bother me much if my actions are inconsistent" was reverse-coded. As the internal consistency on the items was high (Cronbach's a = .93), we computed the mean score.

Personal values. To assess personal values, participants rated 16 items from Schwartz's (1992) universal values scale, adapted by Stern et al. (1999), as "guiding principles in their life" on a 7-point from not important (1) to extremely important (7). Due to a programming inaccuracy in the survey the –1 and 0 values were left out. We included three items for hedonic values (e.g., "Pleasure: gratification of desires"), five items for egoistic values (e.g., "Social power: control over others, dominance"), four items for altruistic values (e.g., "Equality: equal opportunity for all"), and four items for biospheric values (e.g., "Respecting the earth: harmony with other species"). PCA mainly confirmed the four value sets. However, the item "wealth" loaded equally high on the egoism and hedonism, and the "ambitious" item loaded on both egoism and altruism. The Cronbach's alphas of the predefined value sets showed good internal consistencies: altruistic items $a = .80$, biospheric items $a = .88$, egoistic items $a = .78$, hedonic items $a = .81$. We therefore used the average scores of each of the original four value sets.

Environmental effort budget. As part of this study we explored the concept of an environmental effort budget, by measuring people's attitude to and possible use of this type of budget. For comparison reasons we included a validated scale of 4 items on (financial) mental budgeting developed by Antonides et al. (2011). For example, "I have reserved money (budget) for different expenses, such as food, clothing, transportation, etc." and "If I spend more on one thing, I economize on other expenses." In addition, after including a short explanation of CO2 emission, we included two items on environmental and carbon budgeting inspired by the mental budgeting scale: "I have reserved a carbon budget for different purposes, such as food, clothing, transportation, etc." and "If I produce more carbon than normal on one purpose, I cut back on other carbon producing purposes." Finally, we included four additional items, for example, "It is a good idea for people to start thinking about their carbon footprint," and "If I plan to do something that costs a lot of energy, I make sure I also do some things that use little energy." The internal consistency of the six carbon items was sufficient to form one scale ($a = .69$). Exploratory results are included in Appendix 3.1.

Motivation to choose rewards. After the manipulations participants were asked to motivate their ticket distribution over the reward types. They scored each of the aspects of usefulness, attraction, value, and environmental impact on a scale from 1 (not at all influential) to 5 (extremely influential). Moreover, their consideration of the environmental impact of the rewards was measured using an agree/disagree statement on a 7-point Likert scale, and they were asked to motivate their decision in response to an open question.

Moral licensing and diffusion of responsibility. Finally, we included two questions on moral licensing, including: "I felt I could allow myself to make an environmentally unfriendly choice after doing the task on cycling in cities." One question was included on diffusion of responsibility: "If I do something that saves energy, I am allowed not to think about my energy use for a while. Now others can do their part."

Environmental impact of purchase. The environmental impact of purchase behavior (B2) was determined in two ways. First, we used the absolute CO2 emission figures that were part of the information manipulation. For each participant we multiplied the absolute impact

with the number of lottery tickets they spent on the different rewards. For instance, when they decided to put their six tickets on a reward (cheese) with a CO2 impact of 4kg, their impact score was 6 × 4 = 24 kg. In addition to the absolute figures we created for each participant a dichotomous variable of a low (0) and high (1) impact choice in each category (see Table 3.2). In this case we also multiplied the impact with the number of tickets they spent on the different rewards. For instance, when they put three tickets on a low impact reward (coffee) and three on a high impact reward (book), their score was 3 × 0 + 3 × 1 = 3.

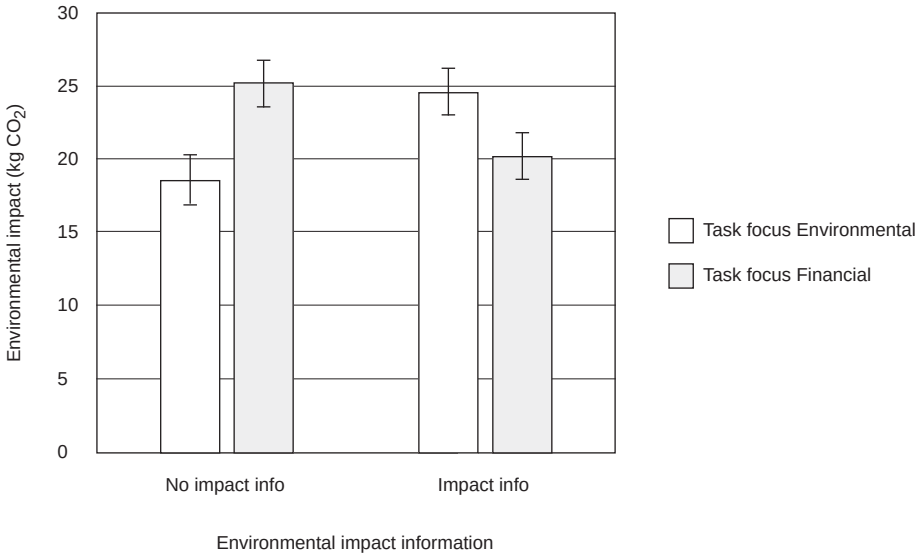
Results

The environmental impact of the chosen rewards was on average 22 kg (SD = 16.4) per participant. Most tickets were attributed to the e-book (335 tickets) and book (285 tickets). Participants described choosing the rewards because they liked it best, could use it, or because it was the best reward from the list. On a 7-point scale participants somewhat disagreed with having considered the environmental impact of the rewards (M = 2.7, SD = 1.7). There was no difference between the information and the no information conditions. Many participants (67%) indeed described they did not think or care about it. Only a small share of participants (6%) stated having thought about the environmental impact but not acting upon it and 7% indicated having thought about it and acting upon it. Because we did not include a clear manipulation check of information we were not able to check whether participants had actually seen the information.

ANOVA with absolute environmental impact as the dependent variable, and task focus and impact information as independent variables, showed no main effect of task focus (F(1,238) = 0.272, p = .603) nor impact information (F(1, 238) = 0.050, p = .823). The interaction between task focus and impact information was significant (F(1, 238) = 7.096, p = .008, η^2 = .029); see Figure 3.1. When adding concern about climate change, personal values, preference for consistency, environmental budgeting and time spent on questionnaire as covariates to the model, we again found a significant effect of task focus × impact information (F(1, 230) = 6.797, p = .010, η^2 = .027). Time spent on the questionnaire was the only significant covariate (F(1, 230) = 7.142, p = .008, η^2 = .029). However, post-hoc Tukey testing showed no significant effects between the environmental task focus/no info and financial task focus/no info conditions, both in the models with and without covariates. The results thus present an unclear picture.

Figure 3.1

Average environmental impact score (kg CO_2) per condition (with SE bars)



Discussion

After an initial behavior most people purchased a reward that reduced the positive environmental effect of the first behavior. Results showed that most people chose a reward based on what they liked and found useful, and did not consider the environmental impact of the rewards that they purchased. This suggests that, in line with our first hypothesis, people are subject to the rebound effect. Moreover, we expected that impact information would lead to a more pro-environmental choice of rewards (H2), but we found no support of this hypothesis. Furthermore, we expected that people who performed B1 for environmental reasons would show a smaller rebound effect than participants who performed B1 for financial reasons (H3). Results show that participants in both task focus conditions purchased rewards quite similarly and both reduced the positive impact of their performance of B1. We therefore found no support for this hypothesis. Finally, we expected that the damping effect of impact information on the rebound effect would be stronger in the environmental task focus conditions than in the financial task focus conditions (H4). Our results appeared to be unclear and did not support this hypothesis.

Our preliminary study had a number of issues that made interpretation difficult. Firstly, participants appeared to prefer the e-book as a reward and this raised the question if all rewards were equally appealing. Furthermore, we felt the experiment could be improved by adding the option of choosing a reward that reduced CO2 impact, clearer definitions of low and high impact rewards (in terms of CO2 impact), and adding a manipulation check on the provided information. Secondly, we defined sample size based on the size of the rebound effect, but to be able to detect small psychological effects such as moral licensing, Blanken

et al. (2015) suggested a minimum of 165 participants per condition. Because of these issues we decided to pilot the rewards and then repeat the experiment.

3.2.2 Pilot

The Pilot focused on testing people's preference of rewards and their perception of the provided environmental information.

Method

Participants

In November 2020 we recruited US citizens (minimum of US high school) in the age group of between 25 and 30 years from the MTurk platform. Participants received $1.50 for their participation. 54 People (Mage = 29.0, SDage = 2.0, 67% males) participated. A first round yielded 21 participants (19 were removed because of missing, erroneous, or overly consistent responses). Since two items were accidentally removed from the survey, we additionally organized a second round. This second round resulted in 33 good quality responses (out of 40).

Questionnaire

The online questionnaire included thirteen questions on ten products or five product-pairs (see Table 3.2); the full questionnaire can be found at the OSF[8] platform. Three product-pairs from Study 1 were included. They were selected based on the variation of the carbon emission: we wanted no overlap between the highest low-emission scores and the lowest high-emission scores. Furthermore, we added a product with a positive environmental impact, namely planting a tree that was paired with an environmentally-unfriendly good cause. Moreover, we added one new product pair (soap).

We asked participants how happy they would be in case they received the products as a gift (on a 7-point Likert scale), and additionally how happy they would be if they could give the product as a gift to someone else. Furthermore, participants were asked to estimate the environmental impact of the ten products. Next, they received information on the carbon emission and environmental impact of the ten products and were asked if they had noticed the added information ("*Did you notice what information we added? Please elaborate*"). Additionally, we asked them about the clarity and credibility of the information (on 7-point Likert scales). Finally, we included questions on environmental identity (scale by Van der Werff et al., 2014), gender, age, and level of education.

8) https://osf.io/des86/?viewonly=9e75e24fbf1445d2b80771a6f0213f14

Results

On average participants were happy to receive all products as a gift and to give all products as a gift to someone else (Table 3.2). By means of repeated measures ANOVA we found no significant differences in the two happiness scores (gift to self and other). Furthermore, participants were well able to assess the environmental impact of the product pairs: they scored the lower-impact product indeed as more environmentally friendly and

the higher impact product as more unfriendly. Cheese (cheddar and mozzarella) was the odd one out: although the repeated-measures ANOVA showed no statistically significant difference, the impact assessment was reversed and the products were thus wrongly assessed. Moreover, the low impact cheese (mozzarella) was assessed as equally unfriendly in between a book and the flowers.

Table 3.2

Average scores on happiness (self and other) and estimated environmental impact of the ten products

Product	CO_2 emission	Happiness self		Happiness other		Estimated impact	
	(kg)	*M*	*SD*	*M*	*SD*	*M*	*SD*
1a. Irish cheddar cheese	5.0	4.96	1.44	4.56	1.75	4.59	1.43
1b. American mozzarella cheese	3.0	4.74	1.71	4.09	1.86	4.41	1.57
2a. E-book or audiobook [a]	0.1	4.67	1.63	4.64	1.62	5.87	1.29
2b. Book	7.5	5.00	1.52	5.24	1.41	4.20	1.60
3a. Bouquet of flowers	8.7	4.56	1.78	5.43	1.46	4.50	1.41
3b. Wildflower seeds	0.1	4.46	1.73	4.43	1.69	5.65	1.43
4a. Make a donation: Plant a tree	-5.9	4.98	1.49	4.81	1.63	6.30	1.13
4b. Make a donation: Support the SeriousFun Children's Network	5.5	5.06	1.55	4.81	1.59	5.02	1.30
5a. Organic soap bars	0.7	5.04	1.30	4.70	1.41	5.54	1.38
5b. Body wash (liquid soap)	4.7	5.22	1.21	4.80	1.42	3.85	1.57

[a] Due to a programming error during the first round this item was assessed by 33 instead of 54 participants

A majority (74%) of the 54 participants noticed the environmental information in the product descriptions. Regarding the clarity and credibility of the information, participants indicated that the information on CO2 emissions was on average clear (M = 5.0, SD = 1.5) and credible (M = 5.11, SD = 1.32), but some (35%) were uncertain about the amount of the emission ("is it large or small?") or found it hard to assess the credibility. Participants viewed the texts about the environmental impact as clear (M = 5.30, SD = 1.49) and credible (M = 5.20, SD = 1.43). The relation between supporting the SeriousFun Children's Network and environmental impact was not clear to a number of participants.

Conclusion

Respondents were happy to receive all products as a gift, and enjoyed giving all products to someone else as a gift. None of the products appeared to be much more appealing than the others. Respondents were well able to assess the environmental impact of the pro-

duct pairs. Since cheese was the odd one out, we excluded the cheese rewards from the study and use the eight remaining products. The environmental impact information appeared to be perceived as clear and credible.

3.3 Study 2

In Study 2 we used the results and insights from Study 1 and the Pilot to repeat the experiment in an improved way. Based on the Pilot we included a better and smaller set of rewards. We added the option of choosing a reward with a positive environmental impact. Furthermore, the power of the study was improved by increasing sample size. The research goals and hypotheses of Study 2 were equivalent to Study 1: We expect that when performing B2 after B1 an indirect rebound effect occurs (H1). We expect that providing information on the environmental impact will lead to a more pro-environmental choice of rewards, and therefore reduces the size of the rebound effect as compared with a condition in which no information is provided (H2). We expect that a potential rebound effect will be smaller for people who perform B1 for environmental reasons than for people who perform B1 for financial reasons (H3). We expect an interaction between task focus and information: the impact of information on the pro-environmental purchase will be stronger in the environmental task focus conditions than in the financial task focus conditions (H4).

3.3.1 Method

Participants and design

Similar to Study 1 participants were randomly assigned to a 2 (task focus: environmental vs. financial) × 2 (information: yes/no) between-subjects factorial design (see Table 3.3). Participants were recruited via Prolific in January 2021. We included US citizens aged between 20 and 30 years. Participants received $3.35 for their participation. Since Study 1 showed smaller effects than expected we determined the sample size based on small effects. Calculation by G*Power showed that a sample size of 768 participants would be sufficient to detect small effect sizes (f = .15), given 5% significance and 90% power. We recruited 801 participants, of which 76 were excluded based on our preregistered criteria (i.e., no consent; missing, erroneous, or overly consistent responses; failing check-tests; demographic fit; too few words in open questions; lack of variance across answers). The final set of participants (n = 725) included 52% males, 47% females and 2% non-binary/third gender. The average age was 26 years (SD = 3.3). Most participants had a four-year college degree (45%), but levels differed from less than high school (0.5%) to a doctoral degree (2%).

Table 3.3
Study design, including final number of participants per condition

Task focus	Impact information	
	Reward with impact information	Reward without impact information
Environmental	$n = 185$	$n = 171$
Financial	$n = 178$	$n = 191$

Procedure, manipulations, and measures

The procedure of the questionnaire and experiment was similar to Study 1 with some small adjustments; the full questionnaire can be found at the OSF[9] platform. The measurement of traits and the first task were left largely unchanged; in the set of questions on concern about major threats we added one item about the covid-19 pandemic. In addition, we now used the 9-point scale to measure personal values ranging from −1 (*opposed to my principles*), 0 (*not important*) to 7 (*extremely important*). Internal consistency of all scales was good: preference for consistency ($\alpha = .89$), altruistic values ($\alpha = .78$), biospheric values ($\alpha = .86$), egoistic values ($\alpha = .83$), hedonic values ($\alpha = .83$), mental budgeting ($\alpha = .70$), environmental budgeting ($\alpha = .82$). Based on the Pilot results we used a different selection of rewards (see Table 3.4). Moreover, in the information conditions we emphasized the positive or negative environmental impact by adding a green thumb up or a grey thumb down. Motivation to choose rewards was measured on a 7-point scale instead of a 5-point scale. Furthermore, we checked more explicitly whether participants noticed the information (1 = *yes*, 2 = *no*, 3 = *not sure*) on environmental impact. Finally, at the end of the questionnaire we included the moral self-image scale that was designed by Carrico et al. (2018) as a measure of moral licensing. Participants rated their level of agreement (from 1 = *strongly disagree* to 7 = *strongly agree*) with the statements that they were compassionate, fair, selfish, moral, and immoral. The selfish and immoral items were reverse-coded before a composite score was created. Cronbach's alpha was .80.

9) https://osf.io/fgy95/?view_only=b49066e00e2f4542bb5a37606dc6f3ee

Table 3.4
Environmental impact (CO_2 emission of production, impact score, thumb up/down) per reward

Reward	CO_2 emission (kg)	Environmental impact	Thumb direction
E-book or audiobook	0.1	Low	Up
Book	7.5	High	Down
Wildflower seeds	0.1	Low	Up
Bouquet of flowers	8.7	High	Down
Make a donation: Plant a tree	-5.9	Low	Up
Make a donation: Support the SeriousFun Children's Network	5.5	High	Down
Organic soap bars	0.7	Low	Up
Body wash (liquid soap)	4.7	High	Down

3.3.2 Results

Manipulation check

Participants indicated on a 7-point scale that their choice of rewards was influenced by whether they could use it (M = 5.8, SD = 1.4) and by its environmental impact (M = 4.5, SD = 2.1). Attractiveness (M = 4.0, SD = 2.0) and value (M = 3.9, SD = 2.1) were of less importance. An ANOVA with "choice influenced by environmental impact" as a dependent variable showed a main effect of information ($F(1, 721) = 4.919$, $p = .027$, $\eta^2 = .007$), no effect of task focus ($F(1, 721) = .389$, $p = .533$), and no interaction effect of task focus × information ($F(1,721) = 2.377$, $p = .124$). Participants in the information conditions assessed the environmental impact as more influential in their choice (M = 4.7, SD = 2.0) than participants in the no information conditions (M = 4.3, SD = 2.2). Furthermore, on a 7-point scale participants somewhat agreed with having considered the environmental impact of the rewards (M = 4.6, SD = 2.1). An ANOVA with "consideration of the environment" as a dependent variable showed a main effect of information ($F(1, 721) = 17.773$, $p = .000$, $\eta^2 = .024$), no effect of task focus ($F(1, 721) = .002$, $p = .964$), and no interaction effect of task focus × information ($F(1,721) = 2.287$, $p = .131$). Participants in the information conditions considered the environment more (M = 4.9, SD = 2.0) than participants in the no information conditions (M = 4.3, SD = 2.1). Furthermore, participants in the information conditions indicated to have noticed the environmental impact information (M = 1.3, SD = 0.6), while participants in the no information conditions indeed indicated there was no environmental impact information (M = 2.0, SD = 0.7). In sum, the information manipulation appeared successful.

Hypothesis testing

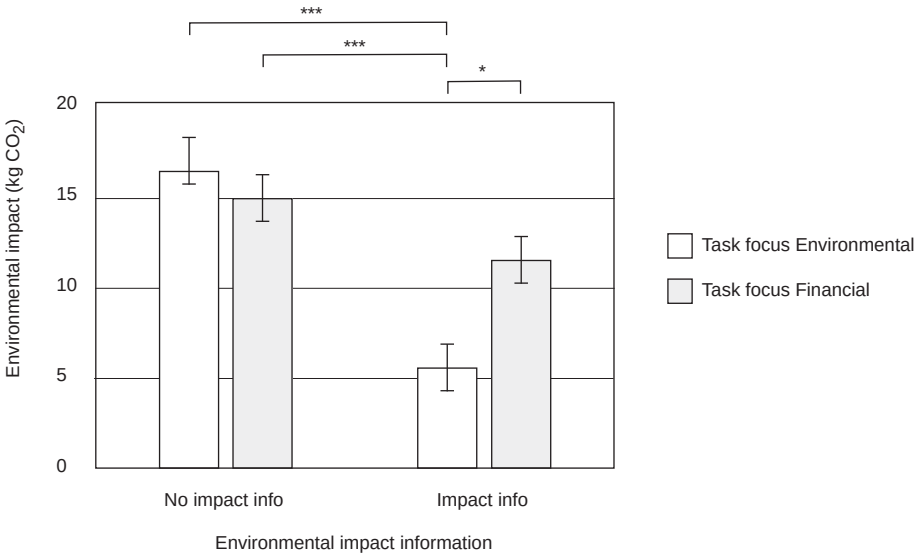
The environmental impact of the chosen rewards was on average 12 kg (SD = 24.4) per participant. In total the 725 participants spent 4,350 tickets. Most tickets were assigned to the book (1,194 tickets) and trees (979 tickets). 311 Participants assigned all their tickets to the low impact rewards (≤4.2 kg) while 414 assigned their tickets (partly) to rewards with higher impact. Three hundred seventy-seven participants assigned between one and six tickets towards planting trees. Overall, after performing a PEB, participants spend their earnings on rewards with a higher environmental impact. Results are in line with H1, that people are subject to the indirect rebound effect.

An ANOVA with absolute environmental impact as the dependent variable, and task focus and impact information as independent variables, showed a main effect of impact information ($F(1, 721) = 15.925$, $p = .000$, $\eta^2 = .022$), in line with H2. Participants in the information conditions indeed chose rewards with a significantly lower impact (M = 8.6, SD = 24.5) than participants who received no information (M = 15.7, SD = 23.8). However, there was no main effect of task focus ($F(1,721) = 0.441$, $p = .230$), contrary to H3. Finally, we expected (H4) that the impact of information on the pro-environmental purchase would be stronger in the environmental task focus conditions than in the financial task focus conditions. Results indeed showed a significant interaction between task focus × impact information ($F(1, 721) = 4.570$, $p = .033$, $\eta^2 = .006$). Figure 3.2 displays that when participants in the

environmental-task-focus condition received information they chose rewards with a lower impact (M = 5.7, SD = 24.3) compared to those who did not receive information (M = 16.6, SD = 23.9). There was no difference in the impact of rewards chosen by participants in the financial task-focus condition, when they either received information (M = 11.6, SD = 24.4) or not (M = 14.9, SD = 23.7). When adding concern about climate change, personal values, preference for consistency, environmental budgeting and time spent on questionnaire as covariates to the model, we still found a significant effect of impact information (F(1, 713) = 17.306, p < .001, η^2 = .023) and of task focus × impact information (F(1, 713) = 5.807, p = .016, η^2 = .008). Biospheric values (F(1,713) = 8.376, p = 0.004, η^2 = 0.011) and environmental budgeting (F(1,713) = 4.313, p = 0.038, η^2 = 0.006) appeared to be significant covariates. Post-hoc Tukey testing showed significant effects, see Figure 3.2, between the environmental task focus/info (M = 5.7, SD = 24.3) and environmental task focus/no info conditions (M = 16.6, SD = 23.9) (t = -4.597, p < .001, d = -0.49), the environmental task focus/info and financial task focus/no info conditions (M = 14.9, SD = 23.7) (t = -4.008, p < .001, d = -0.41) and the environmental task focus/info and financial task focus/ info conditions (M = 11.6, SD = 24.4) (t = -2.696, p = .036, d = -0.28). In other words, participants in the environmental task focus condition who received information chose more pro-environmentally than participants in the other three conditions. This result is in line with H4, namely that we expected a stronger effect of information in the environmental condition than in the financial condition.

Figure 3.2

Average environmental impact score (kg CO_2) per condition (with SE bars)



** p < .05. *** p < .000.*

Exploratory results

Results thus far indicated a rebound effect or negative spillover in all conditions, with the smallest rebound effect or negative spillover in the environmental task focus/info condition. Next, we wanted to know to what extent known psychological explanations of negative spillover, namely moral licensing and diffusion of responsibility, might play a role. In addition, we explored if preference for consistency might explain the smaller negative spillover in the environmental task focus/info condition. A linear regression model with moral licensing, diffusion of responsibility, environmental budgeting and preference for consistency as predictors of absolute environmental impact proved to be significant ($F(6, 718) = 7.910$, $p = .000$; $R^2_{adj}=.05$), with environmental budgeting ($\beta = -.17$, $p = .000$) and licensing due to the cycling safety task ($\beta = .14$, $p = .001$) as significant predictors (see Table 3.5). When participants were more inclined to having an environmental budget and held a more positive attitude towards such a budget, they chose rewards with a lower impact (we elaborate on these results in Appendix 3.1). Moreover, when participants felt more allowed to make an environmentally-unfriendly choice after the task, they chose rewards with a higher impact. The other predictors were not significant.

Next, we wanted to know if our experiment, especially the task focus conditions, indeed created feelings of being allowed and diffusing responsibility. First, we used ANOVA with "licensing due to the cycling safety task" as dependent variable and task focus and impact information as independent variables. Concern about climate change, personal values, preference for consistency, and environmental budgeting were added as covariates. We found no significant main effects or interaction effect of task focus and impact information. Furthermore, we included licensing in general, moral self-image, and diffusion of responsibility as dependent variables in three additional ANOVA models. We found a significant, small effect of information ($F(1,714) = 4,234$, $p = .040$, $\eta^2 = .005$) on moral self-image, indicating that participants in the no information conditions viewed themselves as a "morally better" person ($M = 5.5$, $SD = 0.9$) than participants in the information conditions ($M = 5.4$, $SD = 0.9$). Several covariates were related to moral self-image, including altruistic values ($F(1, 714) = 38.113$, $p < .001$), preference for consistency ($F(1, 714) = 31.222$, $p < .001$), biospheric values ($F(1, 714) = 6.553$, $p = .011$), concern about climate change ($F(1, 714) = 4.651$, $p = .031$), egoistic values ($F(1, 714) = 4.647$, $p = .031$), and environmental budgeting ($F(1, 714) = 4.576$, $p = .033$). An explanation for the main effect could be that participants who chose a reward with a negative environmental impact after they received impact information might have felt bad afterwards and accordingly assessed their moral-self more negatively. As this effect is small it is likely that it does not explain the overall effects on environmental impact of reward choice we found.

Table 3.5

Linear regression coefficients of factors predicting environmental impact of reward choice

Predictor	*B*	*SE*	*β*	*p*
Moral self-image	-.74	1.06	-.03	.484
Moral licensing after cycling safety task	1.91	.55	.14	.001
Moral licensing after saving energy in general	.87	.85	.06	.308
Diffusion of responsibility after saving energy in general	.19	.89	.01	.832
Environmental budgeting	-3.45	.79	-.17	.000
Preference for consistency	.56	.88	.03	.527
Constant	18.13	6.11		.003

3.3.3 Discussion

Although a large part of participants spent some of their tickets on the most environmentally-friendly option of planting trees, the majority chose to buy a reward with an environmental impact. We therefore conclude that, overall, people are subject to the indirect rebound effect (H1): after earning tickets because of behaving pro-environmentally participants spent them in such a way that they reduced the positive environmental impact that was the result of their initial behavior.

Moreover, we find support for H2 that providing people with information on the environmental impact reduces the size of the indirect rebound effect. People who received information on the impact of the rewards spent their money on rewards that had a lower environmental impact. This suggests that providing information of the environmental impact on goods and services, and making clear what the pro-environmental option is, helps to mitigate the indirect rebound effects.

We find no support for H3 that people who performed the initial behavior for environmental reasons show a smaller indirect rebound effect than people who performed this behavior for financial reasons. We do find support for H4 and find that the impact of information on the pro-environmental purchase is stronger in the environmental motivation condition than in the financial motivation condition. An explanation could be that people's environmental identities were triggered by the environmental task and the information that was provided after the task reinforced this trigger. In addition, the information facilitated people in making the most pro-environmental choice. As a result people acted consistently with a triggered identity when choosing a reward. The consistency of performing PEB shows to be a state that was the result of an activated identity and not a personal preference for consistency. The lack of reinforcement of people who were environmentally motivated but did not receive information may have meant that environmental identity was not sufficiently triggered. Moreover, in this condition assessing the environmental impact of rewards would have been more difficult for people since they did not receive information. Based on these results we propose that repeatedly emphasizing the pro-environmental motivation for performing specific behaviors in combination with providing information may stimulate PEB.

Furthermore, our results suggest that people who performed the initial behavior from an environmental motivation and received no information may be subject to moral licensing, as the impact of the rewards chosen by this group was highest compared to the environmental motivation group that did receive information. In other words, after performing the initial behavior for environmental reasons participants may have felt allowed to choose a reward with a higher impact. However, we do not find evidence in our self-reported measures that the manipulations in our study led to licensing or diffusion of responsibility effects. The small effect on moral self-image we found was the result of providing information and not because of the task focus. In general, moral licensing is studied by means of experimental designs that consist of different conditions to demonstrate the occurrence of the effect. Few studies measure moral licensing directly or measure its driving variables such as moral self-worth (Carrico et al., 2018), as we did here. Moral licensing has been described as a largely unconscious process (Khan & Dhar, 2006), but also as a deliberate justification strategy to excuse morally questionable behaviors which includes active engagement in using and searching for available justifications (Blanken et al., 2015; De Witt Huberts et al., 2014). In both cases a direct measure of licensing might be prone to bias: people are either unaware of doing it or they may not recognize licensing in their own justification strategies. This may have also been the case in this study.

Limitations

After Study 1 we concluded that there were a number of limitations. In Study 2 we improved our method and thereby resolved these issues. Still there are some limitations to our study that are mainly related to measuring complex effects in an experiment. In our study we tried to simulate the indirect rebound effect: the phenomenon that performing a pro-environmental (energy-efficient) behavior leads to an increase of consumption of alternative goods and services. This increase in consumption is the result of the income and substitution effect. In our experiment we developed a simplified simulation of the indirect rebound effect which in the basis includes an initial pro-environmental behavior that leads to an income effect and a subsequent behavior that may reduce the positive environmental impact of the initial behavior. The initial behavior performed in the current study, the cycling safety task, is somewhat different from more commonly investigated technical energy-efficiency measures in indirect rebound studies, such as installing insulation or solar panels, or purchasing a fuel-efficient car. The PEB in the task can be considered a behavior that focuses on people's role as a citizen: the PEB is beneficial to society. However, we also stressed that there were personal benefits of performing the task (reduce one's carbon footprint, or save money). We argue that the underlying income effect that we tried to mimic follows a similar pattern: a person does something pro-environmental and this leads to an increase in income. However, in our experiment performance of the initial behavior did not lead to a cost reduction, such as the purchase of a more fuel-efficient car leads to a lower cost of driving. Therefore, the substitution effect was not applicable. It appeared challenging to combine both the income and substitution effect in one study. Here, we focused on the income effect, but are aware that it would be better if studies would take account of both income and substitution effects (Reimers et al. 2021).

The design of this study included four conditions to test potential effects of an initial behavior that was either pro-environmental or financial, on a subsequent behavior that could either be pro-environmental or not. Mullen and Monin (2016) warned for so-called donut-designs when investigating licensing and consistency effects in one study. Donut designs lack a baseline condition and therefore present ambiguous results with regard to licensing. The authors refer to studies that examine both the effects of an initial positive (in our case, pro-environmental) behavior and an initial negative (in our case, environmentally unfriendly) behavior on a second behavior. In our study no initial negative behavior was included. We did include an initial financial behavior that we consider as a neutral, or baseline condition without moral aspects. Our design is therefore no donut design.

The credits and tickets that people received as a form of earned money can be perceived differently than money that people would actually save in real life due to performing a PEB. It could be that participants perceived earning the tickets as a bonus instead. Epley et al. (2006; 2007) showed that income that is paid in form of a bonus is treated differently from regular income. A bonus is more readily spent. Moreover, due to financial limitations we were not able to provide every participant with the reward of their choice. By using a random lottery incentive mechanism, we tried to get around this issue. Random-payment schemes appear to yield roughly equivalent results, at least for simple choices (Camerer & Hogarth, 1999). Paying one option out of several may even be more motivating, if subjects overweigh their chances of being selected.

3.4 Overall implications

The rebound effect is commonly studied as an economic effect and presumes that people make rational financial decisions with regard to spending money they save. In practice people are often not rational in their decision making, both with regard to finances and other issues. Furthermore, next to financial considerations people are guided by other motivations to make decisions. Studies on the rebound effect tend to only investigate one part of the decision-making process. In this study we combined different economic and psychological explanations of pro-environmental decision making to study the indirect rebound effect. On the basis of a pre-study and a pilot study we developed an online experiment. Our results indicate that the money that people save by behaving pro-environmentally is spent in a way that partially negates the pro-environmental impact of the original behavior. People don't seem to realize that this counter effect takes place. It shows that a negative spillover occurs through a financial pathway (via an income effect) and via several psychological factors related to identity.

Our findings emphasize the importance of combining different perspectives: studies on economic phenomena should integrate psychological insights, but the other way around is also relevant. In some psychological studies the rebound effect is treated as something different from behavioral spillover (Dolan & Galizzi, 2015). However, as Sorrell et al. (2020) argue there is much to be gained from bringing economic and psychological research effort together on this topic and conducting experimental and survey-based studies that give appropriate weight to both individual motivations and aggregate environmental impacts that are part of economic studies.

Our study has a number of social and practical implications. It showed that people are prone to the indirect rebound effect and negative spillover: after performing a PEB they may perform behaviors that partially negate the positive environmental impact of the initial behavior. This is in line with studies on the indirect rebound effect and behavioral spillover; with the latter showing that in general there is negative (or no) spillover between behaviors (Geiger et al., 2021; Maki et al., 2019). These findings imply that when implementing an intervention or policy measure, it should be acknowledged that follow-up behavior could negate the positive environmental impact of an initial behavior. In practice, the rebound effect and negative spillover do not completely negate the positive effect of this first behavior, but they do lead to a step back compared to what could have been. It is therefore particularly relevant to look at what can counter the rebound effect and negative spillover. Reminding people of the pro-environmental side of their behavior in combination with providing information on the environmental impact in a clear way encourages them to spend their money in a more pro-environmental way. In addition, when energy efficiency measures, such as home insulation, are marketed they often include a prediction of savings. In practice, these predictions are often too optimistic and do not come true, since the theoretical energy consumption of retrofitted buildings tends to be underestimated (Majcen et al., 2013). The rebound effect is part of the explanation as people may start using more energy after a retrofit. This discrepancy between the theoretical and actual energy consumption often leads to disappointment among people who took the measures, such as home owners or tenants. In addition, energy reduction targets are not met because of too optimistic projections. Future policy targets should therefore include the actual energy consumption of homes to increase their chances of success.

3.4.1 Conclusion

In this experimental study we find evidence that people are prone to the indirect rebound effect: after performing a PEB they use the money they earned because of this behavior to buy rewards that reduce the positive environmental impact of their initial behavior. However, when their knowledge about the environmental impact of the rewards improves because they receive information, they choose more pro-environmentally, reducing the indirect rebound effect and negative spillover. Furthermore, when people receive information and performed the initial behavior from an environmental motivation (instead of a financial motivation) they are most eager to choose pro-environmentally. We expect that consistency and identity are the main drivers of this result. In our study the evidence for moral processes affecting the performance of the subsequent behavior, that is choice of rewards, seems present but is less clear. All in all, our study shows that people spend the money they earn by behaving pro-environmentally in an environmentally unfriendly way and seem unaware that this is happening. We argue that providing information on the environmental impact of goods and services is a good way to encourage people to spend money in a more pro-environmental manner and decrease a potential indirect rebound effect and negative spillover. Emphasizing the pro-environmental motivation that may underlie behavior strengthens this effect.

Appendix 3.1 Exploration of an environmental effort budget

As we described in our paper, it is known that current choices are often evaluated with the knowledge of the outcomes which have preceded them (Thaler & Johnson, 1990), and that people balance their moral behaviors (e.g., Nisan, 1991). Based on the mental accounting hypothesis—i.e., people use psychological accounts to organize, evaluate, and keep track of their financial activities (Thaler, 1999)—we wanted to explore if people may also keep track of the effort they invested in PEBs.

Method

We explored the concept of an environmental effort budget, by measuring people's attitude to and possible use of this type of budget. For comparison reasons we included a validated scale of 4 items on (financial) mental budgeting developed by Antonides et al. (2011). For example, "I have reserved money (budget) for different expenses, such as food, clothing, transportation, etc." and "If I spend more on one thing, I economize on other expenses." Items were scored on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). Internal consistency of the items was sufficient to form one scale, both in Study 1 (α = .65) and Study 2 (α = .70); similar to item variance of α = .70 found by Antonides et al. (2011).

In addition, we included six items on environmental effort budgeting. The question was introduced by a short explanation: "Many of our actions, like driving a car, heating your home or buying products, have an impact on the environment. These actions use up resources (like fossil fuel, wood or water) and can produce pollution, like the gas carbon dioxide (CO2). Minimizing one's environmental impact takes effort. We would like to know how people deal with the effort of behaving environmentally friendly in their daily life. Do people use some sort of environmental effort budget? Please, indicate to what extent each of the following statements apply to you." Two of the six items were inspired by the mental budgeting scale, for example, "I have reserved a carbon budget for different purposes, such as food, clothing, transportation, etc." and "If I produce more carbon than normal on one purpose, I cut back on other carbon producing purposes." Furthermore, we included four additional items: "It is a good idea for people to start thinking about their carbon footprint," "I would like to have more insight in my own carbon footprint,", "I feel like I have a carbon budget: a maximum on my carbon footprint", and "If I plan to do something that costs a lot of energy, I make sure I also do some things that use little energy."

Principal component analysis (PCA) showed two underlying factors (see Table A3.1.1). The first component appears to be about actually having and using a budget, while the second component seems to more abstract on the idea of having a budget and a footprint. Descriptive results described in Table A3.1.2 show that on average participants agreed more with the two abstract items compared to the other items. Although this distinction in two factors can be made, the internal consistency of the six items appeared to sufficient to form one scale both in Study 1 (α = .69) and Study 2 (α = .82). In the paper we therefore used the full scale as one factor in the analyses.

Table A3.1.1

PCA of the six environmental budgeting questions

Item	Component loading	
	1	2
Component 1: Having a budget		
a. I have reserved a carbon budget for different purposes, such as food, clothing, transportation, etc.	**.92**	.05
b. If I produce more carbon than normal on one purpose, I cut back on other carbon producing purposes.	**.93**	.12
e. I feel like I have a carbon budget: a maximum on my carbon footprint.	**.88**	.17
f. If I plan to do something that costs a lot of energy, I make sure I also do some things that use little energy	**.52**	.21
Component 2: The budget idea		
c. It is a good idea for people to start thinking about a budget	.18	**.91**
d. I would like to have more insight in my own carbon footprint	.13	**.92**

Note. N=725. The extraction method was PCA with a Varimax (with Kaiser normalization) rotation. Factor loadings above .30 are in bold.

Results

Descriptive results show that compared to the items of the mental budgeting scale, participants agreed much less with the similar items a) and b) on environmental budgeting (see Table A3.1.2). Furthermore, on a 7-point scale, participants indicated to be neutral towards having an environmental budget (M = 4.0, SD = 1.2), but about 35% scored a value ⩾ 4.5. This latter share of participants appeared to have a positive attitude towards having such a budget.

Table A3.1.2

Descriptive results mental budgeting and environmental budgeting scale and items

Item	*Mean*	*SD*
Mental budgeting scale	4.8	1.1
a. I have reserved money (budget) for different expenses, such as food, clothing, transportation, etc.	5.2	1.6
b. If I spend more than normal on one thing in 1 month, I spend less on other things in the next month.	5.1	1.6
c. If I spend more on one thing, I economize on other expenses.	5.3	1.4
d. I never spend more than a fixed amount on food, clothing, transportation, etc.	3.5	1.7
Environmental budgeting scale	4.0	1.2
a. I have reserved a carbon budget for different purposes, such as food, clothing, transportation, etc.	2.7	1.8
b. If I produce more carbon than normal on one purpose, I cut back on other carbon producing purposes.	2.9	1.8
c. It is a good idea for people to start thinking about a budget	5.4	1.5
d. I would like to have more insight in my carbon footprint	5.4	1.5
e. I feel like I have a carbon budget: a maximum on my carbon footprint.	3.1	1.9
f. If I plan to do something that costs a lot of energy, I make sure I also do some things that use little energy	4.4	1.6

A linear regression model with environmental budgeting as the dependent variable and preference for consistency, concern about climate change, personal value types, and demographics as independent variables proved to be significant ($F(9, 716) = 52.428$, $p = .000$; $R^2_{adj} = .39$), with preference for consistency, concern about climate change and the four personal value types as significant predictors (see Table A3.1.3). Results showed that when participants held stronger biospheric values ($\beta = .34$, $p = .000$), or egoistic values ($\beta = .31$, $p = .000$), were more concerned about climate change ($\beta = .22$, $p = .000$), or had a stronger preference for consistency ($\beta = .11$, $p = .000$) this was related to a stronger agreement of having an environmental budget. On the other hand, having stronger hedonic values ($\beta = -.13$, $p = .000$) was related to disagreeing more to having an environmental budget. Demographics, including gender, age, and level of education were non-significant predictors.

Table A3.1.3

Linear regression coefficients of factors predicting environmental budgeting

Predictor	*B*	*S.E.*	*β*	*p*
Preference for consistency	.13	.04	.11	.000
Concern about climate change	.20	.03	.22	.000
Biospheric values	.31	.04	.34	.000
Egoistic values	.24	.03	.31	.000
Hedonic values	-.11	.03	-.13	.000
Altruistic values	.04	.04	.04	.319
Gender	-.13	.07	-.06	.058
Age	.00	.01	.00	.968
Level of education	.02	.03	.02	.595
(Constant)	.40	.36		.260

Conclusion

Our exploration on environmental budgeting shows that a minority of people think that they have a mental environmental budget, or is willing to think in terms of an environmental budget. People seem to apply such an account much less compared to mental budgeting of finances. The environmental budget appears to be related to different sets of personal values. When people hold stronger biospheric and egoistic values an environmental budget appears to be more relevant for them. In case of biospheric values they might feel the importance more, while people with stronger egoistic values might in general relate issues more to themselves. On the other hand, people with stronger hedonic values appear to be more opposed to the idea of having a budget, possibly because having a budget or limit interferes with living a comfortable, feel-good life without too much effort.

This first exploration of environmental budgeting raises the question of whether people would actually use an environmental budget and track previously invested effort or whether our scale is a measure of something else, such as pro-environmental attitude. However, the relation with egoistic values might imply the existence of a more individual mechanism. These are interesting topics for further investigation. The extensive literature on mental budgeting can provide inspiration for follow-up experimental studies.

Chapter 4:

Perceived similarity and behavioral spillover

This chapter is based on: Dreijerink, L., Handgraaf, M., & Antonides, G. (in preparation). Perceived similarity and behavioral spillover.

Abstract

Similarity of pro-environmental behaviors is a moderator of behavioral spillover: when behaviors are perceived as similar positive spillover is more likely. Interventions to encourage positive spillovers should therefore include similar behaviors to be most effective. How people perceive similarity is, however, unclear and it is uncertain which combinations of behaviors should be targeted. In a survey (n = 1,536) we investigated how people clustered a variety of pro-environmental behaviors and why. Moreover, we explored potential spillovers between people's current and desired behaviors. People appeared to mainly cluster behaviors according to domains (such as energy, mobility) but they also applied other categorization types. Furthermore, positive spillovers from actual to desired behavior occurred both within and between domains. Overall, similarity appeared less important in behavior–desire spillover than we expected.

4.1 Introduction

Given the current climate change situation and the accompanying challenges ahead, there is growing interest in how low-carbon, pro-environmental behavior (PEB) can be encouraged. When creating effective behavioral change strategies to reduce climate change, a narrow focus on single behaviors will however be inefficient and could lead to the creation or worsening of environmental problems outside the focus (Thøgersen, 1999). As "no behavior sits in a vacuum," "sector-thinking" should be abandoned and changing whole lifestyles should be the aim (Dolan & Galizzi, 2015, p. 1). The focus on behavioral spillover research in recent years indicates that there is an increased notion of the need to broaden the scope (e.g., Dolan & Galizzi, 2015; Maki et al., 2019; Penz et al., 2019; Truelove et al., 2014; Van der Werff & Steg, 2018). Behavioral spillover implies that acting in a pro-environmental way changes a person's likelihood or extent of performing other PEBs (Lanzini & Thøgersen, 2014). Behavioral spillover can be positive when the adoption of a particular first behavior (PEB1) is found to increase a person's inclination to engage in another second behavior (PEB2) (Thøgersen & Crompton, 2009). However, spillover can also be negative, in which case the reverse effect is observed: after adopting a PEB1, the probability of an individual adopting another PEB2 declines. Both kinds of spillover can be seen as either a positive or negative feedback loop that leads towards more or less PEBs. Meadows (1999) described feedback loops as ways or "leverage points" to intervene in a system. Steering on these leverage or "social tipping points" (Otto et al., 2020) may help in bringing and speeding up overall change.

Previous studies show that both negative and positive behavioral spillovers occur (Maki et al., 2019), but why the one or the other exactly happens remains unknown. However, a number of spillover moderators have been identified, including the perceived difficulty of PEBs, the strength of one's environmental identity (i.e., the degree to which individuals see themselves as environmentally friendly) and similarity of PEBs (Fujii, 2006; Miller & Effron, 2010; Nilsson et al., 2017; Thøgersen, 2004; Truelove et al., 2014; Van der Werff et al., 2014). Here we focus on the third factor, as there is lack of clarity about how people perceive similarity of PEBs, and researchers use various definitions of similarity when stu-

dying spillovers. In the theoretical framework we describe the state of art of similarity, the process of positive and negative spillovers, and definitions concerning perception and categorization of PEBs.

4.1.1 Theoretical Framework

Similarity and behavioral spillovers

Positive spillovers

Studies show that people tend to be more likely to co-perform behaviors in similar categories (Gatersleben et al., 2002). In other words, when behaviors are perceived as more similar positive spillovers are more likely (Margetts & Kashima, 2017; Thøgersen, 2004). A meta-analysis by Maki et al. (2019) indeed found that PEBs that were perceived as highly similar led to more positive spillover compared with behaviors perceived as medium or low similarity. A commonly used explanation is that people act because of a preference for consistency and a desire to prevent dissonance associated with inconsistent behaviors. In line with this explanation, several studies on the foot-in-the-door effect showed that compliance with a second request was greater when the first request was similar (Nilsson et al., 2017). Moreover, it is suggested that people with a strong environmental identity and high knowledge might be more likely to engage in positive spillover simply because they recognize the behaviors as related (Truelove et al., 2014).

Studies on mental accounting may provide additional explanations of positive spillovers within categories. Mental accounting assumes that people use accounts to organize, evaluate, and keep track of their financial activities (Thaler, 1999). Expenditures are grouped into categories (for example housing, food, leisure, etc.) and spending can be constrained by implicit or explicit budgets. Moreover, similar expenses combined into one category are psychologically integrated, thus hurting less than segregating expenses (Thaler, 1980). Next to financial decision making, mental accounting has been studied in other fields, including ethical (Schütte & Gregory-Smith, 2015), food (Krishnamurthy & Prokopec, 2010), and energy consumption (Hahnel et al., 2020). Also, mental accounts have been described as categories that are organized around active goals (Paul et al., 2018). Pursuing a goal requires protecting it from competing goals, which can be accomplished by committing resources (e.g., money, attention, effort) to that goal rather than to others (Brendl et al., 1998). In these applications of mental accounting, financial expenses are replaced with spending attention or effort. In line with this argumentation, people would therefore be more inclined to subsequently spend these resources within the same category than in a different category.

In contrast, the mental accounting hypothesis has been challenged by several studies showing positive spillovers between categories and people engaging in dissimilar behaviors (e.g., Lanzini & Thøgersen, 2014; Thøgersen & Ölander, 2003; Xu et al., 2018). While correlations between dissimilar PEBs suggest the possibility of wider spillover effects, the reasons for consistency are however not well understood (Nash et al., 2017).

Negative spillovers

Negative spillovers have more often been found between categories, or when behaviors are dissimilar (e.g., Tiefenbeck et al., 2013; Werfel, 2017). For example, Geng et al. (2016) found that after a green purchasing task, respondents were less inclined to save water. An explanation would be that when people do not perceive behaviors as similar, they see no inconsistency (Thøgersen, 2004). Therefore, preference for consistency and desire to prevent dissonance do not encourage them to act pro-environmentally in both instances. From the mental accounting perspective, focusing on one account and less on others would indeed be expected. However, the mental accounting hypothesis has been challenged by several studies showing or suggesting negative spillovers within categories (e.g., Chatelain et al., 2018; Truelove et al., 2014; Weber, 1997).

Categorizing pro-environmental behaviors

In the (limited) literature that explicitly focuses on spillovers and similarity most studies assess similarity by means of domains (Juhl et al., 2017; Nash et al., 2019). For example, in a qualitative study on self-reported spillovers, Nash et al. (2019) described that the most commonly reported types of spillover effects were within behavioral domains (such as waste or resource conservation) as opposed to between domains, in line with the mental accounting hypothesis. Additionally, Thøgersen and Ölander (2003) investigated the spread of PEBs both within and between consumption domains. Although there are exceptions (see Margetts & Kashima, 2017) in spillover studies similarity seems to imply that behaviors are part of specific domains.

The literature shows that (lay) people and researchers apply different ways to categorize PEBs. Most research on PEB attributes has focused on energy experts' conceptualizations about the cost, frequency of action, and environmental impact of one class of PEBs: household behaviors that contribute to greenhouse gas emissions reductions (Truelove & Gillis, 2018). Experts have most frequently proposed a simple dichotomous classification scheme: (a) low-impact, low-cost, repetitive, curtailment behaviors (such as turning down the heat or reducing appliance use); and (b) high-impact, high-cost, infrequent, efficiency behaviors (such as insulating one's home or buying energy efficient appliances) (Boudet et al., 2016).

As Truelove and Gillis (2018) describe, a second class of literature has adopted a more laypeople-driven approach to categorizing a wide set of PEBs. This approach typically involves conducting surveys of people' self-reported PEB frequencies and then factor analyzing responses to see which types of PEBs group together. Similarly, card-sorting procedures and Rasch-type modelling efforts provide insight into which PEBs people cluster as similar. Factor analyses on the frequency of performing PEBs and card-sorting procedures generally reveal clusters based on domains of behavior, such as waste-reduction, recycling, domestic energy conservation, transport, advocacy, and consumer behavior (Bernard et al., 2009; Bratt, 1999; Gatersleben et al., 2002; Whitmarsh & O'Neill, 2010). These domains could be viewed as mental accounts. Antonides et al. (2011) indeed reported that about half of their respondents indicated to reserve money for different expenses, including food, clothing, transportation, and so forth. Additionally, Zhang et al. (2020) found that roughly 60 percent of people use budgetary categories, such as food, clothing, gas, entertainment,

and so forth. However, they also found clear variation in the level of detail at which people categorized their spending.

In addition to the first two approaches and different than researchers, (lay) people appear to categorize behaviors in other ways. For example, in a study on clustering domestic energy consumption behaviors, Gabe-Thomas et al. (2016) found that the degree to which participants agreed on which appliances belonged together was based on location within the home (e.g., kitchen) and on activities (e.g., entertainment). In their sorting study on 44 household water saving behaviors Kneebone et al. (2018) found that location (indoors vs. outdoors) was the primary attribute used to define behavioral similarity. The secondary attribute was behavior type: either curtailment or efficiency.

Besides the various ways of categorization, the broadness of categories and thus the number of categories people use is crucial. Within mental accounting the range of each category or how broad people "set the brackets" is identified as an important aspect (Koch & Nafziger, 2016). Brackets can be defined broadly over large sets of choices or narrowly over very small sets of choices. For example, Heath and Soll (1996) documented how people control their expenditures in narrowly bracketed mental accounts, such as entertainment, clothing, or food, but at the same time, not all accounts are narrow: people do not have a mental account for every item they buy, or for every possible consumption category. It is expected that when people cluster PEBs into one overall account this may have consequences for the occurrence of spillovers. For example, Kaiser (1998) suggested that having a holistic view of PEBs (i.e., "ecological concern"), could lead to an increase of the performance of several PEBs. Therefore, strengthening links between PEBs might lead to higher perceived similarity and possibly to more positive spillovers (Nash et al., 2017). Contrarily, mental organization that bundles different energy-consuming actions together into one broad "carbon account" may result in negative spillovers within this account (Hahnel et al., 2020). Thus, specialization into a few accounts would lead overall to more pro-environmental behavior if these accounts include similar behaviors.

4.1.2 Current study

In the current study we aimed to provide insight into perceived similarity of PEBs and behavioral spillovers. We first focused on the type of categorization prevailing among people, and why they applied a particular categorization. We expected that the majority of people would cluster the PEBs according to domains such as housing, mobility, food, and so forth. In addition, we explored the relation between how people categorize a broad range of PEBs and potential positive and negative spillovers.

In a paper on perceived similarity of 44 household water saving behaviors, Kneebone et al. (2018) described a replicable procedure. We followed their procedure in order to understand which PEBs are seen as similar and why, but we made three adjustments. First, in order to avoid "sector-thinking" (Dolan & Galizzi, 2015, p. 1) we applied the procedure on a broader range of PEBs instead of one domain. Second, in addition to consumer behaviors we added citizen engagement behaviors. Third, we conducted a quantitative (instead of a qualitative) study which enabled us to involve a large group of participants that would include a representative sample of Dutch society.

4.2 Method

4.2.1 Respondents

This study was an addition to a study on social support for climate policy. The latter study used a sample from the I&O Research panel that was representative for Dutch society. Participants were recruited at the end of November 2019. 1,536 People participated, including 54% males and 46% females. Educational levels varied from 24% lower (primary education up to and including incomplete secondary education), 35% medium (secondary education, vocational education, up to and including first year higher vocational education) to 41% higher educated (higher vocational education up to and including university degree). Age varied from 14% in the category 18–39 years, 39% in the category 40–64 years, and 47% were 65 years or older.

4.2.2 Materials and Procedure

As this study was added to an online questionnaire on support for climate policy, parts of the questionnaire are not relevant for this study and are therefore not described. The relevant part of the questionnaire is included in Appendix 4.1. Our study was preregistered at as.predicted (#31213). In this preregistration we described a number of research questions including the present one on categorization. Questions were asked on the following topics.

Pro-environmental behaviors

Performance of PEBs was measured using items inspired by the General Ecological Behavior (GEB) scale items (Arnold et al., 2017). We included items from specific (consumption) domains, namely curtailing in-home energy use, efficient in-home energy use, mobility, food, buying goods, and green citizenship (see Table 4.1). Furthermore, we added variation with regard to the environmental impact of behaviors: some having a low estimated impact (low carbon emission) versus others having higher impacts (higher carbon emission). Impact estimations were based on the Dutch website of Milieu Centraal (www.milieucentraal.nl) that provides thorough information on environmental impacts based on lifecycle assessments (LCA). The goal of these emission estimations was to add variation in the selection of PEBs and not to quantify the exact impact of each behavior. To limit the questionnaire length we made a selection of 13 items from the 74 GEB items. Some items were adjusted to the Dutch situation. For example, prior interviews (Dreijerink et al., 2021) showed that riding a bicycle or taking public transportation to go to work or school were perceived as very different and should therefore not be combined into one item (we have included three mobility items, i.e., 7, 8, and 9 in Table 4.1). In addition, items were shortened for clarity. Finally, we added four items to have a sufficient number of items per domain (item numbers 2, 14, 16, 17 in Table 4.1).

Table 4.1

17 PEBs per domain and with an estimated carbon emission impact

PEB	Domain	Est. carbon impact
1. Buy solar panels	Energy in home - efficiency	High
2. Buy a heat pump	Energy in home - efficiency	High
3. Insulate the house to keep it warm	Energy in home - efficiency	High
4. Put on a sweater in the house when it's cold	Energy in home - curtailment	Low
5. Switch off lights and heating when you leave	Energy in home - curtailment	Low
6. Take short showers (maximum 5 minutes)	Energy in home - curtailment	Low
7. Use a bike for short distances (5 to 10 km)	Mobility	High
8. Use public transport for medium distances (30 to 60 km)	Mobility	High
9. Not go on a holiday by airplane [a]	Mobility	High
10. Only buy fruit and vegetables grown in the Netherlands	Food	Low
11. Be a vegetarian (not eating meat or fish)	Food	High
12. Throw empty glass jars and bottles in bottle bank	Food	Low
13. Read about climate and environment	Green citizenship	Low
14. Vote for a political party committed to climate/ environment	Green citizenship	High
15. Only buy products from eco companies	Goods	High
16. Buy second-hand items	Goods	High
17. Repair things and clothing that break down	Goods	High

[a] Reversed in analyses

Clustering task

Following a procedure used by Gabe-Thomas et al. (2016), but adjusted to our quantitative study setting, respondents were asked to cluster the 17 PEBs into groups depending on how they felt behaviors naturally "went together." Respondents were instructed that they could cluster the cards in any manner they wished provided they made a minimum of one and a maximum of eight groups. On average respondents defined six clusters in the studies by Gabe-Thomas et al. (2016) and by Kneebone et al. (2018). Since we included fewer behaviors than previous studies, we expected that a maximum of eight would suffice.

After forming each cluster, respondents were asked to provide names to describe its contents. 124 (8%) Of the respondents indicated they were not able to cluster the behaviors and were excluded from the analyses (see Table 4.2). The modal number of groups the remaining 1,412 respondents clustered the 17 PEBs into was 3 (M = 3.2, SD = 1.3). Not all respondents provided relevant names, for instance they filled in "no," or "group 1," or a similar name that was not explaining their clustering choice. However, since this group of 97 respondents (6%) stated to be able to cluster the behaviors, we included them in our analysis.

Table 4.2
Number of clusters respondents created

Number of clusters	Number of respondents
0 [a]	124
1	157
2	256
3	446
4	323
5	172
6	54
7	2
8	2
Total	1,536

[a] Not able to cluster

Performing the PEBs

Next, respondents were asked whether or not they performed the behaviors, on a 5-point scale from 1 (never), 2 (seldom), 3 (occasionally), 4 (often) to 5 (always). In addition, respondents could indicate they did not know. For four items, including having solar panels installed, having a heat pump installed, having their home insulated, or being a vegetarian, respondents were asked to indicate whether or not they performed this behavior, or that it was not applicable to them.

Desire to perform the PEBs

Finally, respondents were asked for each of the 17 PEBs to what extent they would desire to perform them on a 10-point scale ranging from 1 (totally do not want to do this) to 10 (totally want to do this). If respondents had indicated on the previous questions on performance that they already had installed solar panels, a heat pump, or insulation, or if they were vegetarian, the questions on their desire to perform these behaviors were skipped. This means that we only measured the desire of respondents who did not perform these four PEBs.

4.2.3 Analysis

A three-step combination of (a) multidimensional scaling analysis (MDS) and hierarchical cluster analysis (HCA) with (b) thematic content analysis and (c) categorical principal components analysis (CATPCA) was applied to investigate which behaviors were seen as similar and why they were seen as similar (see Kneebone et al., 2018). In addition to the confirmatory analysis, we explored the relation between how respondents cluster the PEBs and their (spillover) behavior, by means of regression analyses.

4.3 Results

4.3.1 Categorization

Clustering the behaviors

MDS can be used to find a structure in a set of distance measures between objects or cases. As we wanted to identify similar behaviors, MDS was performed on the 17 PEBs of the 1,412 respondents, based on a 17´17 co-occurrence matrix. The MDS analysis was carried out using the PROXSCAL option (Euclidean model) in SPSS (version 24). We tested multiple dimension options (1 to 5 dimensions) to assess the most interpretable solution, where stress-values were minimized. The results suggested a 3-dimensional orthogonal solution was optimal, with a "fair" S-stress value of 0.09 (Kruskal, 1964). A larger number of dimensions led to better stress-levels but the accompanying scree plot showed an optimum ("elbow") at three dimensions. The first dimension appeared to distinguish between behaviors that are known to be pro-environmental and that are quite concrete (such as insulating one's home, turning lights and heat off when you leave) and more unknown behaviors that may be perceived as more abstract (for example, voting for a "green" political party, and reading about climate and the environment). The second dimension seemed to distinguish between large-impact behaviors (such as eating vegetarian food, buying products from ecological companies, buying a heat pump) and small-impact behaviors (for example repair clothes and things that break, and take short showers). Finally, the third dimension seemed to distinguish between actions close to home (such as buying Dutch fruits and vegetables, putting a sweater on) and behaviors that are about going away from home (including use of public transport for 30–60 km distances, not flying when going on holiday). An overview of the loadings per dimension is added in Appendix Table A.4.2.1.

In addition to the MDS analysis aimed at finding an underlying structure of the PEBs, we used an agglomerative HCA of the co-occurrence matrix to investigate which behaviors respondents most frequently grouped together. Ward's solution provided the clearest outcome in terms of interpretability, with the shortest branches. The HCA and accompanying scree plot indicated the best result at five main clusters, of which the first could be subdivided into two sub-clusters (see Figure 4.1). Results showed a distinction between five main clusters (energy in home, mobility, green citizenship, consumption of goods, and circularity), and two sub-clusters (energy investment and energy curtailment). The clusters are plotted on the MDS dimensions in biplots (Figures 4.2 and 4.3).

Figure 4.1

Dendrogram showing grouping of PEBs

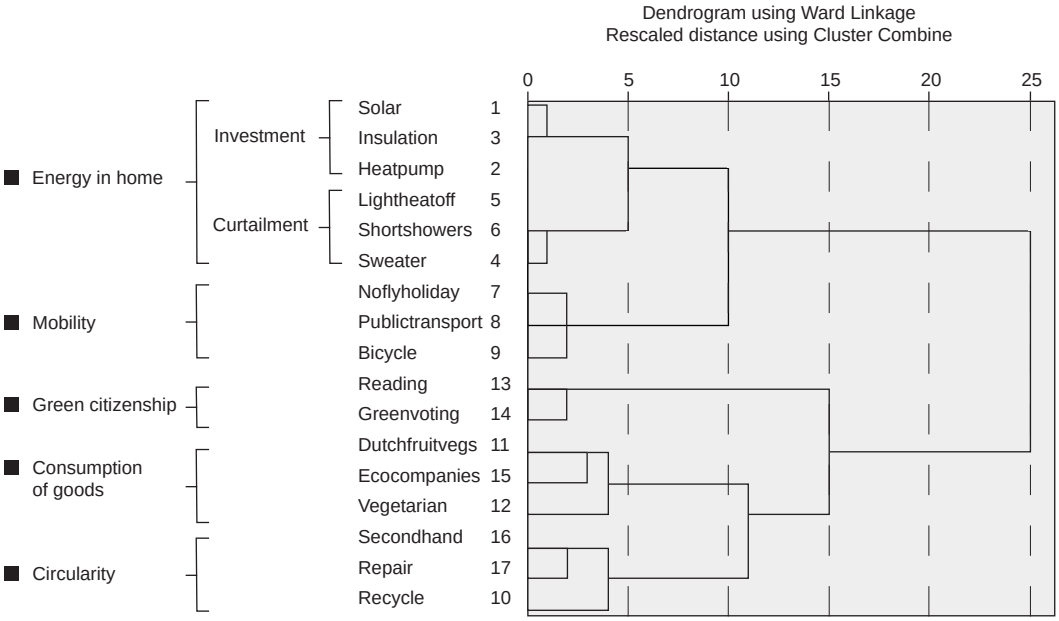


Figure 4.2

Biplot of dimensions 1 (abstract/concrete) and 2 (large/small impact) with HCA clusters

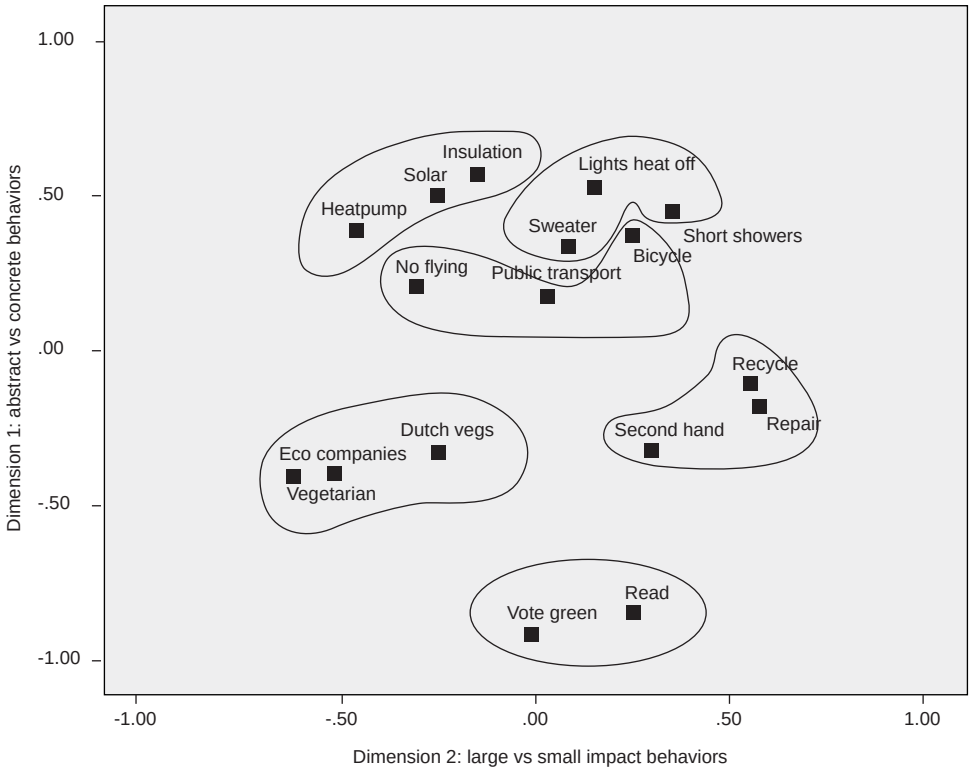
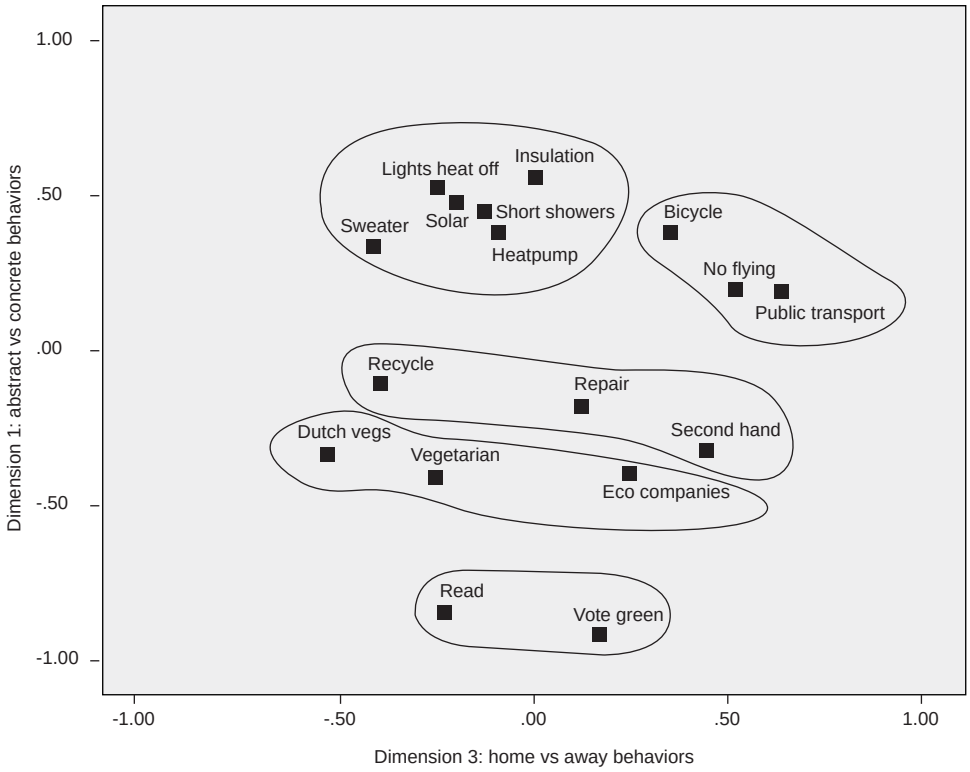


Figure 4.3
Biplot of dimensions 1 (abstract/concrete) and 3 (home/away) with HCA clusters



Naming the clusters

In addition to clustering, we analyzed the names respondents assigned to the groups they clustered, to explore why particular behaviors were placed together. We summarized names they provided into themes and constructs, by using a combination of a priori constructs from behavior categorization literature, for example, consumption domain or location, and inductively defined constructs. In total the respondents clustered and named 4,228 groups. Our thematic content analysis summarized this list into 30 descriptive constructs, arranged into 11 themes. The frequency of use of each construct was recorded in a contingency table (Table 4.3), showing that "Consumption domains" themed constructs made up 43% of responses. Within this theme, especially the construct of "energy" and the related constructs of "curtailment" and "efficiency" (15%), and "mobility" (10%) stand out as often applied constructs. Additionally, the constructs of "personal practice" (10%), "effectiveness" (10%), "difficulty of behavior" (10%), "lifestyle" (8%), "location" (7%), "typology" (5%), "rationality" (1%), "money savers" (1%), and "frequency of the behavior" (1%) were used. Around 5% of the descriptions ("other") did not fall within any one of these themes.

Finally, the analysis showed that although consumption domains were used most often, respondents largely used a mix of clustering themes. For instance, some respondents (n = 127) used only consumption domains to describe their clusters, while a larger group (n = 693) used both domains themes and other themes.

Table 4.3

Contingency table of proportional frequency of constructs used by respondents when describing clusters of similar behaviors, with Variance Accounted For (VAF) in CATPCA in the final column

Theme	Construct	Sample terms used by respondents	Frequency of use (%)	VAF Total Eigenvalue CATPCA
Consumption domains	Energy	Saving energy, energy improvement	11.0	0.99
	Energy- Curtailment [a]	Saving by use, frugal	2.3	0.87
	Energy- Efficiency [a]	Home insulation, energy investment	1.7	0.97
	Mobility	Transport, travel	10.3	0.97
	Circularity	Waste, materials, re-use, recycling	5.1	0.82
	Goods	Clothing, sustainable consumption, buying less	4.6	0.56
	Food	Food, eating	4.5	0.94
	Green citizenship	Voting, politics, knowledge, information, forming an opinion	3.9	0.62
	TOTAL		43.3	6.74
Personal practice	Can practice	Things I can do, things everyone can do	5.4	0.92
	Practice in future	Next steps	1.5	0.61
	Other	Normal to do, practical, theory	1.3	0.44
	Do practice	Things I do	0.7	0.69
	Do not practice	No go, do not do	0.7	0.56
	Can with help	With others, help	0.3	0.85
	Want to practice	My goals, what I want to do	0.2	0.26
	TOTAL		10.1	4.33
Effectiveness	Effective	Sustainable, CO_2 saving, effective	6.9	0.88
	Ineffective	No use, useless, no effect	1.9	0.83
	Small effect	All little things help, it could help	0.9	0.29
	TOTAL		9.7	2.00
Difficulty of behavior	Easy	Easy to do, quick wins, no costs	5.3	0.95
	Difficult	Big changes, high costs	3.8	0.85
	Medium	More difficult things	0.3	0.68
	TOTAL		9.5	2.48
Lifestyle	Lifestyle	Conscious sustainable living, behavior	7.8	0.90
Location	In home	Home, household, house, kitchen	5.5	0.99
	In or close to home	In or around the house, garden, outside	1.0	0.98
	Surroundings	Living environment, local, hometown	0.5	0.70
	TOTAL		7.1	3.57

Typology	Type of person who would do this	Green party voters, premium environmentalist, people with money	4.7	0.90
Rationality	Use of mind	Common sense, reflect	1.4	0.88
Money savers	Money savers	Save money	0.7	0.85
Frequency	Frequency	Daily behaviors	0.5	0.87
Other	Other	Pets, taking responsibility, companies, no, group number, no reason	5.2	0.94
TOTAL			100	23.54

[a] If people were more specific regarding energy, their description was coded as curtailment of efficiency

Combining clustering and naming

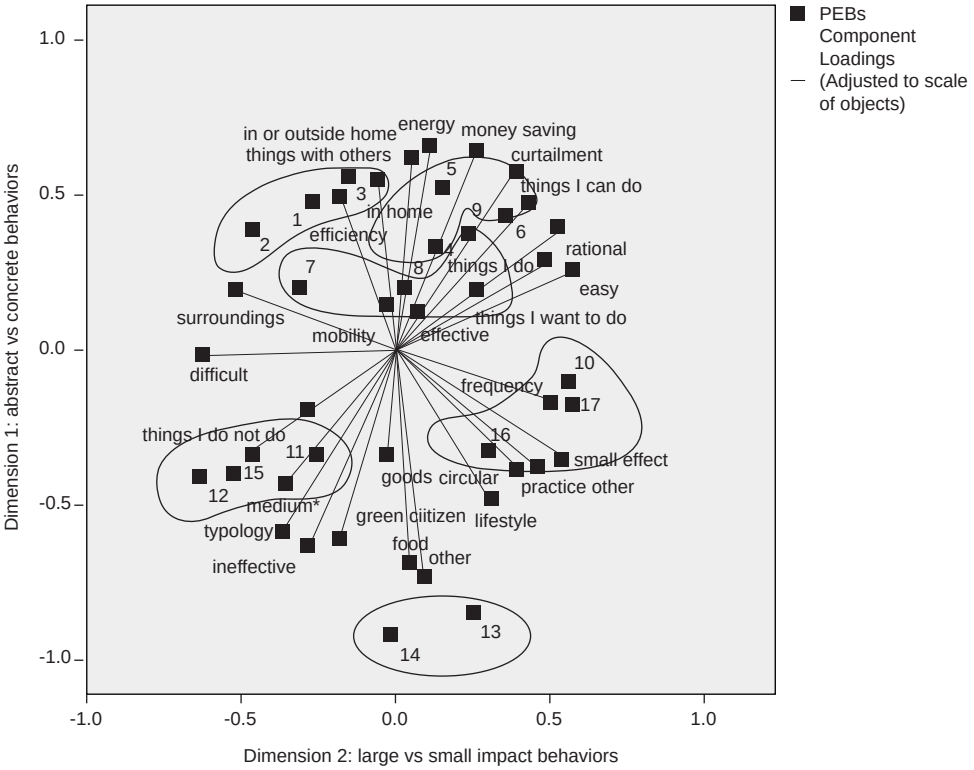
In the final step, we combined the results on the clustering task with the names respondents provided for each of the clusters. The results from MDS and HCA, with the thematic content analysis, were linked using CATPCA. Similar to standard PCA, CATPCA reduces data dimensions into "principal components" accounting for as much of the variance in the data as possible. SPSS allows incorporation of the behavior location coordinates from the MDS analysis as a fixed configuration (Dobbie, 2013; Kneebone et al., 2018). In other words, the coordinates of PEBs obtained during the MDS analysis were used in the CATPCA. CATPCA was performed with optimal scaling and variable principal normalization, on 17´30 matrices containing the number of times a construct was mentioned in relation to each of the 17 PEBs. This way we could analyze why respondents grouped the PEBs, with the use of what constructs.

After testing the CATPCA on one to five dimensions, we selected a 3-dimensional solution as the most meaningful with high internal consistencies of the three factors (Cronbach's αs of, respectively .94, .92, and .71) accounting for 79% of variance, and 24% of eigenvalue variance (VAF). All constructs had variance larger than 0.1 and were therefore all included (see the VAF column in Table 4.3). PEB coordinates on the three dimensions obtained from MDS were used in the CATPCA by means of a fixed configuration.

The 30 constructs were plotted in Figures 4.4 and 4.5 over the MDS dimensions and HCA clusters (displayed in Figures 4.2 and 4.3). Each construct is illustrated as a vector. Vector length indicates the relative frequency of construct use (the higher the frequency, the longer the vector) and vector direction is determined by the location of the PEBs the construct was used to describe. The biplots therefore combine data illustrating which PEBs are seen as similar and why they are seen as similar. The biplots show, for example, that on the abstract/concrete dimension (dimension 1), the abstract side is related to the constructs of "ineffective," "typology," "other," "food," "green citizen," and "lifestyle" (see Figures 4.4 and 4.5). On this side we see PEBs related to goods and green citizenship. On the concrete side of the dimension the constructs of "energy," "money saving," "in or outside the house," "curtailment," "things I can do," and "things with others" appeared. On this side PEBs were related to energy and mobility.

Figure 4.4

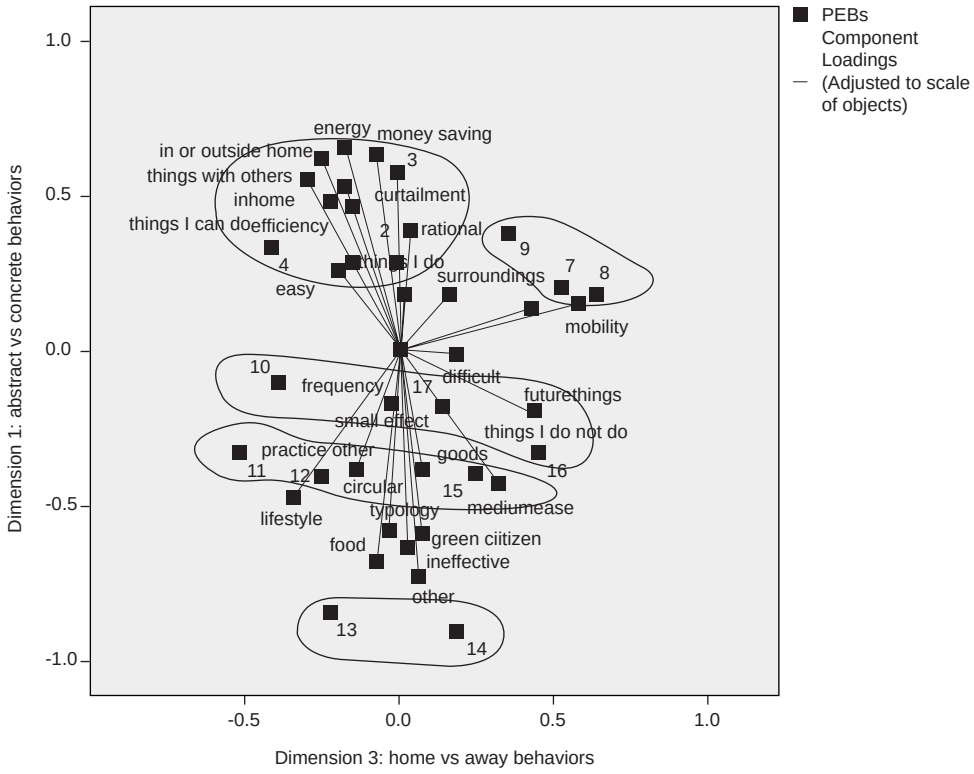
CATPCA biplot of constructs defining behavioral similarity, superimposed on the MDS dimensions (unknown/known) and 2 (consumption/consuming less), including the HCA clusters



Note. 1 PEB code numbers: 1 = Install solar panels; 2 = Buy a heat pump; 3 = Insulate one's home; 4 = Put on a sweater; 5 = Turn lights and heat off; 6 = Take short showers; 7 = No flying; 8 = Use public transport; 9 = Cycle short distances; 10 = Recycle glass; 11 = Buy Dutch fruit/vegs; 12 = Vegetarian; 13 = Read; 14 = Vote "green"; 15 = Buy from eco companies; 16 = Buy second hand; 17 = Repair things/clothes.

Figure 4.5

CATPCA biplot of constructs defining behavioral similarity, superimposed on the MDS dimensions 1 (unknown/known) and 3 (easy/difficult), including the HCA clusters



In sum, next to the consumption domains description, the respondents added various constructs to the clusters. Generally speaking, the behaviors within the energy curtailment cluster were labelled as easy concrete things related to energy people can do within the home that have small effects. The behaviors within the energy investment cluster were labelled as difficult concrete things related to energy people can do, but do not do within the home. Mobility behaviors were labelled as concrete effective things related to mobility that people want to do in the future. The citizen engagement behaviors were labelled as abstract ineffective things related to food and the other category. The goods cluster behaviors were labelled as abstract difficult food and goods behaviors that are related to lifestyle. Finally, the behaviors in the circular cluster were labelled as easy, rational things that have a small impact. In sum, the CATPCA shows that the perception of the behaviors and clusters is richer than solely naming the consumption domains. Still, the consumption domains prevail within respondents' perception.

4.3.2 Spillovers

With insights on how respondents clustered the PEBs and named these clusters, we could explore if clustering and naming affected positive or negative spillovers within and between clusters. We started with analyzing potential spillovers on a general level.

Within- and between-cluster spillovers

Potential within- and between-cluster spillovers related to the six HCA clusters were explored. We conducted linear regression for each cluster separately to predict a respondent i's mean desire (MDij) to perform behaviors within cluster j from respondent i's total performance (TPij) of all PEBs within that same cluster (see Appendix 4.2 Table A4.2.2, model 1). We used TP of PEBs in clusters that were already performed to predict MD of PEBs in clusters that were not yet performed. Following previous dichotomization of the same 5-point scale (e.g., Dreijerink et al., 2022; Kaiser & Lange, 2021), we defined the item categories never, seldom, and occasionally as not performing a PEB, and often and always as performing a PEB. Per respondent TP per cluster was calculated of PEBs that were already performed and MD per cluster was calculated for PEBs that were not performed. Results showed that, except for the energy investment cluster, for all other clusters MD was significantly affected by TP. For most clusters, performing behaviors within this cluster increased respondents' desire to perform PEBs in the same cluster; this implies a potential for within-domain spillovers. Only for the goods cluster this was not the case: the negative coefficient indicates that the more respondents already did the less they desired to do more. Possibly the low desire to become a vegetarian explains this result (see Appendix 4.2 Table A4.2.3).

To investigate between-cluster effects we conducted linear regression (Equation 1) for each of the six clusters separately to predict respondents' MD to perform behaviors within the cluster from the TP of PEBs in all six clusters, with coefficients b_{0j} (constant) and b_j, with J = 6, and error term ε_{ij}. Again we used MD for PEBs that were not performed and TP for PEBs that were performed.

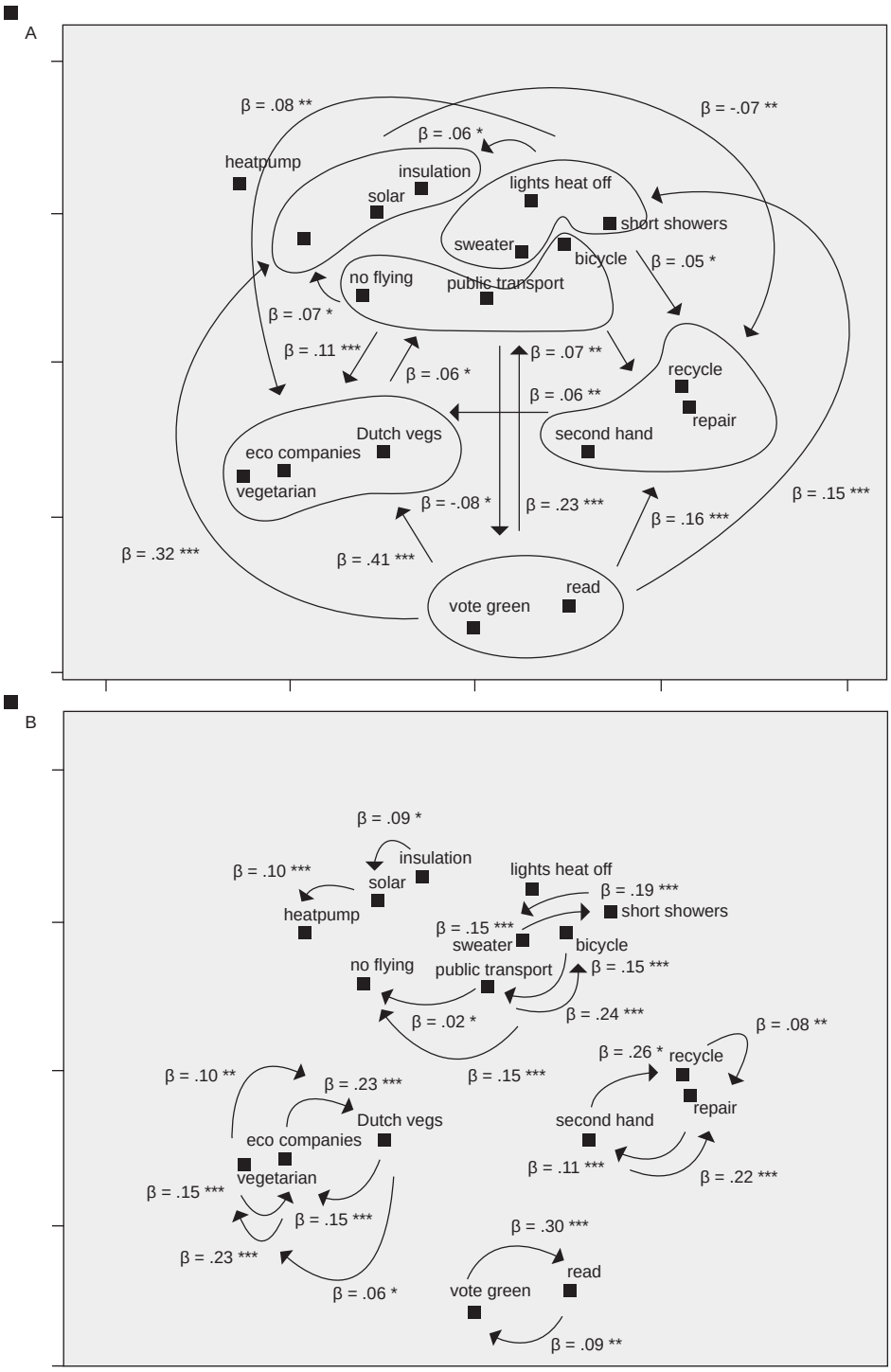
■ (1)

$$MD_{ij} = b_{0j} + \sum_{j=1}^{J} b_j * TP_{ij} + \varepsilon_{ij}$$

Results showed again within-cluster effects, but only for the mobility and goods clusters, and unlike model 1, for the energy investment cluster (see Table A4.2.2, model 2). In addition, we found several effects between clusters. Figure 4.6A displays the significant between-cluster effects (plotted on MDS Figure 4.2 for recognizability). Positive (negative) coefficients in Table A4.2.2 indicate positive (negative) spillover effects. All significant coefficients were positive, except for the relation between the goods and circularity cluster. The green citizenship cluster appeared to be the strongest significant predictor for energy investment and the mobility clusters, and a significant predictor of the goods and circularity clusters. This result implies that when respondents read on environmental issues and vote for a political party committed to the environment they are more inclined to perform PEBs in other clusters. The coefficients for within-domain effects appeared not to be stronger than the coefficients for between-domain effects; only for the goods cluster the coefficient was the strongest within its cluster. This result indicates that positive spillover effects within domains are not necessarily stronger than between domains. Furthermore, TP of some clusters (including energy curtailment and mobility) affected the MD to perform PEBs in other clusters (such as goods) while there were no reverse effects. This result implies that some spillover directions are more fruitful than others. For example, performing behaviors in the mobility cluster may be a stepping stone to also perform goods related behaviors. Finally, we found one negative relation: the goods cluster TP was related to a somewhat lower MD for PEBs in the circularity cluster.

Figure 4.6

Significant coefficients of regression models 2 and 3 on desire to perform (clusters of) PEBs



Note. Panel A: Between clusters. Panel B: within clusters. Non-significant relations are not included, but can be found in Table A4.2.2
* p < .05. ** p < .01. *** p < .001.

To gain more insight into why the energy investment cluster deviated in model 1, we analyzed the within-domain effects for the separate PEBs. We conducted linear regression (Equation 2) for each domain separately to predict a respondent's desire (D_{ij}) to perform behaviors within cluster *j* from the performance (P_{ijk}) of the *k* PEBs within this cluster, with coefficients b_{0j} (constant) and b_{jk}, and error term ε_{ij}. Only respondents who had not performed the desired behavior were included.

■ (2)

$$D_{ij} = b_{0j} + \sum_{k=1}^{K} b_{jk} * P_{ijk} + \varepsilon_{ij}$$

Within clusters, D appeared for almost all PEBs to be affected by one or more Ps (see Figure 4.6B). For the energy investment PEBs it was found that having solar panels increased respondents' desire to also install a heat pump, and having insulated one's home increased respondents' desire to install solar panels. As the mean D for the most difficult energy behavior (only 54 respondents had installed a heat pump) was quite low (see Table A4.2.3), this could indeed explain the negative coefficient reported in Table A4.2.2. Overall, the results imply that performing a specific PEB within a cluster can increase desire within that cluster and may therefore lead to behavioral spillover. Moreover, the results show possible stepping stones, as performing one PEB increases desire to do another. For example, using public transport affected the desire to use one's bicycle more often and to refrain from flying. Coefficients were not significantly negative and we thus did not find indications of potential negative spillovers within clusters.

Effect of naming and clustering on potential spillovers

Until now we described potential spillovers within and between clusters on a general level, but given that our results on categorization showed that not all respondents used clustering into consumption domains, and our expectation that spillover effects would be stronger for respondents who clustered and named the clusters using a domain approach, we tested three additional models. We conducted linear regression (Equation 1) to predict respondents' MD to perform behaviors within cluster j from the TP of PEBs in cluster j while adding the number of clusters (NCLUSTER) respondents made to the equation (Table A4.2.2, Model 4). In the second additional model (Table A4.2.2, Model 5), we added a dummy variable CLUSTER, indicating whether respondents indeed grouped the PEBs belonging together into the relevant cluster—for instance, cycling, not flying, and traveling into the mobility cluster—to the equation. Note that the relevant cluster could also include other PEBs (for instance, circularity PEBs in the mobility cluster). In the third additional model (Table A4.2.2, Model 6) the dummy variable CONSTRUCT was added to Equation 2, which was about whether respondents used domain constructs to name their clusters, such as "mobility."

NCLUSTER appeared to be a significant predictor of MD for four of the six clusters (see Table A4.2.2). The more clusters respondents created, the higher their MD for performing mobility, green citizenship, goods, and circularity related behaviors. CLUSTER proved only to be a significant predictor of the energy investment and curtailment clusters. Results show that when the PEBs were put into one of either cluster the MD within the cluster increased. The fact that the CLUSTER variable could also include other PEBs next to the domain-specific ones possibly created less strong of a factor. CONSTRUCT was no significant predictor of MD for all clusters. Adding NCLUSTER, CLUSTER and CONSTRUCT to the models did not affect the relations between the other predictors and MD.

4.4 Discussion

As expected, people predominantly based the similarity of PEBs on underlying (consumption) domains, but they applied several other approaches and did not exclusively follow one approach. As Thøgersen (2004) described, the degree to which two behaviors are similar in one person's mind indeed differs from the way they are perceived as similar in another's mind. Truelove and Gillis (2018) also found that people's perceptions of individual PEBs are complex and include unexpected dimensions. To construct a unifying categorization model of behaviors could be of interest, but will be a challenge. Regarding mental accounting, Zhang et al. (2020) described that, to construct a theoretical model of budgeting behaviors, it not only needs to be general enough to capture the widespread use of various categories but also be flexible enough to allow for differences in how broadly or narrowly people categorize.

Nevertheless, categorization into (consumption) domains prevailed. Our findings differ from studies that point to curtailment versus efficiency behaviors as the most common distinction (e.g., Boudet et al., 2016; Kneebone et al., 2018). People used this distinction, but it proved less important. We could, however, have included a better distinction on the curtailment /efficiency division on the other domains (such as mobility). Moreover, our findings differ from studies that identified location as an important categorization factor or that suggested that energy consumption is not an important factor in people's categorizations (e.g., Gabe-Thomas et al., 2016; Kneebone et al., 2018). PEB selection is probably an explanation for these differences: we included a broad set of PEBs incorporating various domains, while other studies focused on specific domains resulting in more detailed categorizations.

The perception of similar PEBs is important as it is expected that people are more inclined to act consistently pro-environmentally when behaviors are perceived as similar. Our study indeed shows that when people perform behaviors within a category their desire to perform more behaviors with this category increases. However, we also found spillovers between categories. Moreover, within-cluster effects were not stronger than between-cluster effects. In addition, we did not find evidence that people who clustered the PEBs according to our domains or used relevant terms to name their cluster showed a higher desire to behave pro-environmentally in this cluster. Finally, we did not find negative effects between clusters. All in all, in our exploration we found no clear support for the mental accounting hypothesis.

However, it appeared that behavior–desire spillovers between certain categories were more likely to occur than between others. The most promising starting point for the

design of an intervention on encouraging positive spillover could therefore focus on these specific combinations. For some domains the strongest effects could be expected if PEB1 and PEB2 are part of the same domain, but effects could also occur between domains. Specific combinations of behaviors seem most fruitful, where one behavior can be a stepping stone that may lead to the uptake of another.

4.4.1 Limitations and implications

Our study had a number of limitations. One was the relatively small selection of PEBs, due to questionnaire length. We therefore did not vary all PEBs (except for the energy consumption domain) on curtailment and efficiency. Also, the number of citizen engagement behaviors we included was limited. By presenting a larger selection of PEBs than the 17 we included, with more PEBs that could have fitted a domain could have resulted in a clearer image.

In addition, in general behavioral spillovers are studied with regard to behavior, intentions and policy support (e.g., Maki et al., 2019). In our study we measured how much people wanted to perform PEBs, which is different from intentions. People can for, example, want to buy from eco-companies, but not intend to because they lack the money, or they can have a desire to install solar panels, but not intend to because they rent their place. In other words, desire can be seen as something one wants without considering the practical obstacles. The psychological distance from desire to behavior is thus even larger than between intentions and behavior. For a follow-up study it would be interesting to relate a clustering task to intentions and policy support instead of desires. This way we might gain insight if similarity would play a clearer role in other types of spillover. The role of similarity in spillover between two actually-performed behaviors would be another useful direction of research, but would require a different, experimental research setting.

Furthermore, in our exploration of spillover we used a classification into six clusters, based on the underlying consumption domains that we defined. However, on average respondents grouped the PEBs into three clusters, and the six clusters we used therefore did not fit the majority's approach. This may have affected our results, as we imposed a classification that people didn't see or use themselves. Our choice may also have resulted in the variables CLUSTER and CONSTRUCT having no effect. Because different people group the PEBs in different numbers of clusters, it could be that people who use more clusters might also apply mental accounting in a different way than people who use less clusters. It appeared that the number of clusters indeed affected people's mean desire. Follow-up studies could therefore focus on investigating differences between people, and how these differences could affect both their way of clustering as potential spillovers.

4.4.2 Conclusion

Many people assess the similarity of PEBs based on their belonging to specific (consumption) domains. Other ways of categorization are also applied but to a lesser extent. It is important to know how people assess the similarity of PEBs as it is expected that similar behaviors are more prone to positive spillovers. Our study indeed shows that when people perform a behavior within a specific domain their desire to do more within this domain increases. However, we found that performing a behavior in a domain is also related to a higher desire to perform behaviors in certain other domains. So, overall, similarity appeared less important in behavior–desire spillover than we expected. In addition, the mental accounting hypothesis appears not to be appropriate.

Appendix 4.1 Questionnaire

Pro-Environmental Behavior

Q. Below you see 17 examples of pro-environmental behavior. Could you cluster these examples into groups according to how you think they belong together? (You can divide the groups any way you want as long as there is at least 1 group and a maximum of 8 groups. Can you provide each group with a name?)

Installing solar panels on your roof
Buy a heat pump
Insulate your house to keep it warm
Putting on a sweater when it is cold in your home
Turn off the lights and heating when you are away
Take short showers (maximum 5 minutes)
Not going on vacation by plane
Using public transport for medium distances (from 30 to 60 km)
Using a bicycle for short distances (from 5 to 10 km)
Throw empty glass jars and bottles into the bottle bank
Only buy fruits and vegetables that are grown in the Netherlands
Being a vegetarian (not eating meat or fish)
Read about the climate and environment
Vote for a political party that is committed to the climate and the environment
Only buy products from eco companies
Buy second hand items
Repair things and clothing that break down

Q. Can you indicate to what extent you perform the behaviors?
Never, Rarely, Occasionally, Often, Always

I put on a sweater in the house when it is cold
I turn off lights and heating when I go out
I shower briefly (maximum 5 minutes)
I go on holiday by airplane
I use public transport for medium distances (from 30 to 60 km)
I use a bicycle for short distances (from 5 to 10 km)
I dispose of empty jars and bottles in the bottle bank
I only buy fruits and vegetables that are grown in the Netherlands
I read about the climate and environment
I vote for a political party that cares about the climate and the environment
I buy products from eco companies
I buy second-hand items
I repair things and clothes that break down

	Yes	No	N/A	*Routing*
I have solar panels on my roof				*If yes skip next item*
I have a heat pump				*If yes skip next item*
I insulated my house to keep it warm				*If yes skip next item*
I am a vegetarian (I don't eat meat or fish)				*If yes skip next item*

Q. Can you indicate for each of the 17 behaviors how much you would like to perform them?
Use the slider to rate each behavior, from 1 (This I would not like to do at all) to 10 (This I would like to do very much).

Appendix 4.2 Tables

Table A4.2.1
MDS dimension loadings

Dimension 1		Dimension 2		Dimension 3	
Abstract/concrete		Large/small impact behaviors		Home/away	
PEB	loading	PEB	loading	PEB	loading
Vote “green”	-0.915	Be vegetarian	-0.628	Buy Dutch fruit/vegs	-0.523
Read	-0.846	Buy from eco companies	-0.518	Put on a sweater	-0.421
Be vegetarian	-0.409	Buy a heat pump	-0.461	Recycle glass	-0.397
Buy from eco companies	-0.398	No flying	-0.305	Be vegetarian	-0.256
Buy Dutch fruit/vegs	-0.331	Install solar panels	-0.266	Turn lights and heat off	-0.239
Buy 2nd hand	-0.327	Buy Dutch fruit/vegs	-0.252	Read	-0.232
Repair things/clothes	-0.178	Insulate one’s home	-0.151	Install solar panels	-0.204
Recycle glass	-0.106	Vote “green”	-0.009	Take short showers	-0.126

Use public transport	0.191	Use public transport	0.031	Buy a heat pump	-0.092
No flying	0.204	Put on a sweater	0.127	Insulate one's home	0.002
Put on a sweater	0.333	Turn lights and heat off	0.149	Repair things/clothes	0.128
Cycle short distances	0.382	Cycle short distances	0.237	Vote "green"	0.175
Buy a heat pump	0.390	Read	0.253	Buy from eco companies	0.242
Take short showers	0.440	Buy 2nd hand	0.300	Cycle short distances	0.355
Install solar panels	0.481	Take short showers	0.360	Buy 2nd hand	0.441
Turn lights and heat off	0.526	Recycle glass	0.555	No flying	0.518
Insulate one's home	0.563	Repair things/clothes	0.577	Use public transport	0.629

Table A4.2.3

Table B.3. Descriptive results PEB performance and desire (only when respondents had not performed this PEB)

	Behavior (scales 1–2 or 1–5)			Desire (scale 1–10)		
	M	*SD*	*N*	*M*	*SD*	*N*
Energy investment cluster	1.10	0.68	1409	5.15	2.73	1145
Insulate one's home [a]	1.83	0.37	1345	6.90	2.79	415
Install solar panels [a]	1.34	0.47	1363	6.07	3.12	1073
Buy a heat pump [a]	1.04	0.20	1353	4.44	3.00	1482
Energy curtailment cluster	4.07	0.67	1536	5.56	2.29	757
Turn lights and heating off	4.50	0.81	1536	5.21	2.58	126
Put on a sweater	3.84	1.01	1536	5.68	2.40	458
Take short showers	3.88	1.13	1563	4.94	2.47	471
Mobility cluster	3.36	0.77	1536	4.62	2.47	1172
Cycle short distances	3.75	1.26	1536	5.20	2.89	501
No flying	3.82	1.06	1536	4.04	2.41	567
Use public transport	2.51	1.36	1536	4.29	2.69	1131
Green citizenship cluster	3.17	1.04	1536	5.03	2.42	528
Read on environment	3.29	0.96	1536	4.79	2.18	868
Vote "green"	3.06	1.50	1536	3.49	2.38	882
Goods cluster	2.14	0.57	1536	4.87	2.40	768
Buy Dutch fruit/vegetables	3.20	0.91	1536	5.91	2.42	907
Buy from eco companies	2.97	0.84	1536	5.75	2.37	1168
Be vegetarian [a]	1.08	.027	1450	3.22	2.50	1420
Circularity cluster	3.58	0.61	1536	5.37	2.23	1316
Recycle glass	4.81	0.67	1536	4.92	2.85	61
Repair things/clothes	3.33	1.04	1536	5.64	2.37	842
Buy second hand	2.60	1.02	1536	4.96	2.38	1259

[a] Scale 1-2

Table A4.2.2

Linear models of predictors of MD per clusters, including standardized (b) coefficients and significance per predictor

Dependent	Predictor	Model 1		Model 2		Model 4		Model 5		Model 6	
variable		*β*	*p*			*β*	*p*	*β*	*p*	*B*	*p*
MD Energy investment (n_1=1,145; $n_{2\text{-}6}$=394)	TP Energy investment	-.056	.059	-.139	.005**	-.147	.003**	-.131	.007**	-.144	.004**
	TP Energy curtailment			.074	.146	.078	.126	.074	.137	.077	.134
	TP Mobility			.002	.968	.004	.931	-.001	.991	-.002	.965
	TP Green citizenship			**.175**	.001**	**.162**	.001**	.147	.003**	**.168**	.001**
	TP Goods			.035	.486	.041	.417	.048	.336	.033	.517
	TP Circularity			.093	.073	.099	.056	.089	.079	.100	.055
	NCLUSTER					.095	.055				
	CLUSTER							**.222**	.000***		
	CONSTRUCT "*energy*"									.055	.273
MD Energy curtailment (n_1=757; $n_{2\text{-}6}$=146)	TP Energy investment			.003	.986	-.010	.910	-.004	.961	.003	.977
	TP Energy curtailment	.155	.000***	-.014	.867	.009	.917	.005	.947	-.014	.817
	TP Mobility			-.097	.254	-.104	.216	-.069	.396	-.097	.257
	TP Green citizenship			.154	.075	.137	.111	.102	.221	.153	.080
	TP Goods			.020	.818	.028	.744	.062	.461	.019	.825
	TP Circularity			-.024	.783	-.022	.796	-.015	.857	-.023	.788
	NCLUSTER					.142	.096				
	CLUSTER							**.306**	.000**		
	CONSTRUCT "*energy*"									.004	.968
MD Mobility (n_1=1172; $n_{2\text{-}6}$=321)	TP Energy investment			-.001	.988	-.009	.863	.003	.962	.000	.994
	TP Energy curtailment			.091	.109	.094	.094	.087	.123	.090	.111
	TP Mobility	.113	.000***	.112	.045*	.116	.036*	.113	.042*	.115	.039*
	TP Green citizenship			**.193**	.001**	**.177**	.002**	**.183**	.001**	**.180**	.002**
	TP Goods			.010	.858	.014	.804	.016	.775	.013	.812
	TP Circularity			.029	.611	.036	.534	.027	.639	.031	.592
	NCLUSTER					.116	.036*				
	CLUSTER							.084	.125		
	CONSTRUCT "*mobility*"									.068	.219
MD Green citizenship (n_1=528; $n_{2\text{-}6}$=195)	TP Energy investment			.123	.089	.080	.258	.124	.089	.110	.129
	TP Energy curtailment			-.018	.811	.011	.833	-.016	.828	-.009	.902
	TP Mobility			.118	.105	.105	.138	.120	.104	.105	.152
	TP Green citizenship	.124	.004**	.040	.582	.064	.366	.039	.595	.049	.501
	TP Goods			-.024	.741	-.011	.884	-.027	.721	-.002	.983
	TP Circularity			.062	.425	.058	.444	.063	.417	.055	.474
	NCLUSTER					**.257**	.000***				
	CLUSTER							-.014	.853		
	CONSTRUCT "*green cit.*"									.123	.096

MD Goods	TP Energy investment			.016	.740	.007	.876	.019	.683	.017	.721
(n_1=768;	TP Energy curtailment			.106	.029*	.110	.024*	.108	.027*	.104	.033*
$n_{2\text{-}6}$=383)	TP Mobility			.127	.009**	.129	.008**	.128	.009**	.129	.008**
	TP Green citizenship			.236	.000***	.224	.000***	.232	.000***	.224	.000***
	TP Goods	-.204	.000***	**-.305**	.000***	**-.299**	.000***	**-.299**	.000***	**-.301**	.000***
	TP Circularity			.077	.119	.085	.086	.075	.131	.084	.091
	NCLUSTER					.103	.030*				
	CLUSTER							.057	.230		
	CONSTRUCT "*goods*"									.020	.680
	CONSTRUCT "*food*"									.069	.149
MD Circularity	TP Energy investment			-.029	.585	-.040	.455	-.029	.591	-.030	.586
(n_1=1,316;	TP Energy curtailment			.061	.274	.062	.261	.062	.271	.062	.269
$n_{2\text{-}6}$=333)	TP Mobility			.093	.095	.097	.079	.091	.100	.093	.095
	TP Green citizenship			.148	.008**	.135	.015*	.146	.009***	.147	.008**
	TP Goods			**-.154**	.006**	**-.148**	.007**	**-.151**	.007**	**-.153**	.006**
	TP Circularity	.129	.000***	-.029	.601	.041	.464	-.027	.633	.029	.603
	NCLUSTER					.113	.040*				
	CLUSTER							.017	.762		
	CONSTRUCT "*circularity*"									.012	.830

Note. Strongest significant predictor by model is in bold. The amount of respondents is indicated below the dependent variables, where n_1 represents the amount of respondents of model 1, and $n_{2\text{-}6}$ represents the amount in the models 2, 4, 5 and 6.

*p < .05. **p < .01. ***p < .001.

Chapter 5:

The impact of personal motivation on perceived effort and performance of pro-environmental behaviors

This chapter is based on: Dreijerink, L., Handgraaf, M., & Antonides, G. (2022). The impact of personal motivation on perceived effort and performance of pro-environmental behaviors. Frontiers in Psychology, 13.

Abstract

In order to minimize climate change it is important that people take up a sustainable lifestyle. Sustainable lifestyles call for pro-environmental behaviors (PEBs) in several domains, such as in-home energy use, mobility, and consumption of food and goods. However, studies show that people often do not consistently behave pro-environmentally in all domains. In this study we investigated how a combination of personal motivation, and the difficulty and the perceived effort of a PEB, predicts the performance of PEBs in various domains, using a survey (n = 1,536). By means of Rasch analysis we identified the difficulty of 17 PEBs and estimated respondents' pro-environmental motivations. In addition, we investigated if performance of certain PEBs increased the probability of performing other PEBs. This way we could identify for each level of motivation which behaviors respondents were (probably) performing and which behaviors they did not yet perform, but would be least effortful new behaviors. Furthermore, using a non-recursive structural equation model we investigated the relations between perceived effort, PEB performance, motivation, underlying traits, and demographics. Results showed a feedback loop between motivation and perceived effort: when respondents were motivated they perceived behaviors as less effortful and also lower perception of effort was related to higher motivation. Our results imply that people mainly perform PEBs that fit their level of pro-environmental motivation and that they are inclined to do the things of which they can justify the effort they need to invest. This amount of effort seems quite similar for people: no one wants to invest too much effort, but people highly differ in how effortful they assess different behaviors. Our study thus indicates that rationalizations play a key role. Encouraging people to embrace more sustainable lifestyles may involve step-by-step increases in PEB performance. We propose that people should be encouraged to perform behaviors that are closest to their current motivation level in order for them to progress from performing easy to more difficult PEBs.

5.1 Introduction

Minimizing climate change requires transitions in people's lifestyles (e.g., De Coninck et al., 2018; IPCC, 2022; UNEP, 2020). A sustainable lifestyle is characterized by patterns of behavior and habits embedded in society and facilitated by institutions, norms, and infrastructures that frame individual sustainable choices (UNEP, 2016). Sustainable lifestyles require pro-environmental behaviors (PEBs) in various domains such as housing, food, mobility, leisure, and clothing. Next to consumption behaviors, behaviors in the citizenship domain that may affect institutions, norms and infrastructures, including voting or participating in social movements, are important to facilitate sustainable lifestyles (e.g., Nielsen et al., 2021; Stern, 2000). However, people do not consistently behave pro-environmentally across different domains. For instance, people may recycle their waste but at the same time make environmentally-unfriendly mobility choices (Steg & Vlek, 2009); and saving energy at home does not imply that people save energy while on holidays (Barr et al., 2011). In this study we explore these seemingly conflicting choices. We focus on the roles of motivation and of effort related to performing PEBs in various domains, as we expect that when PEBs

are perceived as more difficult, people will need to put in more effort and therefore need to be more motivated to act pro-environmentally.

5.1.1 Motivation and effort

Motivation is a (psychological) force that drives behavior and that consists of a direction (e.g., a goal) and intensity or amplitude with which this direction is pursued (i.e., effort) (Inzlicht et al., 2018)[10]. Although not all behaviors are goal-directed, all behaviors do require the investment of more or less effort aimed at overcoming financial, physical, cognitive, and temporal barriers (e.g., Attari et al., 2011). A behavior that is easier to perform and thus requires less effort is more likely to be adopted, and vice versa: when behaviors are more difficult and require more effort people are less likely to perform them (Attari et al., 2011; Urban & Ščasný, 2016). In addition, people appear to be willing to exert effort up to a limit (Brehm and Self, 1989; Richter et al., 2016), but which factors and mechanisms underlie the investment of resources (i.e., effort) to carry out behavior is still one of the main questions of motivation science (Richter et al., 2016).

10) When we describe motivation we mean intrinsic motivation (i.e., driven by internal forces), and not extrinsic motivation (i.e., driven externally, such as by means of a financial incentive).

The concept of effort has been studied across various fields, but this has not led to one overall definition. Steele (2020) distinguishes between actual effort (i.e., objective effort) and the perception of that effort (i.e., subjective effort), with perceived effort building on actual effort. In psychological studies the focus lies mainly on perceived effort, and effort has been defined as the increase ("intensification") of either mental or physical activity to meet some goal (Inzlicht et al., 2018). Effort thus refers to the intensity of behavior, but the goal is left unspecified. In this sense effort differs from motivation in that the latter is focused on a goal. It is generally assumed that effort is costly and that people avoid it to spare their resources; i.e., the principle of least effort (Zipf, 1949)[11]. In psychological studies, effort is often studied in the context of task performance.

11) Effort can, however, also have positive value by itself, as people tend to also associate effort with reward and will sometimes select objects or activities because they require effort (e.g., Inzlicht et al., 2018; Gathen & Praxmarer-Carus, 2020).

The perceived difficulty of a task is a key concept in these psychological effort studies. Perceived difficulty enables individuals to avoid wasting effort as it provides information about the resources required for task success (Richter et al., 2016). In other words, when people know the difficulty of a task they can estimate how much effort they have to invest to complete the task. Difficulty of a task is thus seen as a property of the task itself. Although effort typically tracks difficulty (with people working harder when an action is more difficult) this relationship breaks down when incentives are too low or when an action is too difficult (Inzlicht et al., 2018). In that case, people give up on performing a task. Motivational Intensity Theory (MIT) describes that, as long as someone is able to perform the required behavior, the upper effort limit is determined by "potential motivation"; that is, the maximum amount of effort that is justified for task success (Brehm and Self, 1989). When people know that success is possible and benefits are large enough to justify the effort they need to invest, they remain motivated to act. MIT predicts that effort rises proportionally to subjective task difficulty as long as success is possible and necessary effort is justified. When

a task is moderately difficult, the levels of required effort and potential motivation are much lower compared to a highly difficulty task. When the amount of effort required exceeds potential motivation, effort reached its peak and falls to zero: people stop performing the task.

5.1.2 Pro-environmental motivation

We expect that MIT's assumptions can also be applied to pro-environmental motivation and behaviors. Pro-environmental motivations are often described as moral motivations to do the "right" thing (e.g., Bolderdijk et al., 2013; Van der Linden, 2015). When people are more committed to reaching the goal of lowering one's environmental impact or being environmentally friendly, their pro-environmental motivation is stronger. Although people can also perform PEBs because of other motivations, such as health or money saving, in this study we solely focus on the general pro-environmental motivation and goals. For this reason, we include multiple PEBs in our study. Similar to MIT, performance of a PEB could depend on the difficulty of the behavior and on a person's potential motivation. Moreover, acting pro-environmentally requires people to be motivated to reach a certain goal—that is, lower one's environmental impact or be environmentally friendly. In case of PEB, potential motivation stands for a person's maximally justified effort that is needed to reach their goal of reducing one's environmental impact. However, we suspect that, in line with a previous qualitative study (Dreijerink et al., 2021), the perception of effort may differ among people. In this study we asked a small sample of participants to score and explain the effort they attributed to several PEBs. Results indicated that those who did not perform PEBs associated these behaviors with higher effort levels compared to those who performed the PEBs.

Pro-environmental motivations are determined by a multitude of factors including values, beliefs, attitudes, and emotions (RLI, 2014). Although these determinants of motivation are not the focus of this study, the notorious gaps that are found in the relationship between (determinants of) motivation and behavior are relevant. For instance, the gap between attitudes and behaviors shows that people often hold pro-environmental attitudes but do not act upon them (e.g., Glasman & Albarracin, 2006). The value–action gap is a similar concept that points to a gap between values and behavior (Barr, 2006). A number of factors can reduce the gaps between motivation and behavior (e.g., Kollmuss & Agyeman, 2002). For example, Kaiser et al. (2021) described that the gap might stem from ignoring the fact that behavior typically involves costs, including personal resources. They found that attitudes must be strong enough to compensate for the costs of a behavior before the behavior has a reasonable chance of becoming manifest. This is similar to MIT's presumption that people need to have a certain level of potential motivation to perform a behavior.

5.1.3 Research goals

In order for a lifestyle to be sustainable people should not only perform easy PEBs, but also more difficult ones. In the current study we investigate how a combination of behavioral difficulty, effort, and motivation predicts the performance of PEBs in various domains. In doing so, we focus on differences between people. Firstly, we explore the levels of motivation and effort that are needed to perform individual PEBs. We want to understand where

the limits of potential motivation lie and how those limits differ between people. More insight into people's limits may provide clues how to encourage people to take up more difficult PEBs. Secondly, we investigate on an overall level how difficulty, effort, and motivation are related. In line with MIT we expect that for more difficult PEBs the maximally justifiable motivation—and thus required effort—is higher than for easier PEBs. As a result a smaller proportion of people will perform the PEB. In addition, we suspect that the perception of effort may differ among people: those who do not perform PEBs may associate these behaviors with higher effort levels compared to those who perform the PEBs. Furthermore, we explore the role of a number of determinants of motivation and demographics.

5.2 Method

5.1 Participants

This study was an addition to a study on social support for climate policy. The latter study used a sample from the I&O Research panel that was representative for Dutch society. In advance, we calculated by means of G*Power[12] that our sample size was sufficient to detect small effects (f = .10), given 5% significance and 80% power. Participants were recruited at the end of November 2019. 1,536 People participated, including 54% males and 46% females. Their education level varied from 24% lower education (primary education up to and including incomplete secondary education), 35% medium education (secondary education, vocational education, up to and including first year higher vocational education), to 41% higher education (higher vocational education up to and including university degree). Age varied from 14% in the 18–39 year bracket, 39% in the 40–64 year bracket, and 47% were 65 or older.

12) G*Power is freely available software from the Heinrich-Heine University Düsseldorf (see Faul et al., 2009). Gathen & Praxmarer-Carus, 2020).

5.2 Materials and procedure

As this study was added to an online questionnaire on support for climate policy, parts of the questionnaire were unrelated to this study and are therefore not described. The relevant part of the questionnaire is included in the Appendix 5.1.

Personal values

We added one question on personal values to explore their role as a determinant of motivation. To assess personal values, respondents rated 16 items from Schwartz's (1992) universal values scale adapted by Stern et al. (1999) as "guiding principles in their life" on a 9-point scale ranging from −1 (*opposed to my principles*), 0 (*not important*) to 7 (*extremely important*). We included three items for hedonic values (e.g., "Pleasure: gratification of desires"), five items for egoistic values (e.g., "Social power: control over others, dominance"), four items for altruistic values (e.g., "Equality: equal opportunity for all") and four items for biospheric values (e.g., "Respecting the earth: harmony with other species"). Principal Component Analysis (PCA) showed that each of the items defined as altruistic, biospheric,

egoistic, and hedonic did indeed load highest on the corresponding component. One exception was the altruistic item "A peaceful world" which loaded slightly higher on the biospheric component than on the altruistic component (0.51 versus 0.44). Since the difference was small, we decided to keep this item in the original group of altruistic values. The internal consistencies of the scales appeared good for all value groups: altruistic (Cronbach's α = .69), biospheric (α = .85), egoistic (α = .79) and hedonic (α = .74). We therefore computed the mean score for each value group.

Concern about climate change

We added an item on concern about climate change to explore the role of this emotion as a determinant of motivation. To measure concern we used an item from research panel I&O (2020): "To what extent are you concerned about greenhouse gas emissions (including CO2), climate change and its effects on the environment?" Concern was measured on a 5-point scale ranging from 1 (very much concerned) to 5 (not at all concerned). In addition, respondents could indicate they did not know (these responses were excluded from the analysis). The scale was reversed in the analysis.

Performance of PEBs

Performance of PEBs was measured using items inspired by the General Ecological Behavior (GEB) scale items (Arnold et al., 2017). We included items from specific (consumption) domains, namely curtailing in-home energy use, efficient in-home energy use, mobility, food, buying goods, and green citizenship (see Table 5.1). Furthermore, we added variation with regard to the environmental impact of behaviors: some having a low estimated impact (low carbon emission) versus others having higher impacts (higher carbon emission). Impact estimations were based on the Dutch website of Milieu Centraal (www.milieucentraal.nl) that provides thorough information on environmental impacts based on lifecycle assessments (LCA). The goal of these emission estimations was to add variation in the selection of PEBs and not to quantify the exact impact of each behavior. To limit the questionnaire length we made a selection of 13 items from the 74 GEB items. Some items were adjusted to the Dutch situation. For example, prior interviews (see Dreijerink et al., 2021) showed that riding a bicycle or taking public transportation to go to work or school were perceived as very different and should therefore not be combined into one item (we have included three mobility items, i.e., items 7, 8, and 9 in Table 5.1). In addition, items were shortened for clarity. Finally, we added four items to have a sufficient number of items per domain (items 2, 14, 16, 17 in Table 5.1).

Respondents were asked how often they performed the behaviors, on a 5-point scale ranging from 1 (never), 2 (seldom), 3 (occasionally), 4 (often) to 5 (always). In addition, respondents could indicate they did not know (these responses were excluded from the analysis). For four items, including having solar panels installed, having a heat pump installed, having their home insulated, or being a vegetarian, respondents were asked to indicate whether or not they performed this behavior, or that it was not applicable to them.

Table 5.1

17 PEBs per domain and with an estimated carbon emission impact

PEB	Domain	Est. carbon impact
1. Buy solar panels	Energy in home - efficiency	High
2. Buy a heat pump	Energy in home - efficiency	High
3. Insulate the house to keep it warm	Energy in home - efficiency	High
4. Put on a sweater in the house when it's cold	Energy in home - curtailment	Low
5. Switch off lights and heating when you leave	Energy in home - curtailment	Low
6. Take short showers (maximum 5 minutes)	Energy in home - curtailment	Low
7. Use a bike for short distances (5 to 10 km)	Mobility	High
8. Use public transport for medium distances (30 to 60 km)	Mobility	High
9. Not go on a holiday by airplane*	Mobility	High
10. Only buy fruit and vegetables grown in the Netherlands	Food	Low
11. Be a vegetarian (not eating meat or fish)	Food	High
12. Throw empty glass jars and bottles in bottle bank	Food	Low
13. Read about climate and environment	Green citizenship	Low
14. Vote for a political party committed to climate/ environ.	Green citizenship	High
15. Only buy products from eco companies	Goods	High
16. Buy second-hand items	Goods	High
17. Repair things and clothing that break down	Goods	High

*Reversed in analyses

Perceived effort of PEBs

Perceived effort of each of the 17 PEBs was measured using a ten-point scale, from 1 (*very much effort*) to 10 (*very little effort*). The scale was reversed during analysis.

Motivation and difficulty

In order to test MIT, we measured the difficulty of the PEBs, potential motivation, and perceived effort. Difficulty and motivation were determined by means of Rasch analysis. According to Campbell's Paradigm, developed by Kaiser et al. (2010), one's motivation to act pro-environmentally becomes apparent through the behaviors one actually performs.[13] Campbell's paradigm is implemented by means of a Rasch model, that specifies that a person's odds of engaging in a behavior (p) versus not engaging in that behavior ($1\text{-}p$) are a function of their environmental motivation (θ) and the costs or difficulty (δ) of the specific behavior (see Equation (1)); with k indicating a person and i indicating a PEB. The Rasch equation implies that when θ_k equals δ_k the probability that behavior i is performed by person k equals

13) In Campbell's Paradigm and the literature on Rasch models it is convention to use the term attitude to refer to a person's probability of performing the given set of PEBs, we prefer to view θ as an expression of motivation. We argue that θ is an expression of engagement with certain behaviors that goes beyond weighting beliefs about advantages and disadvantages of behaviors, as is the definition of attitudes (RLI, 2014).

the probability that *i* is not performed. When θk is larger than δi, the probability of person *k* performing the behavior i increases. In other words, the stronger one's motivation relative to the difficulty of a behavior item, the higher the probability that one performs that behavior.

■ (1)

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

Rasch models have been used to predict energy-related and other pro-environmental behaviors (e.g., Kaiser, 1998; Kaiser and Wilson, 2000; Kaiser et al., 2021; Starke et al., 2020). In Rasch analysis behavioral probabilities are calculated by means of the (frequency of) performance of PEBs. Rasch analysis provides two outcomes: a rank order of behaviors according to their so-called behavioral costs or execution difficulty (δ), and a rank order of individuals according to their pro-environmental motivation (θ). A strong advantage of the Rasch model is that it uses data on actual behavior performance to reveal one's underlying motivation (θ), as opposed to measuring motivation by means of a survey question that might be more subject to biases. In the current study we used Rasch analysis to determine the difficulty of the PEBs by means of δ and the motivation driving behavior by means of θ.

5.3 Results

Results are reported in three sections. In the first section, results from the Rasch model to assess difficulty and environmental motivation are described. The second section includes an overview of the level of personal motivation that is needed for each of the 17 PEBs. We explore if we can identify PEBs that respondents did not perform (frequently) but that would fit one's motivation. In the third section the relationship between PEB performance, environmental motivation, difficulty, and perceived effort is described.

5.3.1 Rasch model

We constructed a unidimensional dichotomous Rasch model using the TAM package for R (version 4.02). For 4 PEBs performance was measured by means of a *yes/no* (or N/A) statement, while for the remaining 13 PEBs performance was measured on a 5-point scale (*never* to *always*). Since the practice of dichotomization in Rasch analysis is well-established and well-justified (Kaiser and Lange, 2021), we recoded responses to the 17 polytomous items to either yes (i.e., *always, often*) or no (i.e., *occasionally, seldom, never*). N/A answers on the four dichotomous items were excluded from the analyses. As a first step we investigated the fit of the items. As a rule of thumb, Linacre (2002) described a mean square (MSQ) fit value of 0.6 as a lower limit and 1.4 as an upper limit for item fit. All 17 PEB items were within these limits. Next, we investigated person separation reliability which indicates if a set of items is sensitive enough to distinguish between different individual performance levels[14.] It is measured by means of weighted likelihood ability estimates (WLE). For the dichotomous model it turned out that the set of items was able to make a distinction between two groups of either low or high motivation (*WLE* = .59).

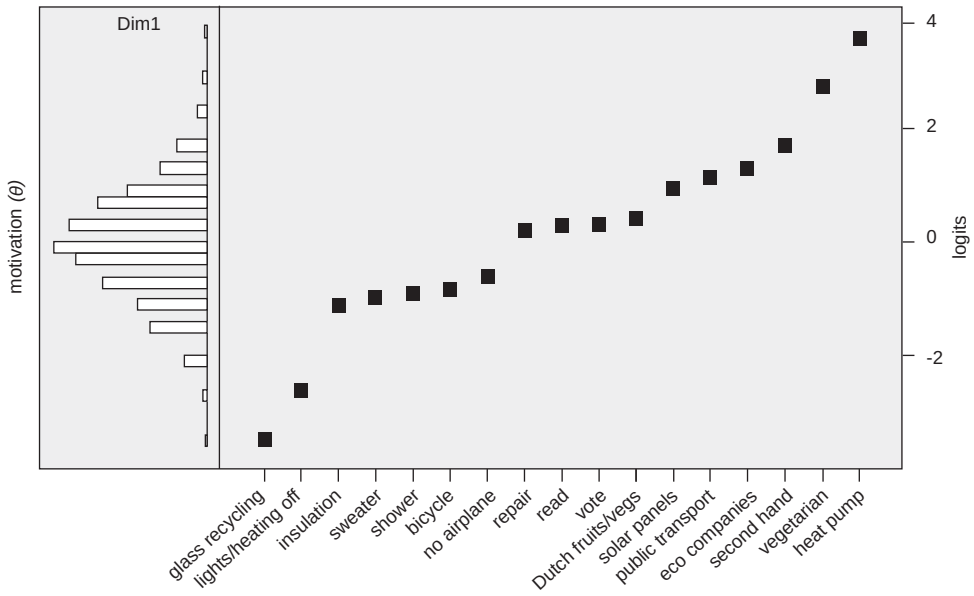
As described, the Rasch model has two outcomes: a rank order of behaviors according to their difficulty (δ), and a rank order of individuals according to their motivation (θ). Figure 5.1 displays both outcomes in a so-called Wright Map or item-person map. The item-side on the right shows the difficulty of the PEBs: glass recycling appeared to be the easiest and installing a heat pump was the most difficult PEB. Furthermore, the person-side on the left shows that personal motivation scores (θ) ranged from −3.48 to 3.68 (M = 0.00, SD = 0.97)[15]. A lower negative θ reflects a weaker pro-environmental motivation, while a higher positive θ reflects a stronger motivation. Moreover, the Wright Map shows the lowest level of motivation (θ) at which a certain PEB is performed. For instance, with a motivation (θ) of zero a respondent performed about half of the PEBs (from glass recycling up to not travelling by airplane). Repairing things and clothing was a PEB that about half of the respondents performed.

14) Rasch analysis is commonly used in the development of educational test instruments. For these types of tests it is important that the test items are able to distinguish if a student performs low or high, and thus would fail or pass the test.

15) θ is assessed in logits, which represent the natural logarithm of the ratio of the number of pro-environmental and environmentally unfriendly self-reported behaviors (Kaiser et al., 2021).

Figure 5.1

Wright Map including person motivation (θ) and item difficulty (δ) of the 17 PEBs



5.3.2 Behaviors by level of motivation and perceived effort

As Figure 5.1 shows, motivation (θ) levels are positively correlated with the performance of certain PEBs and the difficulty of the PEBs (with some deviations from a linear relationship). For example, respondents with the lowest motivation levels only recycled their glass and turned off lights and heating. For this group, the nearest, least difficult next PEB would be to insulate their home. Moreover, the Wright map shows that some PEBs are close to each other in terms of difficulty (δ); for instance, difficulties of repairing, reading, green voting, and buying Dutch fruits and vegetables are all in between 0.2 and 0.45. Therefore, it would be likely that respondents with the corresponding motivation level on the person-side would perform all of these PEBs. Or, in case they did not perform all behaviors, it would be likely that the not-performed PEB would fit their motivation and would be the least difficult, new PEB. In addition to the clusters of PEBs with similar difficulties, the Wright map displays leaps between PEBs, implying that the subsequent behavior would be a lot harder to perform; for instance, from not going on holiday by airplane to repairing, or from buying Dutch fruits and vegetables to installing solar panels. Using the Wright map we can therefore identify the easiest, new PEBs for each motivation level.

In addition, with regard to levels of perceived effort we found that when respondents performed the PEBs (*always, often*), they on average assessed the effort of the 17 PEBs at 2.4, with a maximum perceived effort score of 3.8 for buying from eco companies. On the other hand, non-performers (*occasionally, seldom, never*) assessed the effort of all 17 PEBs on average at 6.4, with the minimum score of 4.7 for putting on a sweater. The level of effort a respondent attributes to a behavior may therefore provide an indication of how likely someone is to perform the behavior.

Furthermore, we investigated if the performance of each PEB on the slope of the Wright map could serve as some kind of stepping stone or gateway for the next PEB to occur. For each PEB we calculated conditional probabilities; that is the probability of a behavior (PEB2) occurring (yes/no) given that a previous behavior (PEB1) occurred (yes/no). We compared conditional probabilities with unconditional probabilities of PEB2 occurrence and found that for 12 PEBs the probability of PEB performance was higher when respondents had performed a previous behavior (see Table 5.2). The largest conditional probabilities appeared between reading and voting (16%), public transport and buying from eco companies (10%), and buying from eco companies and buying second hand (10%). Since these three steps were not part of the leaps in Figure 5.1 we described, this result seems another indication that the occurrence of these combinations of PEBs might be more likely than other combinations of PEBs. Strikingly, when respondents had installed solar panels the probability of using public transport was lower compared to unconditional probability. A possible explanation could be that the motivation to install solar panels is different compared to why people perform other PEBs, such as using public transport. In addition, solar panels may be installed more often by people with higher incomes, who may be less inclined to use public transport. Finally, installing solar panels may provide a license to refrain from additional PEBs.

Table 5.2
Unconditional and conditional probabilities of PEB performance

Step		P(PEB2=Yes)	P(PEB2=Yes | PEB1 =Yes)	Difference
PEB1	PEB2			
Recycle glass	Lights and heating off	.92	.92	0
Lights and heating off	Insulate	.73	.73	0
Insulate	Put on a sweater	.70	.70	0
Put on a sweater	Take short showers	.69	.73	.04
Take short showers	Use a bicycle	.67	.72	.05
Use a bicycle	No holiday by airplane	.63	.64	.01
No holiday by airplane	Repair	.45	.50	.05
Repair	Read	.44	.49	.05
Read	Vote green	.43	.59	.16
Vote green	Buy Dutch fruit and vegs	.41	.46	.05
Buy Dutch fruit and vegs	Install solar panels	.30	.34	.04
Install solar panels	Use public transport	.26	.21	-.05
Use public transport	Buy from eco companies	.24	.34	.10
Buy from eco companies	Buy second hand	.18	.28	.10
Buy second hand	Be a vegetarian	.08	.13	.05
Be a vegetarian	Install a heat pump	.04	.04	0

5.3.3 Relation between motivation, perceived effort and PEB

Finally, we investigated the relationship between the (perceived) difficulty of a PEB, motivation, and PEB performance. Item difficulty (δ), as measured in the Rasch model, correlated strongly with the average performance of each separate PEB ($r(16) = -.825$, $p = .000$), indicating that difficult PEBs were performed less frequently. In addition, we asked respondents about the perceived effort of each PEB. Average perceived effort of the 17 PEBs appeared to correlate very strongly ($r(16) = .96$, $p = .000$) with item difficulty (δ). We decided to use perceived effort as the indicator of difficulty as it provided variation between respondents. Motivation was measured using estimated θs from the Rasch model. In addition, we were interested in exploring the role of personal values, concern about climate change and demographics within the relationship between perceived effort, motivation, and PEB performance.

We used LISREL (version 11.4.2) to estimate and explore several models, including both recursive and non-recursive models. A recursive model is a type of structural equation model (SEM) that is characterized by effects that go into one direction, as opposed to a non-recursive model that includes reciprocal effects or feedback loops. In three recursive models and one non-recursive model we included PEB, motivation, and perceived effort as dependent variables (y), and personal values, concern about climate change and demographics as predictors (x). Based on theoretical insights, we expected the non-recursive model to be the best. First, as described in the introduction, MIT states that motivation is affected by perceived effort of a behavior, since people remain motivated to act depending on

justifications of the effort they need to invest. Second, we described that motivation may affect the perception of effort, since people who perform PEBs and are therefore more motivated assess behaviors as less effortful. Both relations are included in the non-recursive model. In addition, we tested three underlying, simpler models to explore if any of them would be better than the non-recursive model. These four models included all possible combinations between motivation and perceived effort in relation to PEB performance: in model 1 PEB was predicted by motivation and perceived effort, and predictors (x) were added to explain PEB, motivation, and perceived effort. Model 2 was similar to model 1 but with perceived effort predicting motivation; model 3 was similar to model 1 but with motivation predicting effort; and model 4 was similar to model 1 but with a feedback loop between motivation and perceived effort. In order to identify the feedback loop, we restricted some relationships between x variables and y variables to zero (see Figure 5.2). In addition, we explored if there might be one or two underlying factors that could explain the relations between all variables. We therefore tested three models in which we combined the observed variables into latent traits. These three models included all possible combinations with underlying factors. Recursive model 5 and non-recursive model 6 included two latent variables, namely $\eta 1$ based on the observed variables PEB and motivation, and η_2 that was equal to perceived effort. In model 5 we included a direct effect of η_2 on η_1. In model 6 we included a reciprocal relation between η_1 and η_2. Finally, in model 7 the latent variable η was based on the observed variables PEB, motivation, and perceived effort. In the three models variables (x) were included as predictors of the latent variables. In non-recursive model 6 we applied restrictions to some relationships between x variables and y variables, similar to model 4.

Since the different models were not nested in general (i.e., each model typically could not be considered a restricted form of another model) we used AIC (Akaike Information Criterion; Akaike, 1974) and BIC (Bayesian Information Criterion; Schwartz, 1978) values that are suitable for comparing the quality of non-nested models (Henson et al., 2007). As lower AIC and BIC values indicate a better fit, non-recursive model 4 proved to be the best, while models 5 and 6 came in second and third (see Table 5.3). In addition, modification indices and expected parameter changes provided insight into whether models could be improved by removing restrictions between variables. We found that model 1 would improve by adding relations between motivation and perceived effort, as we did in models 2, 3 and 4. Modification indices showed no additional improvements for models 2, 3, and 4. Models 5 and 6 could both be improved by relating η_2 (perceived effort) to PEB and motivation and by relating the measurement errors of the predictors x to the measurement errors of PEB and motivation, but this would go against our idea of the existence of two latent variables. Model 7 could be improved by relating measurement errors of the predictors x to the measurement errors of PEB, motivation and perceived effort, but this would go against the idea of one latent variable. Finally, squared multiple correlations provided an indication of the proportion of variance in the variables y accounted for by the variables on the structural equations. As displayed in Table 5.3, model 4 appeared to explain most variance of PEB (34%), motivation (30%) and perceived effort (31%) when compared to models 2 and 3. In short, model 4 turned out to be of best quality. Since model 4 was saturated, the goodness of fit was perfect, that is the empirical correlation matrix did not differ significantly from the fitted (modeled) covariance matrix (Ganzeboom & Nikoloski, 2012).

Model 4 showed a significant feedback loop between motivation and perceived effort. Motivation appeared to have a highly significant negative impact on perceived effort (β = −1.39, t = 21.03, p = .000) and perceived effort appeared to have a (less significant) negative impact on motivation (β = −1.62, t = −4.69, p = .000). In addition, motivation appeared to have a positive impact on PEB performance (β =.84, t = 2.93, p =.003), while the relation between perceived effort and PEB was not significant (β =.24, t = 1.18, p =.237). In addition to direct effects, LISREL provides insight into the indirect effects and total effects in a model. We were especially interested in the total effects (i.e., the sum of the direct and indirect effects) of predictors (x) on the dependent variables. As shown in Table 5.4, stronger biospheric values, a higher concern about climate change, being female, and having a higher education were related to more frequent PEBs and a stronger motivation. With age, respondents appeared to be more motivated. On the other hand, holding stronger hedonic values was a negative predictor of PEB and of motivation. Furthermore, we found that higher perceived effort was associated with lower biospheric and altruistic values, lower concern about climate change, being male, a lower education level and age, and stronger hedonic values.

Table 5.3

AIC, BIC, squared multiple correlations, df, AGFI and RMSEA values for the seven models

Model	AIC	BIC	Squared multiple correlations for reduced form					df	AGFI	RMSEA
			PEB	Motivation	Perceived effort	Eta1	Eta2			
1	9336.833	9683.649	.37	.27	.15			1	.943	.634
2	8723.836	9075.988	.27	.22	.15			0	1.00	.000
3	8723.836	9075.988	.32	.27	.30			0	1.00	.000
4	8651.836	8811.905	.34	.30	.31			0	1.00	.000
5	8704.256	8821.640				.39	.31	8	.935	.069
6	8706.256	8828.976				.39	.31	7	.926	.076
7	9751.063	9820.426				.31		17	.587	.194

Table 5.4

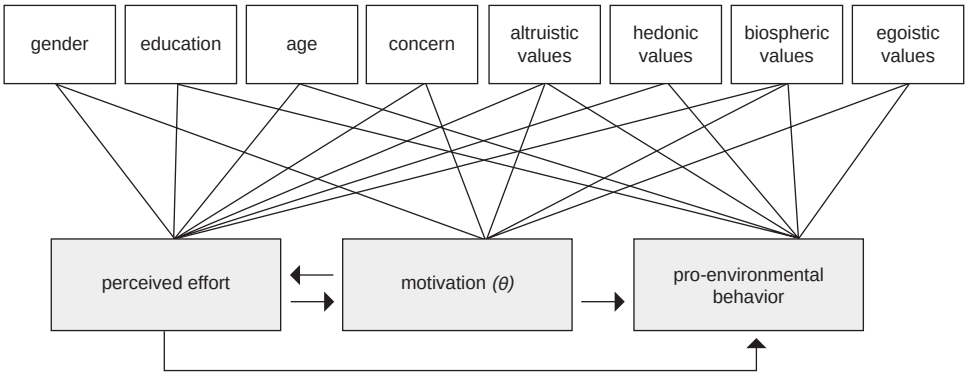
Total effects (coefficients and t-values) of predictors (x) on PEB, motivation and perceived effort of model 4

	PEB		Motivation		Perceived effort	
	β	*t*	*β*	*t*	*β*	***t***
Biospheric values	**0.09**	9.51	**0.19**	9.48	**-0.26**	-9.66
Egoistic values	0.00	-0.64	0.00	0.25	0.00	-0.25
Hedonic values	**-0.05**	-6.35	**-0.15**	-8.04	**0.09**	3.67
Altruistic values	0.01	0.84	0.00	-0.11	**-0.08**	-2.13
Concern about climate change	**0.11**	12.14	**0.22**	11.35	**-0.3**	-11.04
Gender	**0.13**	7.05	**0.21**	5.36	**-0.21**	-3.68
Education	**0.05**	3.87	**0.11**	4.55	**-0.21**	-5.56
Age	0.02	1.25	**0.15**	4.82	**-0.21**	-4.95

Note. Significant coefficients are shown in bold face.

Figure 5.2

Overview of non-recursive model 4, with missing arrows from predictors (x) showing a relation that was restricted to 0



5.4 Discussion

In this study we investigate how a combination of behavioral difficulty, perceived effort and motivation predicts the performance of PEBs in different domains. In doing so, we focus on differences between people. First, in our overview of the levels of motivation that are needed for people to perform PEBs we show that specific levels of personal motivation are associated with the performance of specific PEBs. We find that the performance of certain PEBs seems to increase the probability of performing other PEBs. It appears that certain combinations of PEBs fit together; although effects are small. Since our study is correlational, we cannot prove causality. However, if causal relations between behaviors would be

the case this would imply behavioral spillover; that is, the performance of one PEB leading to another (e.g., Thøgersen, 1999). The literature on behavioral spillover indeed shows that for some combinations of PEBs (positive) spillover occurs, but in general effects are small and results are mixed (e.g., Geiger et al., 2021; Maki et al., 2019). However, in previous studies on behavioral spillover personal motivation levels were not included. We propose that when designing interventions (such as a campaign or an experiment) aimed at encouraging behaviors that are part of sustainable lifestyles, insights from our study could be taken into account. For example, a tailored intervention could include PEBs that are closest to a person's level of motivation and their current behaviors. Starke et al. (2020) indeed showed that when energy-saving measures are more tailored to one's motivation people perceive them as more adequate. In addition, it could be effective to encourage people to increase the frequency of PEBs that they already engage in occasionally. Follow-up experimental and field studies could investigate the effects of this approach and what role a personal motivation level plays.

Furthermore, we want to understand where the limits of potential motivation lie and how those limits differ for people. We find that if a PEB is perceived as too effortful people generally do not perform it. People thus indeed hold a limit with regard to how much effort they are willing to invest, as previous studies have described (Brehm & Self, 1989; Richter et al., 2016). In this line of thinking, the difficulty of a PEB is a property of the behavior (task) itself, consistent with MIT. Additionally, our study shows that behaviors can be ranked from easy to difficult and people are more inclined to perform the easy behaviors than the difficult ones. However, in line with our previous findings (Dreijerink et al., 2021), we also find that people who perform a PEB generally assess the behavior as less effortful, as opposed to people who do not perform the same behavior, who do consider it effortful. People indeed adjust their perception of the effort of a PEB. In this sense, "difficulty" does not seem to be a property of the behavior (task) itself, but is a result of motivation and whether a behavior has been performed. We find that motivation plays a key role as a predictor of both PEB performance and perceived effort: when people are motivated they are more inclined to behave pro-environmentally and perceive PEBs as less effortful. It might be that they downplay the effort level of PEBs compared to people who are less motivated, or that people who are less motivated exaggerate the effort of behaviors. Recalling MIT's description of potential motivation as a person's maximally justified effort that is needed to reach one's goal, it appears that perception of effort might play a role within these justification processes. If a person's goal is to lower their environmental impact, it might not fit one's pro-environmental identity to "complain" about effort. Another explanation could be that if one would want to lead by example, downplaying the level of effort might inspire others to do the same thing. On the other hand, if a person's environmental goal is less strong it might help to exaggerate the effort as a justification for not performing a PEB. Although we find that motivation indeed needs to compensate for effort in order for a behavior to become manifest, as Kaiser et al. (2021) described, this compensation mainly seems to occur within people's perception of effort. The feedback loop between motivation and perceived effort shows a more complex process. In addition to motivation affecting the perception of effort, a lower perceived effort level of a PEB may motivate people to perform this particular PEB, although the latter effect is somewhat weaker than the former. It appears that perceived effort mainly affects be-

havior indirectly via motivation. Follow-up studies could investigate this reciprocal process and the accompanying rationalizations. For example, why the effect of motivation on perceived effort is stronger than the other way around, or what the processes of exaggerating and downplaying may entail. Our previous qualitative study (Dreijerink et al., 2021) showed that when people perceive behaviors as more effortful they increasingly seemed to use arguments to rationalize why performing the behavior is difficult or impossible. It may also be interesting to study rationalizations to perform behaviors that are perceived as easy, or if people may experience internal struggles between pro-environmental and environmentally-unfriendly rationalizations.

Based on our findings, motivation and (perceived) effort can be seen as levers that can encourage people to perform PEBs more frequently or to perform PEBs they had not performed before. In this sense, motivation turns out to be a more important lever than perceived effort because of the relatively strong relation running from motivation to perceived effort. Although this study did not include ways to increase motivation or to reduce (perceived) effort, results may be helpful. Motivation seems to be affected by several factors that are difficult to change, including personal values and demographics. However, concern about climate change is a factor that may change when the sense of urgency within society would be greater. At the moment, there is a generally felt concern about climate change but at the same time (high greenhouse gas emitting) societies and governments exude little urgency. An increased feeling of urgency could lead to higher levels of motivation and additionally to lower perceptions of effort. In addition, perception of effort could be lowered when in general the performance of PEBs will be less effortful and difficult; for example, PEBs could be made less expensive, less time consuming or less demanding. In other words, people's agency or ability to act would improve. This might in particular be helpful for specific groups of people that are at the moment least inclined to perform PEBs and who justify their inaction by the high levels of needed effort. In sum, the often proposed combination of increasing urgency and improving agency will be a suitable approach to encourage sustainable lifestyles.

5.4.1 Limitations

Our study has several limitations. Due to questionnaire length we could only include a limited number of PEBs. We made a selection of the most relevant PEBs for Dutch households, but a larger selection would have improved the study. For example, we were interested in making a distinction between behaviors in different domains and wanted to examine if there would be differences in perceived effort and motivation per domain. In case of adding more PEBs, we could have developed a multidimensional Rasch model to explore the dimensionality of motivation. In unidimensional Rasch models it is assumed that the difference between two subjects in responding to a set of items depends on a single latent trait (Bartolucci, 2007), while in a multidimensional model multiple latent traits affect subjects' responses (Katz et al., 2021). In our study the number of items was too small for such an analysis and we therefore used a general motivation measure (θ). In general, the distinguishing power of the scale between people with different levels of motivation would improve if more items were added.

Moreover, our study focused on the interrelations between motivation, perceived effort, and PEB performance. Although we did control for personal values and concern about climate change, our study was not about the determinants of motivation, such as values, attitudes, beliefs, and emotions. What combination of factors exactly defines motivation is, however, an interesting issue that calls for further research. In relation, our focus on pro-environmental motivation excluded other types of motivations, such as health or financial reasons that may (co-)drive PEB performance. To understand why people perform behaviors, or to understand what motivates different people to perform different behaviors at different times, Kaiser (2021) describes an approach in which all possible motivations are considered and included in as many models as there are personal goals. Such an approach, although complex, could provide important insights into how different combinations of motivations may affect PEB performance.

Finally, MIT is often tested by means of effort tasks and has not previously been applied to self-reported PEBs. We see some differences between performing a task in a lab and performing a PEB in real life. For example, the description that people work harder when a task is more difficult (Inzlicht et al., 2018) does apply to a lab task but does not seem to apply to PEB. In addition, the difficulty of a PEB seems to be surrounded by more subjectivity than the difficulty of, for example, a memory, or a letter-scanning task. Although our study is less relevant for supporting MIT we think our results contribute to insight into PEB performance.

5.4.2 Conclusions

In the introduction we described that people do not consistently behave pro-environmentally across domains, as they recycle their waste but also make environmentally-unfriendly mobility choices, or save energy at home but not while they are on holidays. We would now state that waste recycling and mobility choice, and energy use at home and at a holiday destination are on different difficulty levels and it is no surprise that not everyone conducts both types of behaviors as it does not fit everyone's motivation. People appear to perform specific sets of PEBs depending on their motivation. For some this set of PEBs is limited while for others this set is more expansive. Although most people have pro-environmental intentions and thus have some sort of environmental motivation, this does not mean they are willing to (frequently) perform all kinds of PEBs. People are inclined to only do the things for which they can justify or rationalize the effort they need to invest. The amount of perceived effort seems quite similar for people: they do not want to invest too much effort, but they highly differ in how effortful they assess different behaviors. Our study indicates that rationalizations appear to play a key role. Encouraging people to embrace more sustainable lifestyles may involve step-by-step improvements in PEB performance. We propose that people should be encouraged to perform behaviors that are closest to their current motivation level and that can therefore be justified. This way people can progress from performing easy to more difficult PEBs.

Appendix 5.1 Questionnaire

Q. How important are the following 16 values for you as a guide in your life? Your scores can range from –1 to 7. The higher the number (0, 1, 2, 3, 4, 5, 6, 7) the more important the value. The score -1 means that the value goes against your principles. The score 0 means that the value is not important to you at all. Try to vary your judgments as much as possible, and only score the values that are extremely important to you a 7.

EQUALITY. Equal opportunities for everyone
RESPECT FOR THE EARTH. Living in harmony with other species
SOCIAL POWER. Control over others, dominance
FUN. Enjoyment, fulfilment of desires
UNITY WITH NATURE. Feeling connected to nature
A PEACEFUL WORLD. Freed from wars and conflict
WEALTH. Material assets, money
AUTHORITY. The right to lead and determine
SOCIAL JUSTICE. Recovering injustice, caring for the weak
ENJOY LIFE. Good food, sex, free time, etc.
ENVIRONMENTAL PROTECTION. Preservation of the environment and nature
INFLUENCE. Have an impact on people and events
USEFULNESS. Promote the well-being of others
AVOID ENVIRONMENTAL POLLUTION. Protect natural resources
ENJOYMENT. Doing as many fun things as possible.
AMBITIOUS. Work hard, pursue ambitions and goals

Q. To what extent are concerned about greenhouse gas emissions (including CO2), climate change, and its effects on the environment?

1. Highly concerned
2. Somewhat concerned
3. Neutral
4. No so much concerned
5. Not concerned at all
6. Don’t know

Q. Can you indicate to what extent you perform the following 17 behavior? Never / rarely / occasionally / often / always

I put on a sweater in the house when it is cold
I turn off lights and heating when I leave
I take short showers (maximum 5 minutes)
I’m going on a holiday by airplane

I use public transport for medium distances (from 30 to 60 km)
I use the bike for short distances (from 5 to 10 km)
I throw empty jars and bottles in the glass container
I only buy fruit and vegetables that are grown in the Netherlands
I read about the climate and environment
I vote for a political party that is committed to climate and environment
I buy products from sustainable companies
I buy second-hand stuff
I repair things and clothing that break
Yes / No / Not applicable
I have solar panels on my roof
I have a heat pump
I insulated my house to keep it warm
I am a vegetarian (I do not eat meat or fish)

Q. Some pro-environmental behaviors take more effort than others. If you look at the 17 examples of behavior, how much effort would it take you to perform the behavior?
(Use the slider to assess every behavior; from it takes me very much trouble (score 1) to it takes me very little trouble (score 10)).

Install solar panels on the roof
Purchase a heat pump
Insulate the house to keep it warm
Wear a sweater in the house when it is cold
Switch off the lights and heating when away
Take short showers (maximum 5 minutes)
Not go on holiday by airplane
Use public transport for medium distances (from 30 to 60 km)
Use the bike for short distances (from 5 to 10 km)
Throw empty jars and bottles into the glass container
Only buy fruit and vegetables grown in the Netherlands
Being vegetarian (do not eat meat or fish)
Read about the climate and environment
Voting for a political party that is committed to climate and environment
Only buy products from sustainable companies
Buy second-hand stuff
Repair items and clothing that are broken

Chapter 6:
General discussion

Although almost all people perform pro-environmental behaviors (PEBs), the overall environmental impact of people in higher-income countries such as the Netherlands is too high. To reduce this impact, consumption patterns must become less polluting. Alternative consumption patterns require, among other things, different behaviors and choices in several domains, including mobility, housing, food, and goods. How these different behaviors and choices affect each other is an important issue that is the central focus of this dissertation. Previous studies show that, on the one hand, people are inconsistent in performing PEBs: after performing a PEB they may act environmentally-unfriendly. But on the other hand, after performing a PEB, people are sometimes inclined to perform another PEB. To be able to encourage people to adopt more pro-environmental consumption patterns, more insight is essential on how behaviors affect each other, and how to counteract negative behavioral spillover and to stimulate positive behavioral spillover.

The current dissertation addresses several theoretical questions related to behavioral spillover. First, we investigated how a combination of psychological and economic factors can explain the direction of the spillover process. In Chapter 2 we used interviews to explore how aware people are of the psychological and economic pathways, especially when it comes to negative spillover. Chapter 3 tested how the two pathways actually played a role in a negative spillover from performing a pro-environmental task to spending tickets on rewards with greater or lesser environmental impact. Second, we investigated the role of two moderators with regard to the perception of the PEBs in the behavioral spillover process. Chapter 4 described how the way people *perceive similarity* of different PEBs affects their desire to perform more of them. In Chapter 5, *perception of difficulty and effort* of PEBs and its relation to pro-environmental motivation and the performance of PEBs were further investigated.

The different chapters provide answers to the two main issues and contribute to the overall understanding of positive and negative behavioral spillover. In the current chapter the main findings are listed and we discuss their scientific relevance and practical implications. In the first section (6.1) we reflect on the two pathways and how they contribute to spillover. Then in Section 6.2, we discuss the role of the two moderators. In addition, we address the impact of providing people with information on the environmental impact of their choices. In Section 6.3 we discuss the overall practical implications of our results. More in particular, we describe ways how positive spillover can be stimulated and how negative spillover can be counteracted by policy makers or other parties invested in encouraging PEB. The current chapter ends with concluding thoughts in Section 6.4 on our research within the bigger picture of societal challenges and limiting climate change.

6.1 Spillover pathways

In Chapter 1, we drew an image of two different pathways of the behavioral spillover process: a psychological and an economic path from an initial PEB1 to a subsequent PEB2 (see Figure 1.1). Before going into describing the pathways, we want to reflect on why we included certain PEBs in our studies. First, we wanted to gain insight into what people do when left to their own devices (given current norms and policies), and therefore PEBs were investigated regarding how they occur in people's lives on a daily basis spontaneously, without any specific intervention causing them. In addition, a broad range of PEBs was

included, as pro-environmental consumption patterns are not limited to performing a few behaviors in one domain, with both one-time and more frequent behaviors. Moreover, we included both easy PEBs (such as recycling or wearing a sweater) which often have a lower environmental impact, and more difficult PEBs (such as eating vegetarian, buying solar panels, or using public transportation), that have a higher environmental impact. It is important to include behaviors with a higher environmental impact, since psychological predictors of low-impact behaviors are less predictive of higher-impact behaviors, for which contextual factors beyond the individual are usually of greater importance (Nielsen et al., 2021). In addition, in order to limit climate change, people should perform not only easy behaviors but also difficult ones. As MacKay (2009, p. 114) described: "If everyone does a little, we'll achieve only a little. We must do a lot." Finally, next to consumptive choices, people can perform PEBs in non-consumer roles, including as citizens, investors, employees, and members of communities (Nielsen et al., 2020). Especially in their role as citizens, people can impact systemic aspects, such as the direction of rules and policies. We therefore included different citizenship behaviors, for instance, voting for a political party committed to climate and the environment. All in all, with the exception of the experimental study in Chapter 3, our studies included a set of behaviors that are the most common daily behaviors that Dutch people can perform to reduce their own environmental impact.

In the spillover Figure 1.1, we included a psychological and an economic path to create a more complete picture of the process. We assumed that in situations of subsequent behaviors people are driven by both economic and moral considerations. Furthermore, in line with the literature, we expected that psychological processes related to consistency and identity would be important. The interview study, described in Chapter 2, provided insight into how people consider these concepts and processes. It showed that although some people could imagine that the rebound effect and moral licensing occurred and provided examples from their own lives, most people assessed these concepts as not rational. We concluded that, even though literature shows that moral licensing and the rebound effect exist, people are unaware or claim to be unaware of them. In Chapter 3 we investigated the combination of the two pathways in an experimental setting. We indeed found that after performing an initial PEB1, people generally performed a subsequent behavior (choosing a reward) that reduced the positive environmental impact of their PEB1. It seemed clear that the income effect (as part of the rebound effect) caused this finding: when participants had money to spend they spent it. However, the role of morality was less clear. Although people who indicated to "have felt allowed after PEB1 to choose less pro-environmentally" indeed chose rewards with a higher impact, we did not find clear results in the experimental conditions. Overall, our studies show that morality is part of the decision process, but measuring it proves to be complex. Moral licensing is often studied by means of experimental designs that consist of different conditions to demonstrate the occurrence of the effect; as we did in Chapter 3. Few studies measure moral licensing directly or measure its driving factors including moral self-worth (Carrico et al., 2018). Moral licensing has been described as a largely unconscious process (Khan & Dhar, 2006), but also as a deliberate justification strategy to excuse morally questionable behaviors which includes active engagement in using and searching for available justifications (Blanken et al., 2015; De Witt Huberts et al., 2014). In both cases a direct measure of licensing (as we did in Chapters 2 and 3) might be prone to bias:

people are either unaware of doing it, they may not recognize licensing in their own justification strategies, or they claim to be unaware of it. However, decoupling moral licensing from other effects, as in case of situations where an income effect applies, requires a way to measure it directly. The moral self-image scale we used appeared not to be useful in our case as wells as in the original study by Carrico et al. (2018); therefore a different measurement instrument appears to be needed.

In addition, the interviews showed that people are also often unaware of the relation between a PEB1 and PEB2, and that this prevents them from realizing that their behavior is inconsistent. This may also have been the case in the experimental study, as participants were inclined to choose rewards with a higher environmental impact; except for the participants who performed PEB1 from an environmental motivation and were provided with information on the environmental impact of the rewards. Participants in this condition chose most pro-environmentally. The results imply that reminding people of the environment on two occasions (during the task and during the choice of rewards) triggered them to choose more consistently pro-environmentally. Since it takes effort to be consistent, there needs to be a reason for people to pursue consistency (Kurzban, 2011). Identity, or one's self-perception as a certain type of person, has been identified as a key explanation for consistency effects (Truelove et al., 2014). Previous studies show that consistency is mainly a factor when people hold strong personal ecological norms (Thøgersen & Olander, 2003; Steinhorst et al., 2015). Especially for people with strong ecological norms a desire to avoid cognitive dissonance creates a drive to behave consistently. For these people, performing PEB1 affects or triggers their environmental sense of self or their identity. However, when people hold weak ecological norms, it matters little to be inconsistent as their identity is not threatened by environmental behavior. In our experimental study we also found that the strength of biospheric values, as a covariate, affected reward choice; that is, people with stronger values chose less impactful rewards. However, the results with regard to the experimental conditions were not affected: for example, when respondents did not receive information, those with stronger biospheric values also chose environmentally-unfriendly rewards. It raises the question of how strong and dominant biospheric values or personal norms must be for people to actually act consistently pro-environmentally.

As described in Chapter 1, the current, overall state of behavioral spillover is that PEBs generate positive spillover to pro-environmental behavioral intention, and that there is negative or no spillover from PEBs to behavior (Geiger et al., 2021; Maki et al., 2019). Our results seem in line with this overall state of the art. The clustering study, described in Chapter 4, mainly showed positive spillover from self-reported behavior to desire to perform PEBs in the future. In this study we investigated how much people wanted to perform PEBs, which is different from intentions. Desire can be seen as something one wants without having to consider practical obstacles. The psychological distance from desire to actual behavior is therefore probably somewhat larger than between intentions and behavior, although the direction of spillover appeared to be similar. The effect sizes were in line with findings described in meta-studies (Geiger et al., 2021; Maki et al., 2019). Chapter 3, where we studied a sequence of two actual behaviors in an experimental setting, showed that people are prone to the indirect rebound effect and hence to negative spillover. This result is in line with the more commonly found negative spillover between behaviors (although we should

note that the number of studies is still limited). Similar to previous studies, the size of the negative spillover effect was larger than observed effects in self-report studies, but overall still small. In addition, Carrico (2021) described that when behavior is observed, average effect sizes from behavior to behavior spillover are larger than when it is self-reported. In other words, negative spillover appears to be stronger when actual behaviors are measured. Possibly social desirability when reporting one's own behavior explains this difference. Our findings should be viewed from this perspective: in Chapters 2, 4 and 5 we included self-reported behavior and desires. These results therefore mainly provide us insights into patterns and processes that shape adoption. In Chapter 3 we focused on actual behaviors.

Based on our studies we now conclude that both the economic path and the psychological path play a role in spillover processes, especially in case of negative spillover. When people save money because of an energy-efficiency measure, it allows them to spend it, possibly on goods and services that became cheaper. The rebound effect is an established and frequently mentioned phenomenon. However, the presumption of the rebound effect that people are rational, financial agents and act fully in line with these cost effects, does not fit psychological insights. In that sense the literature on the rebound effect could benefit from psychological knowledge on moral decision making, consistency, and identity. Including economic and psychological factors as we did, indeed provides a more comprehensive picture.[16] As Sorrell et al. (2020) also conclude there is much to be gained from bringing the economic and psychological communities together on this topic and conducting experimental and survey-based studies that give appropriate weight to both individual motivations and aggregate environmental impacts that are part of economic studies. From a psychological perspective, more insight on the impact of different moderators of the spillover process would be useful. ■

16) In this dissertation we did not investigate economic factors in positive spillover, but this also is an interesting research avenue, especially in the current situation of high energy prices. Reverse spending in rebound situations, or how to encourage people to spend saved money in a pro-environmental way, is a highly relevant topic.

6.2 Insights on moderators of the behavioral spillover process

As described, people's perception of PEBs moderates the spillover process. When people perceive PEB1 and PEB2 as more similar, positive spillover from behavior to intention and from behavior to behavior is more likely. In addition, the difficulty of both PEB1 and PEB2 affects the performance of PEB2. Here we discuss these two moderators.

6.2.1 Perceived similarity

How people *perceive the similarity of PEBs* is a somewhat understudied subject. Similarly, within the mental accounting literature there has been limited research on how people construct their accounts. In Chapter 4 we added insight by studying how people cluster the most common everyday PEBs. Our results fit previous findings that categorization into domains seems dominant (Kneebone et al., 2018; Seebauer, 2022). However, people also applied other ways of categorization, but to a lesser extent. Although clustering into domains is dominant, people's perceptions of individual PEBs appear to be more complex and include unexpected dimensions (see also Truelove & Gillis, 2018). When designing interventions

or policies based on domain similarity, one should therefore realize that this approach may fit and be effective for a large group of people, but not for everyone.

Our study indeed showed that when people performed a behavior within a specific domain their desire to perform more PEBs within this domain increased. The results thus align with ideas on similarity and positive spillover, and with the mental accounting hypothesis. However, people who performed a behavior in a specific domain also had a higher desire to perform behaviors in other domains. So, overall similarity appeared less important than we expected. Therefore, the mental accounting hypothesis appears was rejected, also because we generally found no negative spillover between domains. It could be that our focus on behavior-to-desire spillover is partly the reason, since it is common to find positive spillover between PEB1 and intentions. It would therefore be interesting for follow-up study to investigate categorization and spillover between two actually-performed behaviors (instead of intentions or self-reported behaviors), and if the mental accounting hypothesis could after all be useful. For example, studies that previously showed behavioral spillover between two actually-performed behaviors (e.g., Geng et al., 2016; Lanzini & Thøgersen, 2014; Tiefenbeck et al., 2013) could be replicated with an additional part on how respondents would cluster different PEBs, including those that are part of the studied spillover.

Even though our study did not show a clear influence of similarity, the topic could be pursued, for example by exploring what it means if one person perceives PEBs differently than another person. Mental accounting could be more personal than assumed. In addition to what we described in Chapter 4, it would be interesting to study if clustering could be influenced, for example, by providing people with information on climate, biodiversity, or pollution before a clustering task, and if this would affect people's pro-environmental choices. Kaiser (1998) suggested that having a holistic view of PEBs ("ecological concern"), may result in an increase of the performance of a broad variety of PEBs. In that line of thinking, Nash et al. (2017) described that strengthening links between PEBs may lead to higher perceived similarity and possibly to more positive spillover between behaviors. However, in line with the mental accounting hypothesis, we would expect that the use of several clear categories would increase intentions. In addition, participants in our studies did not use this one holistic view that represented ecological concern or something similar. One overall account therefore does not seem to reflect how people perceive the similarity of PEBs. However, strengthening links between PEBs within categories might be a way to encourage positive spillover; for example, by communicative interventions that underline the relation between behaviors. A clustering study with conditions that either include such a communicative intervention or not could be insightful.

6.2.2 Perceived effort

In addition to perceived similarity we focused on the *perception of effort and difficulty* of PEBs as an important moderator. The interview study (described in Chapter 2) and the study on motivation (in Chapter 5) showed that when people do not perform a PEB they associate this PEB with a higher effort level compared to people who do perform the PEB; people who perform PEBs assess these behaviors as less effortful. In other words, there seems to occur a shift in people's point of reference: in hindsight, things appear easier.

In Chapter 5 we described which PEBs are perceived as easy and which as more difficult, and how PEBs were related to a personal pro-environmental motivation level (see Figure 6.1). It appeared that people perform specific sets of PEBs depending on their level of motivation: as their motivation increased, the set of PEBs they perform became larger. Moreover, some PEBs appeared to be a stepping stone for the next PEB to occur. That is, certain PEBs seem to go together. For example, when people read on climate and environment-related issues, they are more probable to vote for a political party that is committed to climate and the environment. We only investigated the PEBs according to the order of the slope, but it would be interesting to study more relations. For instance, it would be interesting to know whether certain PEBs have to be adopted in general before people would vote for a party that is invested in environmental and climate issues. In addition, it would be interesting to look for possible stepping stones on the level of clusters; that is if performing PEBs related to one cluster would increase the performance of PEBs in another cluster. From a mental accounting perspective, we would argue that people are more inclined to perform similar PEBs that fall within one domain. However, from an environmental impact perspective it is desirable that people perform PEBs in different domains. The clustering study in Chapter 4 showed that performing behaviors within one certain cluster may enhance the desire to perform behaviors in other clusters; for example, performing mobility related behaviors increases people's desire for goods and foods related PEBs. Figure 6.1 indeed indicates that the mobility related behaviors (cycling, no flying, and public transport) are lower on the slope than the goods related behaviors (local fruits and vegetables, eco companies and vegetarian).

Furthermore, Chapter 5 resulted in another striking finding, namely a feedback loop between motivation and perceived effort. It appeared that when people are motivated, they perceive behaviors as less effortful which is in turn related to an increased motivation to perform PEBs. On the other hand, when people are less motivated, they perceive behaviors as more effortful which is in turn related to a decreased motivation (see Figure 6.2). In addition, a higher motivation is related to more PEB performance, and a higher perceived effort is related to less PEB performance. Studies in the field of system dynamics describe that feedback loops are important levers of change, namely by stimulating feedback loops that have a positive environmental impact and counteracting feedback loops that have a negative environmental impact (e.g., Meadows, 1999). Behavioral spillover can also be viewed as the start of a feedback loop, as, for example, a PEB might negatively spillover into another PEB2. Although potential third order or even further order effects are hardly studied, these PEB2s might in turn affect again PEB1 or another behavior. Viewing an individual as a system with potential feedback loops would be an interesting line of research. In addition, more insight into the role of individuals as part of a larger societal system, could be beneficial for the field of system dynamics (or transition studies) and for the field of environmental psychology.

Figure 6.1
Difficulty of the PEBs (easy to difficult) against level of motivation (low to high)

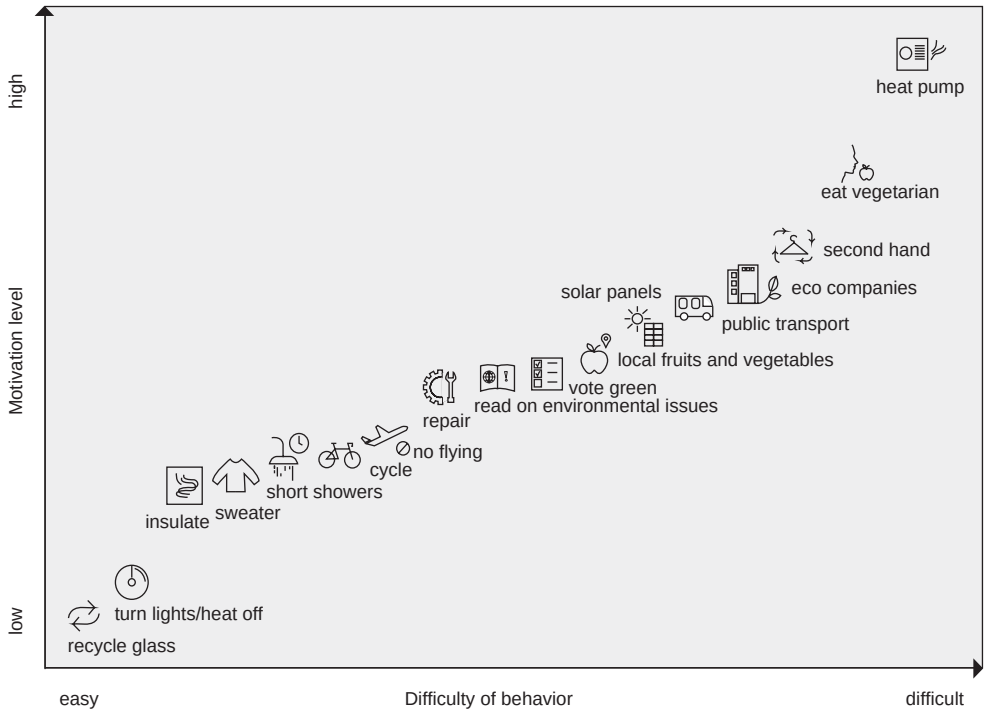
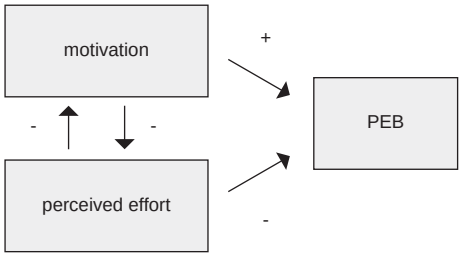


Figure 6.2
Feedback loop between motivation and perceived effort and their relation to PEB performance



Justifications

Although motivation affects people's perception of effort, we also found that no one wants to invest too much effort, and people who are more motivated have a limit too for how much effort they want to invest in a PEB. But since people differ in how effortful they assess different behaviors, what is too much for some is no effort for others. The issue of people's effort limits would be an interesting topic to research further, and especially if it could be possible to push their limits. During the interviews, several participants suddenly realized that they have such a limit; they had often never thought about it.

From the interviews it also appeared that rationalizations or justifications played a key role in people's assessment of effort. The more effort people associated with PEBs, the more arguments they used to substantiate or justify their behavior. Furthermore, in general, people felt satisfied with their own actions and effort related to acting pro-environmentally. Similarly, when they performed behaviors that have a negative environmental impact people justified their behaviors. What exactly drives justifications is not clear, but they seemingly allow a person to cross their own (moral) lines while minimizing the psychological harm normally associated with such discrepant behavior (De Witt Huberts et al., 2014). Studies on ethical decision making show a similar mechanism: using minor lies allows people to simultaneously benefit financially while keeping up a self-image of an honest person (Shalvi et al., 2011). In case of PEB, people may try to keep up a self-image of a pro-environmental person by using rationalizations, including using arguments with regard to effort of PEBs. Depending on one's ecological norms and biospheric values, this self-image is more of less pro-environmental, leaving more of less room for transgressing one's own (moral) lines. A systematic overview of all types of justifications that people use when talking about their pro-environmental efforts could provide more insight in what processes play a role in spillovers. In addition, such an overview could help remove the grounds for justifications (see also Section 6.3 on counteracting negative spillover).

So, in short, what do our studies contribute to conclusions on perceived difficulty and spillover? As described in Chapter 1, the literature presents a mixed image on how perceived difficulty affects behavioral spillover. In Chapter 5 on motivation and difficulty we did not study actual spillover, but we focused on how people perceive effort and difficulty. These results mainly provide insights in the spillover process. Not surprisingly, our results confirm that people are most willing to perform easy behaviors. It is, however, not to say that easy behaviors always lead to positive spillover. Although Lanzini and Thøgersen (2014) found positive behavioral spillover when both behaviors were low-cost, in other studies easy PEB1s actually led to negative spillover (Maki et al., 2019). For difficult behaviors the results are also mixed: in some studies initial difficult behaviors led to performance of another difficult behavior (Gneezy et al., 2012; Lauren et al., 2016), while Maki et al. (2019) found that performance of moderately difficult PEBs did not spillover to PEB2s. Our study shows that on a general level we can assess the difficulty of PEBs, but depending on motivation people assess the effort of PEBs quite differently: what is difficult for one (unmotivated) person is easy for another (motivated) person. More systematic research on spillover between easy and difficult PEB1s and PEB2s would provide a much better image. These studies should, however, take into account that perception of difficulty depends on motivation and that for one

person a PEB is difficult while for another it is easy. This is something to keep in mind, for example when selecting a sample. It would be relevant to ask participants about their motivation or about how effortful they assess both behaviors.

6.2.3 Environmental effort accounting

In addition to our findings on the separate moderators, we see an interesting avenue for future research in the combination of *perceived similarity* and *perceived effort*. As we described in Chapter 1, it is known that current choices are often evaluated with the knowledge of the outcomes, or the costs of behaviors, which have preceded them (Thaler & Johnson, 1990). Moreover, the difficulty of one behavior affects the likelihood of the uptake of another (Maki et al., 2019). If people take into account the difficulty or the effort invested in previously performed PEB(s), this would imply that they use some sort of tracking mechanism. Such a mechanism could be similar to mental accounting. Since we found that many people indeed organize PEBs into specific consumption domains, several mental accounting principles might be applicable, including its main functions. Mental accounting may help simplify environmental decision making and keep invested effort under control or in line with personal limits. However, an important difference with financial accounting would be that, in finance, people probably would like to spend *more* money but are limited by their funds, while, with regard to PEB, people would want to spend *less* effort but have a self-created limit of how much effort they want or need to spend on behaving pro-environmentally. Another difference is that in accounting of environmental effort morality would play a role, whereas this is less the case for financial decision making. Therefore, moral processes such as licensing and cleansing, which are related to consistency and identity, could play a role in how environmental effort is tracked. Environmental effort accounting could thus be a combination of financial and moral mental accounting mechanisms, in which mechanisms and processes of environmental identity and preferences operate in such a way that they may enhance each other or cancel each other out.

We identify several principles from the mental accounting literature that might be applicable to effort accounting. First, similar to mental accounting, people may be susceptible to errors in decision making, such as *underconsuming* (see Heath & Soll, 1996); that is, investing a large amount of effort in an action belonging to one account at one time may lead to a lower effort investment in actions fitting the same account at a later time. Second, Thaler and Johnson (1990) showed that a (financial) loss after a small loss hurts more than a similar loss after a large loss. In case of effort accounting, performing PEB2 after having invested little effort or performance of an easy PEB1 (i.e., a small loss) would be more painful than after having invested much effort or performance of a difficult PEB1 (i.e., a large loss). When a decision is more painful, people are probably less inclined to make it. Third, Evers et al. (2021) showed that people prefer grouping similar losses close together in time and spread dissimilar losses further apart. Their results support the idea of hedonic editing (Thaler, 1985) which supposes that people integrate losses and segregate gains. However, Evers et al. (2021) show this only holds when losses are perceived as similar. These different principles and the overall tracking mechanism could be investigated in follow-up studies.

6.3 Implications for practice

In sum, this dissertation presents a number of insights on behavioral spillover. Our results are in line with general findings on spillover: after performing a PEB1 people's intention to perform more PEBs increases, but their actual pro-environmental behavior is either not affected or affected in a negative way. Although the effects are small, they do exist. The rebound effect, which we defined as a type of negative spillover, is well established. In social psychological research it is common to find small to medium effects (Schäfer & Schwartz, 2019). Very large effect sizes ($r > .40$) are rarely found (Funder & Ozer, 2019). Smaller effect sizes are partly due to the methods that are used, mostly survey questions. In other scientific fields (such as economics or energy studies) that use more reliable instruments or devices, effects can be measured more precisely, and effect sizes can be larger. However, seemingly small effects can also matter in the long run. Funder and Ozer (2019) describe that a psychological process that affects the behavior of a single individual repeatedly over time, or, analogously, the behavior of many individuals simultaneously on a single occasion, can have important implications. Effects may cumulate over time.

Funder and Ozer (2019) provide a nice example: imagine an aspect of a message that would make it a tiny bit more persuasive. Such a factor may become important when this message is conveyed to millions of people. If a politician wants to run a TV ad that will be seen by 30 million viewers and is choosing between two possibilities that experimental research has shown differ in their effectiveness with an effect-size r of .05, the choice is obviously consequential. Thus, experimentally demonstrated phenomena could cumulate in their importance even if their one-time (or one-person) effect sizes are in the range traditionally dismissed as weak. Small spillover effects, such as a negative effect from PEB1 to PEB2, may become more meaningful when people do it over and over again or when many people do it. Especially when PEB2 would be difficult and impactful. It is therefore important to have a sufficient number of studies that clearly demonstrate the spillover effect, and to address special circumstances that may increase or decrease the effect. Based on our findings we list a number of practical implications for intervention designers, such as policy makers, on how to deal with the occurrence of behavioral spillover overall, and on how to stimulate positive spillover and to counteract negative spillover. In general, when designing interventions or policies all possible second order effects, both positive and negative, should be considered.

6.3.1 Ways to stimulate positive spillover

The foundation for studying spillover processes between PEBs was laid by Thøgersen (1999). At that time, the demonstration that PEBs are not independent was regarded as quite novel. There was an expectation that pro-environmental consumption patterns could take flight if a change in attitude and/or behavior concerning a specific activity, produced by a targeted effort or otherwise, might transfer of "spill over" into related areas and, hence, become more general. Since then, many researchers studied the subject and the body of evidence is still growing. Although Thøgersen (1999) described the possibility of negative spillover, there was also hope of the existence of a sort of "virtuous escalator" that would lead people to engage in more difficult and perhaps more environmentally significant behaviors. However, Thøgersen and Crompton (2009) described that relying on positive spillover would

be insufficient for the urgent and ambitious interventions that are needed to limit environmental problems, and simple and painless steps would not lead to the behavioral change that is proportional to the scale of the challenge. At the moment researchers still advise policy makers not to count on positive spillover too much (e.g., Geiger, 2022; Truelove, 2021), but now based on a larger body of evidence. Therefore, to encourage people to perform different PEBs, it will be most effective not to rely on positive spillover, but to design and implement interventions or policies specifically aimed at each behavior. In some way learning to perform new PEBs might be similar to learning a specific skill. It appears that playing chess (Jerrim et al., 2017), school sports (Ransom & Ransom, 2018) or an instrument (Sala & Gobet, 2020), does not automatically have a positive effect on overall academic achievement (such as, mathematics or literacy). Thus, for children to improve their math and literacy performance they need to be taught and practice this directly. The same might be true for learning to be pro-environmental.

Although policy makers should not rely on positive spillover, we still have a number of recommendations on how positive spillover might be useful and stimulated. And while on an overall level positive spillover from one behavior to another is not found, under some circumstances it may still occur. First, even though our results were unclear, positive spillover might still be more likely when behaviors are similar with regard to consumption domains. When an intervention or policy is designed that targets one specific PEB, but related behaviors in this domain are also desirable, they may be addressed at once. For instance, introducing a meat tax is likely to affect the amount of meat people eat, but it may also affect people's habits of buying vegetables; people might start buying more local or seasonal vegetables. In addition to the meat tax, a campaign to stimulate the purchase of local and seasonal vegetables could be organized. Furthermore, if the perception of similarity and how people construct behavioral mental accounts could be influenced this could possibly improve the definition of accounts. People appear to create separate accounts, but some people define them more clearly than others. When people have this clearer image their pro-environmental desires may become stronger. Providing information on how PEBs are related may help people to develop a clearer image and better defined accounts.

Second, when people hold stronger personal ecological norms they are more susceptible to positive spillover. It feels unpleasant to deviate from one's own rules and thereby compromise one's moral principles (Kurzban, 2011). People with strong ecological norms may allow themselves only minor environmentally-unfriendly transgressions—unless they can justify it (the next section elaborates on counteracting justifications). Interventions or policies aimed at one PEB1 should therefore focus on affirming people's pro-environmental self-image, but prevent people from using it as a justification not to perform PEB2. The focus should therefore be on identity and not on behavior. Still, it has to be kept in mind that this approach will mainly stimulate people with stronger pro-environmental norms.

Third, positive spillover is most likely from PEB1 to pro-environmental intention. However, the gap between intentions and behaviors is notorious (e.g., Kollmuss & Agyeman, 2002). As a consequence a positive spillover from PEB1 to a pro-environmental intention does not reduce environmental impact, unless this intention turns into a behavior. A number of factors can reduce this gap. Based on general behavior change theories and frameworks, PEB performance could, for example, be encouraged by making the desired behavi-

or easy, attractive, timely, and social (EAST model; BIT, 2014), or by teaching people useful capabilities, providing them with the right opportunities and increasing their motivation (COM-B model; Michie et al., 2011). Motivation can, for example, be increased by influencing underlying factors; such as increasing personal benefits of an environmental goal or by increasing people's concern on environmental issues. The fact that PEB1 "only" spills over into an intention, or even a desire, can just as well be a starting point for encouraging a new PEB. Finally, it could be possible that positive spillover occurs by counteracting negative spillover.

6.3.2 Ways to counteract negative spillover

Besides researchers' reservations regarding positive spillover, others warn of potential crowding-out effects due to negative spillover. For example, for Chater and Loewenstein (2022) negative spillover from PEB1s to people's support for climate policy (as described by Maki et al., 2019) shows that interventions aimed at the individual level undermine support for interventions or policies at the system level.[17] Werfel (2017), for instance, studied the effect of an energy saving campaign following the shutdown of the Fukushima power plant in Japan. Some of the respondents were asked to indicate on a list what energy-saving actions they completed during the campaign, while others were not asked. It showed that when people had completed more actions, they were less likely to support a carbon tax increase. Werfel (2017) did not find evidence for moral licensing in the group that reported previous behaviors, but instead found that this group perceived individual actions as more important relative to government regulation, and perceived the issue of energy and the environment as less important. We question if it would be the right way forward to refrain from energy efficiency campaigns, in order to gain more support for climate policies. In practice, negative spillover and the rebound effect do not completely negate the positive environmental effect of the first behavior (also among Japanese people who completed energy-actions there was support for a higher carbon tax), but they do lead to a step backward compared to what could have been. It is therefore particularly relevant to look at what can counter negative spillover. ■

17) Whereas interventions aimed at the individual level focus on people's thoughts and behaviors, interventions aimed at the system level focus on rules, norms, and institutions (Chater & Loewenstein, 2022).

There are several ways to counteract negative spillover and rebound effects. Based on our studies we describe three ways. First, our experimental study showed that providing information on the environmental impact of PEB2 decreases negative spillover. When people were presented with information on CO2 emission of production of the reward and a thumbs-up or thumbs-down, they more often chose rewards with a lower environmental impact. Moreover, combining this impact information with an appeal to environmental motivation rather than financial motivation for PEB1, caused people to choose less environmentally-unfriendly. In other words, an emphasis on environmental aspects of behavior and providing clear environmental impact information appeared to be effective.

Second, to discourage negative spillover the grounds for rationalization should be taken away as much as possible. Policy makers should avoid creating a context that makes it easy for people to justify inaction. As Carmichael (2019) described, if reasons or excuses for inaction are readily available then it will be tempting to persuade oneself and others that

acting on climate change can be, or should be, left to someone else. For instance, governments should express the urgency of limiting climate change and other environmental issues, and lead by example. To address society's most pressing problems individual citizens and consumers need to change, but also the system in which individuals operate. Therefore, both individuals and the system should be urged to change. If large parties within the system can continue to pollute unhindered, it undermines the willingness of individuals to change their behavior and provides a reason to justify inaction.

Rationalizations could also be countered by making behaviors easier. Since people prefer easy and simple behaviors, it would be fruitful to see if there are PEBs that are perceived as requiring low or moderate effort and are effective in reducing environmental impact. For instance, buying seasonal fruits and vegetables, and insulating one's home to keep it warm are associated with a medium effort level by people who do not perform them and are in fact quite effective. By zooming in on the reasons why behaviors are perceived as difficult, designers of policies and interventions could try and make PEBs easier. For example, the cognitive barrier of having to read and learn which fruits and vegetables are seasonal could be reduced by offering the products in a specific part of a shop or by adding a specific label or a country flag to products in grocery stores. Taking away the barriers that affect the ease of behavioral uptake (for example, making a behavior less time consuming or providing infrastructure) would additionally reduce the number of available justification options.

6.4 Concluding thoughts

Given the current state of "system earth" it is important to find ways to stimulate people in higher-income countries to adopt more sustainable consumption patterns. These sustainable consumption patterns imply performing more pro-environmental and less environmentally-unfriendly behaviors. The basic premise of this dissertation was that a change in consumption patterns requires changes in different kinds of behaviors, and that it is important to realize that the performance of these behaviors is related. While people generally have pro-environmental intentions and desires, in practice, it appears that they stick to performing a specific set of PEBs and are satisfied with performing this set. It looks like people are stuck somewhere on the slope of Figure 6.1. Most people can put more effort into reducing their environmental impact, but they will not do it out of the blue. Interventions or policies are necessary to stimulate them to do new things. Encouraging people to embrace more sustainable consumption patterns may involve step-by-step improvements in PEB performance. Some people are already motivated and somewhere higher up the slope, while others are less motivated and perform only few PEBs. If people are encouraged to perform PEBs that are closest to their current motivation level, this might be most promising and lead to the adoption of new behavior. People can justify the effort that is needed to perform such a close-by PEB more easily than a PEB that is higher up the slope. At the same time, we acknowledge that the time to limit climate change and the deterioration of nature is running out, and therefore the speed of moving up the slope must increase.

The (speed of) adoption of more sustainable consumption patterns can be stimulated in several ways. This dissertation is not focused on specific interventions, except for providing information on environmental impact in Chapter 3. Although information provi-

sion appeared to have an effect, solely relying on this type of intervention will be insufficient. For all PEBs that we studied holds that their performance can be encouraged by means of policies that may be financial (e.g., taxes or subsidies), legislative (e.g., laws or bans) or communicative (e.g., campaigns or personal apps) in nature. However, interventions and policies aimed at individuals alone are likely to be insufficient to deal with the problems facing humanity (Chater & Loewenstein, 2022). Also the system with its rules, norms, and institutions, needs to be modified. Changes on a systemic level include, for example, governments setting standards for producers so that consumers can only buy sustainable products (such as energy building codes for new homes, or a ban on incandescent light bulbs), or governments charging prices for goods that include costs of environmental damage (the-polluter-pays principle) so that consumers buy more environmentally-friendly goods and also may buy less. In the end, many systemic changes have an impact on the choices and behaviors of consumers. These changes are not for consumers alone to make, as it proves difficult to move up that slope without any incentive or help. Even though (Dutch) people are satisfied with their pro-environmental effort, they are also concerned about climate change and a large group wants the government to do more to reduce greenhouse gas emissions (I&O Research, 2022). Limiting climate change and other environmental degradation requires a joint effort, with changes on a system and individual level, which society can only do together, guided by a determined government.

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Summary

Humanity's current way of living has a major impact on life on earth. Consumption patterns, especially from people in higher-income countries, put a high pressure on "system earth." This negative impact could be reduced when people would adopt more pro-environmental consumption patterns consisting of pro-environmental behaviors (PEBs) related to mobility choices, in-home energy use, and consumption of goods and food. Alternative consumption patterns thus require the performance of different PEBs and include both one-time behaviors (such as an investment in, for example, solar panels) and repeated, more frequent behaviors (such as using one's bicycle for short distances). However, the performance of one PEB appears to affect the performance of a subsequent behavior. On the one hand, performing an initial PEB can increase a person's inclination to perform another PEB (positive spillover), but on the other hand performing the initial PEB can also reduce the probability of the performance of another PEB (negative spillover). To be able to encourage people to adopt more pro-environmental consumption patterns, it is important to study why positive spillover occurs in one situation and negative spillover in another. Therefore, in this dissertation I focus on increasing the understanding of spillover of pro-environmental consumer behavior.

Previous studies show that both positive and negative spillover do occur. Positive spillover is often explained by psychological processes, including a preference for consistency and acting in line with one's environmental identity. Negative spillover is explained by the process of balancing morality, which includes moral licensing—that is, feeling allowed to do something "bad" after doing something "good." In addition, there is also an economic explanation for negative spillover, especially with regard to energy use, namely the rebound effect. The rebound effect shows that energy-efficiency measures lead to cost reductions, allowing more of the improved product (direct rebound effect) or other products or services (indirect rebound effect) to be bought. Meta-analyses show that, overall, PEB performance leads to a positive spillover to people's intention to do another PEB. So, after performing a PEB intend to perform another PEB. Meta-analyses also show that, in general, PEB performance leads to a negative spillover or no spillover to another PEB. In other words, after performing PEB do not perform another PEB or perform a behavior that is environmentally unfriendly. Overall, spillover effects are small, but under certain circumstances effects may be larger. In this dissertation two of these circumstances (or moderators) were investigated, namely the perceived similarity of PEBs and the perceived difficulty of PEBs.

This dissertation consists of four studies concentrating on different elements of the spillover process. **Chapter 2** describes a qualitative interview study in which we gathered ideas and insights about how people think and talk about concepts related to PEB performance, behavioral spillover, and rebound effect in their daily life. Our main questions concerned whether people are aware of processes such as moral licensing and the rebound effect, and if they acknowledge their occurrence. We found that, although some people could imagine that moral licensing and rebound effect could occur and provided examples from their own lives, most people assessed these concepts as not rational. People seemed unaware of that PEBs are related (e.g., that the negative environmental impact of one behavior, can negate the positive impact of another behavior) and therefore inconsistencies in beha-

vior went unnoticed. As people were good at rationalizing why they did not perform specific PEBs, they generally felt satisfied with their own pro-environmental actions. Furthermore, results indicated that when people perceived behaviors as more effortful, they increasingly seemed to use arguments to motivate and rationalize why performing the behavior was difficult or impossible. Based on these qualitative results, we developed our follow-up studies.

Since behavioral spillover implies a causal relation between an initial and subsequent behavior, it is important to study causality between behaviors and the psychological processes underlying these relations. **Chapter 3** therefore studied spillover in an experimental setting. More specifically, we focused on negative spillover and the indirect rebound effect, thereby combining economic (income effect) and psychological (moral licensing, consistency) explanations. In addition, we investigated how people's knowledge of the environmental impact of goods affected the spillover process. By simulating a situation where a PEB led to earning money that could then be spent on a reward, we found evidence that people are prone to the indirect rebound effect: when they earned vouchers because of behaving pro-environmentally they spent them in such a way that they partially negated the positive environmental effect of the initial behavior. However, when their knowledge on the environmental impact of the rewards improved because they received information, they chose more pro-environmentally; thereby decreasing the rebound effect and negative spillover. Furthermore, when people received information and had the idea that they performed the initial behavior from an environmental motivation (instead of a financial motivation) they were most eager to choose pro-environmentally. Psychological processes related to consistency and identity appear to be the main drivers of this result. The evidence for moral processes affecting the choice of rewards was present but less clear. The findings in this study imply that interventions that combine an emphasis on environmental reasons for performing a behavior with clear information may be fruitful to discourage people to act environmentally-unfriendly.

The next two chapters are about two moderators of the spillover process. **Chapter 4** concentrates on the moderator perceived similarity and on how people cluster PEBs. Although many studies assume and indicate that people assess similarity of subsequent behaviors by whether they are in the same domain, it is important to acknowledge that the degree to which two behaviors are similar in one person's mind may differ from the way they are perceived as similar in another's mind. In a clustering study we focused on a set of 17 generally performed PEBs. We found that people indeed mainly clustered behaviors according to domains, such as energy or mobility, but they also applied other categorization types, such as whether they practice a behavior, or whether they find the behavior effective. Since clustering into domains was the dominant approach, we explored potential spillover between people's current behaviors and their desired behaviors, and how clustering into these domains affected this behavior–desire spillover. Positive spillover from actual to desired behavior occurred both within domains and between domains. In addition, we found that clustering behaviors into a larger number of categories was related to a higher desire to behave pro-environmentally.

Chapter 5 focuses on the moderator perceived difficulty. Particularly, we investigated how a person's pro-environmental motivation in combination with the difficulty and the perceived effort of PEBs, could predict performance of PEBs. First, we calculated the

difficulty of 17 PEBs, the pro-environmental motivation of each respondent, and the conditional probability of performing sequential PEBs. This way we could identify, for different motivation levels, which PEBs respondents would (probably) perform and which PEBs would be the easiest-to-perform new behaviors. Furthermore, when investigating the relations between perceived effort, PEB performance, and motivation, we found a feedback loop between pro-environmental motivation and perceived effort. It appeared that, when respondents were pro-environmentally motivated, they performed more PEBs and perceived these behaviors as less effortful. In addition, a lower perception of effort was related to higher motivation. Motivation thus appears to play a pivotal role in PEB performance in multiple ways. Overall, our results imply that people mainly perform PEBs that fit their level of pro-environmental motivation and that they are inclined to do the things of which they can justify the effort they need to invest. This amount of effort seems quite similar for people: no one wants to invest too much effort, but people differ considerably in how effortful they assess different behaviors. Although the study described in this chapter did not focus on actual spillover, it provided insights for the spillover process. The fact that the level of difficulty that is attributed to a behavior varies per person, has implications for researching the spillover process; for example, when studying spillover from an easy to a difficult behavior researchers should gain insight into how respondents assess PEBs and if behaviors are perceived as easy and difficult.

Conclusion. The basic premise of this dissertation is that a change to pro-environmental consumption patterns requires changes in different types of behaviors, and that it is important to realize that the performance of these behaviors is related. We found that performance of a PEB had a positive impact on people's desire to perform more PEBs. Perception of similarity did not appear to affect this spillover. On the other hand, performance of a PEB had a negative impact on behavior. It seems that while people generally have pro-environmental intentions and desires, in practice they stick to performing a specific set of PEBs and are satisfied with performing this set. People often do not see the relation between PEBs, especially when their pro-environmental motivation is less strong or when, partly because of this, PEBs are not perceived as similar. Moreover, when confronted with a new, more difficult PEB, chances are that people use their previous PEBs to justify why they do not perform this new one. However, our study provides insight into one way to discourage people to adopting a subsequent environmentally-unfriendly behavior. When people are provided with clear information about the environmental impact of a subsequent behavior they are less prone to negative spillover; especially when they are reminded of their environmentally-friendly motivation.

All in all, we argue that when designing interventions or policies it is important to consider the possible positive and negative spillovers. However, one should not rely too much on positive spillover on behavior, as performing one PEB does not spontaneously lead to another. Direct interventions or policies are necessary to stimulate people to perform new behaviors. At the same time negative spillover should be discouraged as much as possible. Stimulating people to embrace more sustainable consumption patterns may involve step-by-step improvements in PEB performance. Although we showed that information provision appeared to have an effect, solely relying on this type of intervention will be insufficient. For all PEBs that we studied holds that their performance can be encouraged by means

of policies that may be financial (e.g., taxes or subsidies), legislative (e.g., laws or bans) or communicative (e.g., campaigns or personal apps) in nature. However, as the time to limit climate change and the deterioration of nature is running out, the speed of changing consumption patterns must increase.

The studies presented in this dissertation contribute to a better understanding of the behavioral spillover process, by combining psychological and economic explanations, and investigating two moderators in-depth. Further studies could address the scientific knowledge gaps we described. In addition, this dissertation results in suggestions for the design of interventions aimed at stimulating positive spillover, counteracting negative spillover and encouraging pro-environmental behavior in general.

Samenvatting

De huidige manier waarop de mensheid leeft, heeft grote invloed op het leven op aarde. Vooral de consumptiepatronen van mensen in landen met hogere inkomens leggen een hoge druk op het "systeem aarde." Deze negatieve invloed kan verminderen als mensen andere, milieuvriendelijkere consumptiepatronen zouden aannemen, die bestaan uit milieuvriendelijke gedragingen wat betreft mobiliteitskeuzes, energieverbruik in huis en consumptie van goederen en voedsel. Alternatieve consumptiepatronen vragen dus om het vertonen van verschillende soorten gedrag en omvatten zowel eenmalig gedrag (zoals een investering, in bijvoorbeeld zonnepanelen) als herhaald, frequenter gedrag (zoals het gebruik van de fiets voor korte afstanden). Het vertonen van het ene milieuvriendelijke gedrag blijkt echter van invloed te zijn op het vertonen van een opvolgend gedrag. Aan de ene kant kan een eerste milieuvriendelijk gedrag iemand ertoe aanzetten om nog een milieuvriendelijk gedrag te vertonen (positieve spillover), maar aan de andere kant kan een eerste milieuvriendelijk gedrag ook de kans verkleinen dat iemand nog een milieuvriendelijk gedrag uitvoert (negatieve spillover). Om te kunnen stimuleren dat mensen milieuvriendelijkere consumptiepatronen aannemen, is het belangrijk om te onderzoeken waarom in de ene situatie een positieve spillover optreedt en in een andere een negatieve spillover. In dit proefschrift richt ik me daarom op het vergroten van het begrip van spillover van milieuvriendelijk consumentengedrag.

Eerdere studies laten zien dat zowel positieve als negatieve spillovers plaatsvinden. De oorzaak van positieve spillover wordt vaak gezocht in psychologische processen, waaronder consistent willen zijn en in lijn met de eigen identiteit willen handelen. Negatieve spillover wordt verklaard door het fenomeen dat mensen moraliteit balanceren, bijvoorbeeld door middel van moral licensing, ofwel vinden dat je iets "slechts" mag doen nadat je iets "goeds" hebt gedaan. Daarnaast is er een economische verklaring voor negatieve spillover, namelijk het rebound-effect. Het rebound-effect is vooral gericht op energieverbruik en laat zien dat energiebesparende maatregelen leiden tot lagere kosten, waardoor iemand meer van het verbeterde product (directe rebound-effect) of van andere producten of diensten (indirecte rebound-effect) kan kopen. Uit meta-analyses blijkt dat milieuvriendelijk gedrag over het algemeen leidt tot een positieve spillover op milieuvriendelijke intenties. Met andere woorden, na het vertonen van een milieuvriendelijk gedrag, hebben mensen de intentie om nog een milieuvriendelijk gedrag te vertonen. Meta-analyses laten ook zien dat milieuvriendelijk gedrag over het algemeen leidt tot een negatieve spillover of geen spillover op gedrag. Met andere woorden, na het vertonen van een milieuvriendelijk gedrag, vertonen mensen geen opvolgend milieuvriendelijk gedrag of gaan zij juist milieuonvriendelijk gedrag vertonen. Spillovereffecten zijn over het algemeen klein, maar onder bepaalde omstandigheden kunnen de effecten groter zijn. In dit proefschrift zijn twee van deze omstandigheden (of moderatoren) nader onderzocht, namelijk de ervaren gelijkenis van milieuvriendelijke gedragingen en de ervaren moeilijkheid van milieuvriendelijke gedragingen.

Dit proefschrift bestaat uit vier studies die zich concentreren op verschillende elementen van het spillover-proces. **Hoofdstuk 2** beschrijft een kwalitatief interviewonderzoek waarin we ideeën en inzichten verzamelden over hoe mensen denken en praten over

concepten met betrekking tot milieuvriendelijk gedrag, spillover en het rebound-effect in hun dagelijks leven. Onze belangrijkste vragen waren of mensen zich bewust zijn van processen zoals moral licensing en het rebound-effect, en of ze het bestaan ervan erkennen. We ontdekten dat, hoewel sommige mensen zich konden voorstellen dat moral licensing en rebound-effecten zouden kunnen optreden en ook voorbeelden uit hun eigen leven gaven, de meeste mensen deze concepten als onlogisch beoordeelden. Mensen leken zich niet bewust te zijn van het feit dat milieuvriendelijke gedragingen met elkaar in verband staan (bijvoorbeeld dat de negatieve milieu-impact van het ene gedrag, de positieve milieu-impact van een ander gedrag teniet kan doen) en daarom werden inconsistenties in gedrag niet opgemerkt. Omdat mensen goed konden rationaliseren waarom ze bepaalde milieuvriendelijke gedragingen niet vertonen, waren ze over het algemeen tevreden met hun eigen milieuvriendelijke gedrag. Bovendien bleek dat wanneer mensen gedrag meer moeite vonden kosten, ze steeds meer argumenten gebruikten om te verklaren en te rationaliseren waarom het vertonen van het gedrag moeilijk of onmogelijk was. Op basis van deze kwalitatieve resultaten ontwikkelden we onze vervolgstudies.

Aangezien spillover een causaal verband veronderstelt tussen een eerste en een daaropvolgend gedrag, is het belangrijk om causaliteit tussen gedragingen en de psychologische processen die aan deze relaties ten grondslag liggen te bestuderen. **Hoofdstuk 3** bestudeerde daarom spillover in een experimentele setting. De studie was gericht op negatieve spillover en het indirecte rebound-effect, waarbij we economische (inkomenseffect) en psychologische (moral licensing, consistentie) verklaringen combineerden. Daarnaast onderzochten we hoe de kennis van mensen over de milieu-impact van goederen het spillover-proces beïnvloedde. Door een situatie te simuleren waarin een milieuvriendelijk gedrag leidde tot het verdienen van geld dat vervolgens aan een beloning kon worden besteed, vonden we dat mensen vatbaar zijn voor het indirecte rebound-effect: wanneer ze vouchers verdienden vanwege milieuvriendelijk gedrag, gaven ze deze op zo'n manier uit dat ze het positieve milieueffect van het eerste gedrag gedeeltelijk tenietdeden. Als mensen echter informatie kregen en daardoor meer kennis hadden van de milieu-impact van de beloningen, kozen ze milieuvriendelijker; het rebound-effect en de negatieve spillover werden kleiner. Wanneer mensen informatie kregen en bovendien het idee hadden dat ze het aanvankelijke gedrag vertoonden vanuit een milieumotivatie (in plaats van een financiële motivatie), waren ze het meest geneigd om een milieuvriendelijkere beloning te kiezen. Het lijkt dat psychologische processen gerelateerd aan consistentie en identiteit de belangrijkste drijfveren van dit resultaat te zijn. Bewijs voor morele processen die van invloed zijn op de keuze van beloningen was wel aanwezig, maar minder duidelijk. De bevindingen in dit onderzoek impliceren dat interventies die een nadruk leggen op milieuredenen voor het vertonen van een bepaald gedrag en dit combineren met duidelijke informatie, effectief kunnen zijn in het tegengaan van milieuonvriendelijker gedrag.

De volgende twee hoofdstukken gaan over twee moderatoren van het spilloverproces. Allereerst focust **Hoofdstuk 4** op de moderator ervaren gelijkenis en op hoe mensen milieuvriendelijke gedragingen clusteren. Hoewel veel studies veronderstellen en vinden dat mensen de gelijkenis van gedragingen beoordelen aan de hand van of ze zich in hetzelfde domein bevinden, is het belangrijk om te realiseren dat de mate waarin twee gedragingen voor de ene persoon gelijk zijn, kan verschillen van de manier waarop ze gelijk zijn voor een

ander. We hebben ons gericht op een set van 17 algemene milieuvriendelijke gedragingen. We ontdekten dat mensen gedrag inderdaad vooral clusterden naar domeinen, zoals energie of mobiliteit, maar dat ze ook andere manieren van categorisering toepasten, zoals of ze iets wel of niet doen, of hoe effectief ze het gedrag vinden. Omdat clustering in domeinen de dominante benadering was, onderzochten we vervolgens mogelijke spillover tussen het gedrag dat mensen al vertoonden en hun gewenste gedrag, en hoe clustering in domeinen deze gedrag-naar-gewenst-gedrag spillover beïnvloedde. Positieve spillover van daadwerkelijk naar gewenst gedrag vond zowel binnen domeinen als tussen domeinen plaats. Bovendien ontdekten we dat wanneer mensen gedrag in een grotere hoeveelheid categorieën clusterden, ze een relatief sterke wens hadden om zich milieuvriendelijk te gedragen.

Vervolgens gaat **Hoofdstuk 5** in op de moderator ervaren moeilijkheid. We hebben met name onderzocht hoe milieuvriendelijke motivatie in combinatie met de moeilijkheid en de ervaren moeite van milieuvriendelijke gedragingen het vertonen van dit gedrag kunnen voorspellen. Allereerst hebben we de moeilijkheid van 17 milieuvriendelijke gedragingen, de milieuvriendelijke motivatie per respondent en de waarschijnlijkheid dat mensen opvolgende gedragingen vertonen berekend. Op deze manier konden we voor verschillende motivatieniveaus achterhalen welke milieuvriendelijke gedragingen respondenten (waarschijnlijk) vertonen en welke nieuwe milieuvriendelijke gedragingen zij het gemakkelijkst zouden vinden. Vervolgens onderzochten we de relatie tussen ervaren moeite, motivatie en milieuvriendelijk gedrag en vonden een feedbackloop tussen motivatie en ervaren moeite. Het bleek dat respondenten die meer gemotiveerd waren, zich vaker milieuvriendelijker gedroegen en milieuvriendelijke gedrag minder moeite vonden kosten. Bovendien was een lagere ervaren moeite gerelateerd aan een sterkere mate van motivatie. Motivatie lijkt dus op twee manieren een belangrijke rol te spelen bij milieuvriendelijk gedrag. Uit onze resultaten blijkt dat mensen voornamelijk milieuvriendelijke gedragingen vertonen die passen bij hun mate van motivatie en dat ze geneigd zijn om de dingen te doen waarvan ze de moeite die ze moeten investeren, voor zichzelf kunnen rechtvaardigen. De hoeveelheid moeite lijkt voor iedereen redelijk gelijk te zijn: niemand wil te veel moeite doen, maar mensen verschillen aanzienlijk in de mate waarin ze gedrag als moeilijk beoordelen. Hoewel het in dit hoofdstuk beschreven onderzoek niet gericht was op daadwerkelijke spillover, leverde het wel inzichten op voor het spilloverproces. Dat de moeilijkheidsgraad die aan een bepaald gedrag wordt toegeschreven per persoon verschilt, heeft gevolgen voor onderzoek naar spillover; bij het bestuderen van spillover van gemakkelijk naar moeilijk gedrag zouden onderzoekers bijvoorbeeld inzicht moeten hebben in hoe respondenten de gedragingen beoordelen en of ze inderdaad als gemakkelijk en moeilijk worden ervaren.

Conclusie. Het uitgangspunt van dit proefschrift is dat het aannemen van milieuvriendelijke consumptiepatronen een verandering van verschillende gedragingen vereist, en dat het belangrijk is om te beseffen dat deze gedragingen niet los staan van elkaar. We vonden dat het vertonen van milieuvriendelijk gedrag een positieve invloed had op de wens van mensen om meer milieuvriendelijk gedrag te vertonen. Aan de andere kant bleek dat het vertonen van milieuvriendelijk gedrag een negatieve invloed had op daadwerkelijk gedrag. Hoewel mensen over het algemeen milieuvriendelijke intenties en wensen hebben, houden ze in de praktijk vast aan een specifieke set van milieuvriendelijke gedragingen en zijn ze tevreden met het uitvoeren van deze set. Vaak zien zij de relatie tussen hun milieuvriendelijke

gedragingen niet, vooral wanneer hun milieuvriendelijke motivatie minder sterk is of wanneer ze, deels door een lagere motivatie, gedragingen niet als gelijk zien. Bovendien is de kans groot dat mensen, wanneer ze geconfronteerd worden met een nieuw, moeilijker milieuvriendelijk gedrag, hun vorige milieuvriendelijke gedrag gebruiken om te rechtvaardigen waarom ze dit nieuwe gedrag niet vertonen. Ons onderzoek geeft echter inzichten in hoe mensen te ontmoedigen om zich na een eerste milieuvriendelijk gedrag milieuonvriendelijk te gedragen. Het bleek dat mensen minder vatbaar zijn voor negatieve spillover wanneer ze duidelijke informatie krijgen over de milieu-impact van het opvolgende gedrag; vooral wanneer ze herinnerd worden aan hun milieuvriendelijke motivatie.

Al met al stellen we dat het bij het ontwerpen van interventies of beleid belangrijk is om rekening te houden met de mogelijke positieve en negatieve spillovers. Tegelijkertijd moet men echter niet te veel vertrouwen op positieve spillover op gedrag, aangezien het ene milieuvriendelijke gedrag niet spontaan tot een volgende leidt. In het algemeen zijn er directe interventies of beleid nodig om mensen te stimuleren om nieuw gedrag te vertonen. Aan de andere kant moet negatieve spillover wel zoveel mogelijk worden ontmoedigd. Het stimuleren van mensen om milieuvriendelijkere consumptiepatronen te omarmen, zou gepaard moeten gaan met stapsgewijze veranderingen van hun gedrag. Hoewel we hebben aangetoond dat het verstrekken van informatie effect heeft, zal het onvoldoende zijn om alleen op dit type interventie te vertrouwen. Voor alle milieuvriendelijke gedragingen die wij hebben bestudeerd geldt dat ze kunnen worden gestimuleerd door middel van beleid dat financieel (bv. belastingen of subsidies), wetgevend (bv. wetten of verboden) of communicatief (bv. voorlichting of campagnes) van aard is. Tegelijkertijd dringt de tijd om klimaatverandering en de aantasting van de natuur te beperken. Het tempo van verandering van consumptiepatronen zou daarom opgevoerd moeten worden.

De studies beschreven in dit proefschrift dragen bij aan een beter begrip van het spillover proces, door psychologische en economische verklaringen te combineren en twee moderatoren nader te onderzoeken. Vervolgstudies zouden de wetenschappelijke kennislacunes die we hebben beschreven verder kunnen aanpakken. Daarnaast beschrijft dit proefschrift suggesties voor het ontwerp van interventies gericht op het stimuleren van positieve spillover, het tegengaan van negatieve spillover en het stimuleren van milieuvriendelijk gedrag in het algemeen.

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About seven-an-a-half years ago, I started as an External PhD (buitenpromovendus) out of curiosity as to why people can be concerned about climate change and sometimes spend their working days on sustainability-related projects, while at the same time making environmentally-unfriendly choices. Although I liked doing applied research on energy and behavior at IVAM at the time, I also wanted to look deeper into why this inconsistency appears to be happening in general. I was lucky to find a place where this was possible. I want to thank several people who helped me along the way.

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About the author

Lieke Dreijerink graduated as a Social Psychologist at the University of Groningen in 2003. In addition, she obtained a Master's degree on Environment and Resource Management from the Institute of Environmental Studies at the VU University in 2005. She started her working career in applied research at the Dutch Institute of Public Health and the Environment (RIVM), focusing on studying a healthy living environment. She then worked for over seven years at IVAM UvA BV, where she carried out projects on monitoring and evaluation of people's energy use and behavior, and on sustainable urban planning. At that time she started as an External PhD in Wageningen. After the unfortunate end of IVAM, she worked for a short while at Tertium and VU University on a project on people's virtues in relation to their energy use and energy investments. Next, she worked for three years as a researcher in the Social innovation team of the Energy Transition Studies department of (ECN part of) TNO, focusing on topics such as energy efficient and sustainable decision making, social support for energy and climate policies, sustainable lifestyles and social change. Since 2022 she works as a program developer and research fellow at AMS Institute on the Ideal(s) City project that concentrates on measuring the ideals of the city of Amsterdam.

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