



Final report

Leveraging Mental Accounting Mechanisms to Promote Energy Conservation

Mental Accounting zur Förderung von umweltfreundlichem Verhalten





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Executive summary

Climate change is one of the major challenges of our time with far-reaching consequences for nature, human living conditions, political stability and social peace. In order to achieve a massive reduction in global greenhouse gas emissions, individuals quickly need to adapt a more sustainable lifestyle. Complementing classic intervention strategies such as economic and legal instruments, insights about human decision mechanism allow for designing behavioral interventions based on modifications of the choice architecture (“nudges”). In this context, *Mental Accounting* is one decision mechanism that may potentially be used to promote pro-environmental behaviors. Mental accounting refers to the fact that people create symbolic linkages between specific acts of consumption and specific payments. Via a set of psychological decision mechanisms, mental accounting has been shown to substantially influence behaviors across financial and non-financial situations.

Across three empirical studies and one conceptual review, we investigated how mental accounting mechanisms may be leveraged in the energy sector. We experimentally show in a first study that individuals indeed have distinct mental accounts for different environmental behaviors which they strive to keep balanced. This allows them to compensate environmentally friendly and harmful behaviors and provides a possible explanation for rebound effects at the population level. In a second study, we demonstrate that money labelled in a green context is more likely to be spent on pro-environmental purchases. This finding supports a fundamental result of the mental accounting literature indicating that money is not fungible between different mental accounts, but rather spent in accordance with the dedicated purpose of its account. The finding suggests various practical applications, such as increasing the likelihood of a tax refund to be invested in an environmentally friendly manner by attaching a green label to it. In a third empirical study, we find that a knowledge intervention teaching the specific environmental impact of a series of energy-relevant behaviors changes how individuals mentally organize the different behaviors, suggesting that the intervention may create a more refined system of mental accounts. The notion that more distinctive accounts affect individual behavior is a central idea of mental accounting, however, the effects of these more differentiated accounts on behavior need further investigation. As a first indication of behavioral effects of the intervention, we find however that following the intervention, individuals are not only able to distinguish more and



less effective behaviors, but also perceive more effective pro-environmental behaviors are more morally relevant, an important precursor to actual behavior change. In a concluding integrative review paper, we discuss how mental accounting mechanisms could be integrated into intervention strategies to increase energy conservation. These include, for example, practical strategies to increase donations and investments into energy-efficient technologies but also strategies aiming to limit energy consumption and rebound effects. Such strategies would be cost-effective and relatively easy to implement.

In sum, we highly recommend the application of mental accounting as a mechanism to promote energy conservation. At the same time, we advise to carefully evaluate the efficacy of any new intervention.

Zusammenfassung

Der Klimawandel ist eine der dringendsten Herausforderungen unserer Zeit mit weitreichenden Konsequenzen für die Natur, unsere Lebensbedingungen, die politische Stabilität und den sozialen Frieden. Ein rascher Wandel zu einem nachhaltigen Lebensstil eines jeden Individuums ist gefordert, um den globalen Treibhausgasausstoss bedeutsam zu reduzieren. Erkenntnisse über menschliche Entscheidungsprozesse legen nahe, dass erforderliche Verhaltensänderungen nicht nur durch klassische Massnahmen wie z.B. wirtschaftliche Anreize und rechtliche Instrumente erreicht werden können. Vielmehr können auch subtile Veränderungen im Entscheidungskontext (*Nudges*) Verhalten in die erwünschte Richtung bewegen. *Mental Accounting* (dt. Mentale Buchführung) basiert auf diesem Ansatz und hat das Potential umweltfreundliche Verhaltensweisen zu fördern. Mental Accounting bezieht sich auf die Erkenntnis, dass Menschen symbolische Verbindungen zwischen spezifischen Konsumhandlungen und spezifischen Zahlungen herstellen. Es wurde gezeigt, dass Mental Accounting über eine Reihe von psychologischen Mechanismen das Verhalten in finanziellen und nichtfinanziellen Situationen wesentlich beeinflusst.

In drei empirischen Studien und einem anwendungsorientierten Review untersuchen wir, wie Mental Accounting-Mechanismen im Energiesektor umgesetzt werden könnten. Mithilfe von Experimenten zeigen wir in einer ersten Studie, dass Individuen für unterschiedliche Umweltverhalten verschiedene mentale Konten besitzen, welche sie bestrebt



sind, im Gleichgewicht zu halten. Diese Denkweise ermöglicht ihnen, umweltfreundliche und nicht-umweltfreundliche Verhaltensweisen zu kompensieren, und liefert eine mögliche Erklärung für einen energieökonomischen Rebound-Effekt. In einer zweiten Studie zeigen wir, dass Geld aus einem grünen Kontext eher in umweltfreundliche Produkte investiert wird. Diese Erkenntnis entspricht der zentralen Annahme von Mental Accounting, dass Gelder von verschiedenen mentalen Konten nicht austauschbar sind, sondern in Übereinstimmung mit dem jeweiligen Konto – in diesem Fall einem «Umweltkonto» – verwendet werden. Diese Erkenntnis birgt Potential für zahlreiche praktische Anwendungen, wie z.B. Steuerrückzahlungen, die mit einem grünen Label ergänzt werden, um deren umweltfreundliche Verwendung wahrscheinlicher zu machen. In einer dritten empirischen Studie zeigen wir, dass eine Wissensintervention, die spezifische Umweltauswirkungen von Verhaltensweisen lehrt, die Art und Weise verändert, wie Individuen ihr Wissen mental organisieren. Solch verfeinerte mentale Wissensorganisation legt nahe, dass die Teilnehmenden auf differenziertere Mental Accounts zurückgreifen. Diese Erkenntnis ist essentiell, da ein verändertes Verhalten aufgrund von unterschiedlichen Accounts eine zentrale Annahme von Mental Accounting ist. Obwohl die Auswirkungen auf tatsächliche Verhaltensänderungen in unserer Studie unerforscht bleiben, liefern die Ergebnisse einen ersten Hinweis auf mögliche Änderungen: Die Teilnehmenden lernten nicht nur, welche Verhaltensweisen am wichtigsten sind, sondern nahmen diese gleichzeitig als moralisch besonders wünschenswert wahr, was ein wichtiger Vorläufer einer tatsächlichen Verhaltensänderung ist. In einem abschliessenden Review diskutieren wir, wie Mental Accounting-Mechanismen in Interventionsstrategien zur Erhöhung von Energieeinsparungen integriert werden könnten. Dies umfasst zum Beispiel praktische Ansätze, um Investitionen in erneuerbare Technologien oder Geldspenden zugunsten von Umweltorganisationen zu fördern, aber auch Strategien zur Beschränkung des individuellen Energiekonsums und von Rebound-Effekten. Die empfohlenen Strategien wären nicht nur kostengünstig, sondern auch relativ einfach zu implementieren.

Zusammenfassend empfehlen wir die Anwendung von Mental Accounting als Mechanismus zur Förderung von umweltfreundlichen Verhalten, regen jedoch gleichzeitig zu einer detaillierten Evaluation von Interventionen an.



Résumé

Le changement climatique représente l'un des défis majeurs de notre temps, avec des conséquences considérables pour la nature, les conditions de vie humaine, la stabilité politique et la paix sociale. Afin d'atteindre une réduction massive des émissions globales de gaz à effet de serre, il est nécessaire que les individus s'adaptent rapidement à un mode de vie plus durable. En complément des stratégies d'intervention classiques, tels que les instruments légaux et économiques, les connaissances au sujet des mécanismes de prise de décision humaine permettent de concevoir des interventions comportementales basées sur des modifications de l'architecture du choix (« *nudges* »). Dans un tel contexte, la comptabilité mentale (« *mental accounting* ») est un mécanisme décisionnel qui peut potentiellement être utilisé pour promouvoir les comportements pro-environnementaux. La comptabilité mentale se réfère au fait que les gens créent des liens symboliques entre des actes spécifiques de consommation et des paiements spécifiques. Par le biais d'un éventail de mécanismes psychologiques de prise de décision, il a été démontré que la comptabilité mentale influence considérablement les comportements dans des situations financières et non-financières.

Dans le cadre de trois études empiriques et une revue conceptuelle, nous avons investigué la façon dont les mécanismes de comptabilité mentale peuvent être mobilisés dans le secteur de l'énergie. Nous avons montré dans une première étude expérimentale que les individus possèdent effectivement des comptes mentaux distincts pour les différents comportements environnementaux qu'ils s'efforcent de garder équilibrés. Cela leur permet de compenser les comportements bénéfiques et nocifs à l'environnement et fournit une possible explication aux effets de rebond à l'échelle de la population. Dans une deuxième étude, nous avons démontré que l'argent labellisé dans un contexte écologique a plus de probabilité d'être dépensé pour des achats pro-environnementaux. Cette conclusion soutient un résultat fondamental de la littérature sur la comptabilité mentale indiquant que l'argent n'est pas fongible entre différents comptes mentaux, mais qu'il est plutôt dépensé conformément à l'usage prévu du compte. Ce résultat suggère des applications pratiques variées, tel que le fait d'augmenter la probabilité qu'un remboursement d'impôt soit investi d'une manière respectueuse de l'environnement en lui attribuant un label écologique. Dans une troisième étude empirique, nous avons trouvé qu'une intervention informationnelle enseignant l'impact



environnemental spécifique d'une série de comportements liés à l'énergie modifie la façon dont les individus organisent mentalement ces différents comportements, suggérant que l'intervention pourrait créer un système amélioré de comptes mentaux. La notion que des comptes plus distincts affectent le comportement individuel est une idée centrale de la comptabilité mentale. Toutefois, les effets de ces comptes plus différenciés sur le comportement nécessitent davantage d'investigations. En tant que première indication des effets comportementaux de cette intervention, nous avons cependant trouvé que suite à celle-ci, les individus sont non seulement capables de distinguer les comportements plus ou moins efficaces, mais aussi de percevoir que les comportements pro-environnementaux plus efficaces sont moralement plus pertinents, ce qui est un important précurseur du changement de comportement réel. Dans une revue intégrative conclusive, nous discutons comment les mécanismes de comptabilité mentale pourraient être intégrés à des stratégies d'intervention afin d'augmenter la conservation d'énergie. Ces dernières incluent, par exemple, des stratégies pratiques pour augmenter les dons et les investissements dans des technologies énergétiquement efficaces, mais aussi des stratégies visant à limiter la consommation d'énergie et les effets de rebond. De telles stratégies seraient rentables et relativement faciles à implémenter.

En résumé, nous recommandons fortement l'application de la comptabilité mentale en tant que mécanisme de promotion de la conservation d'énergie. En même temps, nous recommandons d'évaluer minutieusement l'efficacité de toute nouvelle intervention.





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1 Mental accounting as a subtle approach to behavior change

The adverse impact on nature and mankind caused by climate change has been well-documented (IPCC, 2014). A critical temperature threshold has repeatedly been set to a rise of 2°C compared to temperatures in pre-industrial times, beyond which, the risk for catastrophic changes in the global environment is expected to be strongly elevated. To remain within this limit, carbon dioxide emissions must be reduced to net zero between 2060 to 2075 (UNEP, 2015). To achieve such ambitious objective, relying on technological progress alone won't be enough, individuals will also need to change their behaviors towards a more sustainable lifestyle (IPCC, 2014).

In recent years there has been an increased interest and much hope put in to so-called “nudges” to subtly steer individuals’ behaviors (Sunstein & Thaler, 2012) and complementary strategies of legal and economic instruments, such as subsidies for investments in renewable technology or increases in energy prices (Goulder & Parry, 2008). “Nudging” implies gently pushing individuals towards a desired decision by applying a clever presentation of options but without restricting consumers’ freedom of choice or providing additional incentives (Momsen & Stoerk, 2014; Sunstein & Thaler, 2012). “Nudges” originate from research about psychological decision mechanisms and build upon the observation that people do not always act as rationally as stated by classic economics (Conlisk, 1996; Dhimi, 2016), but are subject to a number of cognitive and affective biases (e.g., Brosch, Patel, & Sander, 2014). Nudging strategies have been shown to be effective interventions across various fields (Sunstein & Reisch, 2013). *Mental Accounting* (Thaler, 1999) is a pervasive psychological mechanism influencing decisions and behaviors in a number of ways, and thus may provide the theoretical foundation for various strategies to nudge individuals towards a sustainable lifestyle.

Mental accounting refers to the finding that individuals create numerous mental categories to organize their consumption activities (Thaler, 1999). One can think about this process as having different “jars” for money at home dedicated to specific purposes, such as rent, food or leisure activities. This way of thinking entails that money can only be used in accordance with the properties and the dedicated purpose of the jar/the mental account. Thus, money is not treated as fungible between accounts, which contradicts classic economic theory (Dhimi, 2016). This mechanism not only affects decision-making in our day-to-day life



(Thaler, 2008), but may also be applied to subtly promote pro-environmental decisions from various angles. For example, previous research has shown that attaching a label to money influences the way it is spent (Beatty, Blow, Crossley, & O'Dea, 2014; Lange, Moro, & Rahman, 2015), directly suggesting applications for sustainable behavior interventions which have been tested in the research line reported here.

Furthermore, rebound effects – increases in consumption following increases in energy efficiency (Herring & Sorrell, 2009) – and their underlying compensatory behaviors may to a certain extent be explained by mental accounting mechanisms. The budgeting mechanism of mental accounting implies that individuals strive to keep revenues and expenditures of their accounts in balance, compensating one with another. In a financial context, this reduces the risk of overspending a budget and facilitates the individual to keep control over consumption (Heath & Soll, 1996; Soman & Ahn, 2011; Thaler, 1999). An in-depth understanding of these processes in the context of sustainable behavior may thus help to inhibit negative spillovers, the compensation of pro-environmental with polluting behaviors, and an implemented upper limit of energy consumption may support individuals to keep up with a sustainable lifestyle.

Overall, the potential of mental accounting to leverage energy conservation is substantial. However, concrete empirical research is needed. This project aimed to advance research on mental accounting and its potential application in interventions in the domain of sustainable behavior. In this report, we will first provide a more detailed description of previous research on mental accounting, as well as outline the underlying mechanisms and implications for decision making (section 2). We will then experimentally investigate two specific fundamental mental accounting mechanisms and their impact on environmental decisions and behaviors (section 3.1 and 3.2). In a third empirical study we investigate the impact of a knowledge intervention on the mental organization of actions as well as related moral judgments (section 3.3), both prerequisites for performing highly effective pro-environmental actions (Markowitz & Shariff, 2012; Steg & Vlek, 2009). In an integrative review paper, we discuss the importance of mental accounting for energy conservation and suggest specific practical applications (section 4). In the concluding section of the report, we integrate the preceding parts and give an outlook on future research.



The present report is based on four articles (sections 3.1 to 4) representing three empirical studies and one review paper. Because each article is meant to be comprehensible on its own, there may occur some redundancy in terms of the presented theoretical background.



2 A primer on previous mental accounting research

In order to fully understand the potential of mental accounting to guide individual behaviors, it is helpful to trace the origins and development of the concept as well as its central implications.

2.1. Historical origins

In the early 1980's, Richard Thaler (1980) published his pioneering article on consumer choice, including everyday observations that people sometimes act in a manner contradictory to that predicted by classic economic theory. For example, people are more likely to travel through a snowstorm to attend a basketball game after having purchased tickets than if they were given to them for free (Thaler, 1980). It is in the context of speculating on the thought process leading to such sunk cost effects and the finding that historical costs affect decisions (Arkes & Blumer, 1985), that the idea of mental accounting was first introduced under the term “psychic accounting” (Thaler, 1980, p. 48). People do not treat outcomes as independent, but “mentally account” for preceding costs when taking decisions. Importantly, in such an accounting process the different gradients for gains and losses predicted by prospect theory (Kahneman & Tversky, 1979) must be taken into account. Prospect theory states that the value function is steeper for losses than for gains, indicating that gains are outweighed by losses. This means that finding a \$50 bill on the ground and losing it again shortly after results in overall negative feelings, because the \$50 loss hurts more than the gain of \$50 was pleasurable. Similarly, negative life events make a greater impact than positive ones, and more positive life events are needed to make up for a negative one (Schwartz, 1986). Thus, not attending the basketball game would be more painful than the combined costs of traveling through the snow and the pleasure of the game (Thaler, 1980). In other words, the trip through the snowstorm and the pleasure of the game are less painful than not attending the game would be.

It wasn't until 1984 that the term “mental accounting” was first used in a peer-reviewed publication. Referring to earlier works from Thaler, Kahneman and Tversky (1984) state that individuals evaluate multi-attribute options, such as when purchasing a product, by setting up a mental account. In such an account, individuals balance advantages and disadvantages of the option against each other. An option is acceptable if the value of its disadvantages is smaller



than the value of its advantages. Both the advantages and disadvantages of an option are relative and defined by a reference state which is determined by the decision context (Kahneman & Tversky, 1984). This is nicely demonstrated by the “classic” calculator experiment (Tversky & Kahneman, 1981). In this experiment, one group of people were asked whether they would be willing to drive 20 minutes to a nearby store to purchase a calculator if they could save \$5 off from \$15. Another group read the same scenario with the only difference that their \$5 saving was in reference to an original price of \$125. Following a complete rationality in behavior, no difference between the two situations would be expected. However, framing the decision in a more topical way, the attractiveness of the saving and the willingness to travel 20 minutes was inversely related to its reference price: the willingness to travel increased with a smaller reference price. In another mental accounting example, individuals were more willing to spend \$10 to see a play after having lost a \$10 bill than after having lost a previously purchased ticket worth \$10 (Tversky & Kahneman, 1981). The reason for this is that the additional ticket would be booked onto the same mental account as the first ticket. This way, the costs of seeing the play would raise to \$20, making it less likely for individuals to visit the theater. The \$10 bill, however, is booked onto a different account and therefore unrelated to the pre-purchased ticket. Even though these examples considerably advanced the progress of mental accounting, it is Thaler (1985) who was the first to dedicate an entire article towards mental accounting and to illustrate its implication for consumer choice across various examples. Lacking empirical evidence for his assumptions to some degree, it is due to his interest in understanding the psychology of choice that more than a decade later he published an empirically more substantiated article outlining why “mental accounting matters”, in which previous hypotheses were confirmed (Thaler, 1999).

2.2. Types of mental accounts and central implications

The essence of mental accounting is hard to capture in one sentence. Simply put, mental accounting could be described as a cognitive process of symbolically linking specific payments and specific acts of consumptions. A recent review distinguishes between three types of mental accounting and several mental accounting functions that have been described so far in literature (Antonides & Ranyard, 2017). *Broad mental accounts* refer to the categorization of financial resources across the life-cycle, namely into “current income”, “current assets” and



“future income” and are linked to the behavioral life-cycle model (Shefrin & Thaler, 1988). Money assigned to one of the three accounts loses its fungibility, and each account is linked to some specific categories of expenses. Whereas current income is most strongly associated with current expenditures and daily consumption, current assets and future income are more strongly related to savings (Antonides & Ranyard, 2017). Similar to broad mental accounts, but set up as an outcome frame for a specific transaction or consumer choice, *specific accounts* were first discussed by Kahneman and Tversky (1984) in the context of the calculator example reported above. From their findings it can be understood that individuals not only focus on the absolute saving, referred to as “minimal accounts”, but furthermore link their potential saving to the initial price of the calculator as a reference price, referred to as “topical accounts”. Finally, Antonides and Ranyard (2017) categorize several other types of mental accounting phenomena collectively under the frame of *other categorization of money*. The general assumption at the base of money categorization processes is that how money is obtained, labeled or categorized defines how it is spent. For example, bonuses are more likely to be used for hedonic purchases such as luxury items, whereas a regular salary is more likely used for utilitarian purchases such as tax books (Helion & Gilovich, 2014; Henderson & Peterson, 1992; O'Curry & Strahilevitz, 2001).

However, mental accounts involve various psychological functions, going beyond the pursuit of matching account and spending. For example, mental accounts serve the purpose of self-control. People tend to control and track expenses to keep the balance of the account positive and avoid exhaustion of resources (Antonides, 2017). Heath and Soll (1996) demonstrated that people tend to underconsume in an account after they previously made a purchase related to that account. This underconsumption increased as the typicality of the previous expense for the account augmented. Another relevant process is hedonic editing, which refers to the segregation or integration of gain and losses, enhancing the positive experience associated with gains and buffering the negative experience related to losses (Thaler, 1985; Thaler & Johnson, 1990).

Even though most of the studies on mental accounting were carried out in a financial context, it was never explicitly restricted to monetary outcomes. On the contrary, the underlying prospect theory has been linked to many different fields such as patients' willingness to accept



risks in therapy (Eraker & Sox, 2016) or the loss of human lives (Fischhoff, 1983; Tversky & Kahneman, 1981). In line with this, recent studies in non-financial contexts have used mental accounting as an underlying theoretical approach to explain their findings. This includes accounting for time and the finding that individuals are more likely to invest time saved in line with its initial purpose (DeVoe & Pfeffer, 2007; Rajagopal & Rha, 2009). Moreover, in the context of nutrition, a salient mental budget of chocolate consumption enhanced subjects self-control and helped them to resist a chocolate cake (Krishnamurthy & Prokopec, 2010).

2.3. Using mental accounting to help people make better decisions

Encouragingly, past research not only regarded mental accounting as an “irrationality-triggering” concept, but rather started to focus on its potential to steer people’s behavior in a desired direction. For example, mental accounting has been shown effective in supporting people’s self-control, helping them save money for retirement. In the “Save More Tomorrow” program by Thaler and Benartzi (2004), a certain percentage of a salary increase is automatically transferred to a separate saving account. As a result, the percentage of saving rates almost quadrupled for people enrolled in the program. The underlying idea is strongly related to mental accounting and loss aversion. Similar to a reference level, individuals get used to a certain level of income. Any reduction in that level is perceived as a loss which looms larger than the gain from the salary increase (Sunstein & Thaler, 2012; Thaler & Benartzi, 2004). However, by automatically transferring a certain percentage of a salary increase individuals do not adapt their reference value. In another experiment, putting part of the wage of a low-income household in a sealed envelope with the ascribed purpose to be saved resulted in a three-fold increase in savings over a period of 14 weeks (Soman & Cheema, 2011).

Thus, the question arises if mental accounting mechanisms may also be applied as a means to help individuals adopt a more sustainable lifestyle. Conceivable are strategies in a financial context, such as increasing investments into renewable technologies, but also strategies relating to the large field of non-investment behaviors. In the remainder of this report, we address these questions across three empirical studies and one conceptual review.



3 Empirical studies

The objective of the conducted experiments was to get a better understanding of the role of mental accounting for energy conservation. The first two articles focus on specific mental accounting mechanisms, whereas the third paper more generally approaches the effects of a knowledge intervention on moral judgments and individuals' mental organization of knowledge which is conceptually closely linked to mental accounts.

In the first empirical study (section 3.1), we tested the hypothesis that people mentally keep a record of past pro-environmental behaviors. Assuming that people strive to keep such an account in balance, this could help to explain negative spillover and why people are sometimes more or less likely to act environmentally friendly after a first pro-environmental behavior. To address this hypothesis, we confronted participants in an online experiment with fictitious scenarios, asking them how likely it was that they would show a certain pro-environmental behavior after having previously performed a similar or non-similar action. We hypothesized that participants would be less likely to show a second behavior if the preceding behavior was similar, than if it was not similar. We replicated the results in a second online experiment and further investigated a possible moderating role of positive and negative affect.

In the second empirical study (section 3.2), we investigated if a green labeling of income is suited to promote purchases of environmentally friendly products. Such an effect would go in line with the mental accounting mechanism, that money is spend in accord with its label. In order to examine this question, we conducted two experiments. In an online experiment, participants learned that they received CHF100 in cash as a windfall or as a remuneration for previously conducted work. Both incomes were either framed in a green or non-green context. In this context, we investigated whether a possible labeling effect is independent from the degree to which an individual values the environment. In a field experiment, we replicated the findings of the online experiment.

In the third empirical study (section 3.3), we examined the role of a knowledge intervention on an individual's mental knowledge representations and moral judgments of specific actions. Both factors are prerequisites for individuals performing most efficient pro-environmental behaviors. We hypothesized that a knowledge intervention leads people to



distinguish in more detail between behaviors with different environmental impacts. Thus, they learn to distinguish which behaviors are particularly effective and morally desirable. This is related to mental accounting, insofar as that one could assume more differentiated mental accounts for people with better knowledge. To test this hypothesis, we applied a multidimensional scaling approach visualizing information about mental distances between various behaviors. Participants were randomly assigned to a knowledge intervention or control group. The intervention group learned the exact environmental impact of a dozen mobility related behaviors, whereas the control group only learned some general information. All participants then had to rate the similarity of all possible pairs of behaviors concerning their environmental friendliness. Additionally, we asked participants to rate the behaviors concerning their morality.



3.1. Study 1: Feel good, stay green: Positive affect promotes pro-environmental behaviors and mitigates compensatory “mental bookkeeping” effects

To counteract climate change people should adopt lifestyles consisting of numerous pro-environmental actions, across different domains, sustained over long time periods. Thus, it is important to understand how initial pro-environmental behaviors can impact the likelihood of subsequent behaviors. We tested the hypothesis that people use mental bookkeeping of past behaviors, allowing them to limit pro-environmental behaviors after having performed similar ones, and investigated the role of affect in this context. Participants read campaign messages framed affectively neutral (Experiment 1) or positive/negative (Experiment 2), followed by fictitious scenarios in which they could perform a second pro-environmental behavior after having shown a first one. Participants indicated a smaller willingness to act pro-environmentally if the behaviors were similar. Positive affect increased the likelihood of showing subsequent behaviors and mitigated negative spillover driven by behavioral similarity. However, the observed effect sizes are too small to be of practical relevance for developing efficient intervention strategies.

Chatelain, G., Hille, S. L., Sander, D., Patel, M., Hahnel, U. J. J., & Brosch, T. (2018). Feel good, stay green: Positive affect promotes pro-environmental behaviors and mitigates compensatory “mental bookkeeping” effects. *Journal of Environmental Psychology*, 56, 3–11. <http://doi.org/10.1016/j.jenvp.2018.02.002>



Introduction

Campaigns and interventions aiming at the promotion of environmentally friendly behavior are present in many situations in our daily life. While many campaigns target changes regarding one specific behavior, an effective reduction of CO₂ emissions requires people to switch to an overall sustainable lifestyle. More precisely, individuals will have to change their behavior not only in one single domain, but act pro-environmentally over a longer time period and across different domains (IPCC, 2014). To develop and evaluate efficient intervention strategies, it is thus important to consider sequences of behavior, taking into account the sequential consequences that the performance of one pro-environmental behavior (hereafter “PEB”) can have on the performance of subsequent PEBs.

While environmental campaigns can indeed succeed in motivating people to perform a targeted PEB (Abrahamse, Steg, Vlek, & Rothengatter, 2005), it is often not taken into account that performing an initial PEB can increase or decrease the likelihood of showing subsequent PEBs (Thøgersen & Ölander, 2003; Truelove, Carrico, Weber, Raimi, & Vandenberg, 2014). These effects are referred to as behavioral spillovers and comprise several related phenomena such as consistency and licensing effects (Lanzini & Thøgersen, 2014; Mullen & Monin, 2016). At best, performing an initial PEB can induce consistency effects that increase the likelihood of performing a second PEB, referred to as positive spillover (Lanzini & Thøgersen, 2014). At worst, an initial PEB is (mis)used to justify a later ecologically harmful behavior or the omission of a second PEB, which is considered as negative spillover (Truelove et al., 2014). Negative spillover effects relate at the psychological level to rebound effects observed at the macroeconomic level, in which improved energy efficiency, for instance, can lead to enhanced energy consumption, reducing the size of potential energy savings (Herring & Sorrell, 2008).

Social-psychological research suggests that behavioral spillovers may be the result of people’s regulation of their moral self-image, which they try to balance at a certain level in order to be able to perceive themselves as a moral person (Zhong, Liljenquist, & Cain, 2009). People experience a heightened moral self-image after performing a moral behavior, and a reduced moral image after engaging in a non-moral behavior (e.g. Sachdeva, Iliev, & Medin, 2009). Based on this perception, they may feel obliged to perform a subsequent moral behavior after an immoral deed or, in contrast, feel entitled to forgo a subsequent moral



behavior or even act immorally after a moral virtue (Higgins, 1996; Zhong et al., 2009). Empirical evidence supports the notion that performing an initial PEB can reduce willingness to engage in subsequent PEBs (Miller & Effron, 2010; Sachdeva et al., 2009). PEBs thus seem to be subject to some form of bookkeeping, in which individuals deposit and withdraw moral credits linked to specific behaviors on a “mental bank account”. This assumption invites comparisons with the behavioral economics literature on mental accounting, which provides strong evidence for mental bookkeeping processes in the finance domain (Thaler, 1980; 2008).

One aim of the present contribution is to develop conceptual links between this body of literature and the literature on behavioral spillover and moral licensing. As we will outline in the next section, while the literature on moral self-regulation does not put much emphasis on the characteristics of a certain behavior (other than that it is perceived as moral or immoral by the actor), the literature on mental accounting is more action-focused. It addresses the important role played by different mental accounts to which transactions (i.e., actions) are booked based on their characteristic and their consequences for decisions and behaviors (Soman & Ahn, 2011). Integrating insights from behavioral economics on mental accounting into the conceptualization of spillover effects may thus be a promising approach to better understand how the characteristics of a sequence of PEBs may contribute to different spillover effects.

Mental accounting of pro-environmental behavior

In the behavioral economics literature, *mental accounting* refers to the fact that people create symbolic mental linkages between specific acts of consumptions and specific payments, which can have large impacts on consumer decisions. Expenditures are grouped into budgets (e.g., food, housing, entertainment), income is divided into categories (e.g., regular, windfall), and wealth is allocated into accounts (e.g., checking, saving, pension fund; see Thaler, 1999). Research has demonstrated how slight variations in the naming, allocation or organization of mental accounts can influence decisions. The influence of mental accounting on decisions was illustrated for the first time in Tversky and Kahneman’s (1981) theatre ticket experiment. They asked half of the participants whether they would be willing to purchase an additional theatre ticket worth \$10 after they had lost an already bought ticket.



The other half of participants was asked whether they would be willing to purchase a ticket worth \$10 after they had lost a \$10 bill. Willingness to buy the ticket was higher when participants envisaged having lost the \$10 bill as compared to the loss of an already bought ticket. This finding was interpreted as illustrating that participants who had lost the theatre ticket placed those costs in a mental “theatre ticket account”. In this group, purchasing the theatre ticket again increased the costs of visiting the theatre from previously \$10 to \$20, while participants from the other group placed the two expenses in separate mental accounts.

One important observation from the domain of financial decision-making is that mental accounting mechanisms lead to a violation of the classic economic notion of fungibility of money. That is, according to mental accounting theory, a credit allocated to one mental account is not a perfect substitute for a credit in another account (Tversky & Kahneman, 1981). For instance, money won in a football bet is more likely to be spent on a dinner in a restaurant, whereas a tax refund is more likely to be used to settle an invoice. This illustrates that people have a tendency to match the source of a credit with the domain in which it will be spent again (O'Curry, 1997). Moreover, people strive to keep an account balanced in the plus zone. In a financial context, this strategy reduces the risk of exceeding an implicit or explicit budget (Soman & Ahn, 2011; Thaler, 1999). However, it can lead to negative consequences, for instance when investors in the stock market are reluctant to sell losing stocks, because it would result in negative closing results for the respective mental account (Odean, 1998).

If similar mental bookkeeping mechanisms exist for the mental organization of moral – including pro-environmental – behaviors, moral credits should be booked on different mental accounts depending on the characteristics of previously shown actions. In line with this idea, Girod and de Haan (2009) suggested that individuals use separate accounts for keeping track of different environmental behaviors, such as the number of flights per journey and the purchase of organic food. Similarly, Schütte and Gregory-Smith (2015) suggested separate mental accounts for holiday-related and sustainable behaviors at home. Such a mental bookkeeping of PEBs would suggest that similar PEBs that are booked to the same account are morally fungible, whereas PEBs that are booked to different accounts are not. For instance, moral credit related to performing a first specific PEB, such as recycling a plastic bottle on the way home, may be deposited on a specific account. If afterwards the occasion



arises to show a highly similar PEB, such as recycling a plastic bottle at the workplace, moral licensing should arise, given that moral credit has already been booked to this account. However, if the occasion arises to show a different PEB, which would be booked on a different account (e.g., using a lid when cooking to save energy), no licensing should be observed.

The potential role of similarity on behavioral spillovers has been examined by Bratt (1999) as well as by Thøgersen (2004). Results of both studies show higher positive correlations between the likelihood of showing similar PEBs (e.g., *limiting residential heating* and *limiting residential use of warm water*) than between less similar PEBs (e.g., *limiting residential heating* and *attention given to environmental information on everyday items*). While at first sight this seems to contradict our hypothesis that an initial PEB should lead to a lower probability of showing a similar subsequent PEB, note that both studies focus on the likelihood of performing certain PEBs in general, rather than in a sequence of conducted behaviors. Based on the motivation to avoid cognitive dissonance (Festinger, 1954), people agreeing to the item “Would you recycle a plastic bottle at your workplace?” are likely to also agree to the item “Would you recycle a plastic bottle on your way home?”, as they try to avoid appearing inconsistent in their general behavior. Thus, a positive correlation between the two items would be expected, given that both represent a general tendency to act. However, when the items are put into a behavioral sequence, “Would you recycle a plastic bottle on your way home after having done so at your workplace?”, balancing effects might occur. Thus, we assume that behaviors occurring over a relatively short-time period are more likely to be linked to each other. This is similar to the payment depreciation effect observed in the financial domain, which describes the observation that the mental linkage between specific costs and benefits gets stronger with increased temporal proximity (Soman & Ahn, 2011).

Based on this reasoning, in the first experiment reported here, we tested the hypothesis that individuals are less likely to show a second PEB after having performed a first PEB if the two behaviors are similar, compared to when the behaviors are different. A further objective of the research presented here was to investigate how a reduction in PEBs due to mental accounting mechanisms can be mitigated. To this end, in the second experiment, we examined the impact of affect on the willingness to act pro-environmentally and the extent to which



affect-inducing environmental campaigns can diminish mental bookkeeping effects. In their theoretical framework of spillover effects, Truelove et al. (2014) refer to the notion of decision modes, arguing that affect-based decisions on whether or not to perform a behavior would be especially prone to negative spillover. They argue that inducing a negative emotion in order to promote a first PEB can result in a lower likelihood to engage in a second PEB. In this view, participants perform the first PEB in order to reduce a negative emotion such as fear or guilt. Once the aversive emotional state is reduced, the motivation to show subsequent PEBs is equally reduced. Based on this reasoning, the authors discourage the use of emotional appeals focused on fear and guilt which are often used in mass media environmental campaigns (Banerjee, Gulas, & Iyer, 2013; Brennan & Binney, 2010; Huhmann & Brotherton, 2013; Mair, 2011). In the current work, we investigate the impact of both positive and negative affect induced by the framing of campaign messages, in order to evaluate to what extent different affect inductions strategies can influence behavioral spillover.

Experiment 1

The objective of Experiment 1 was to examine to what extent mental bookkeeping mechanisms may be linked to behavioral spillover effects and whether this concept can improve predictions of when individuals consistently show a subsequent PEB or, in contrast, forgo a second PEB after having shown a first PEB. As argued above, we expected the likelihood to show a second PEB to be lower if the two PEBs are similar as compared to when they are dissimilar. To test our hypothesis, participants were presented with a fictitious scenario in which they encountered a campaign message related to environmental protection. This campaign message provided some information about the extent to which plastic bottles are being recycled in Germany¹. Participants were informed that, after encountering this message, they showed a first PEB related to the recycling of plastic bottles. Participants' task was to rate how likely it was that they would subsequently show a second PEB. The second PEB was either similar to the first one (i.e., also related to the recycling of plastic bottles) or dissimilar (environmentally friendly, but from a different behavioral domain). We hypothesized that participants indicate a smaller willingness to show a second PEB when the

¹ In Germany plastic bottles are collected and recycled, for example, by bringing them back to their selling point.



second behavior is similar to a first behavior as compared to the condition in which the two behaviors are dissimilar.

A recent meta-analysis of the moral licensing literature has concluded that moral licensing effects are relatively small (average $d = 0.31$). The authors thus recommend that future research interested in the mechanisms underlying spillover effects needs to increase statistical power by using sufficiently large sample sizes (Blanken et al., 2015). In the present research we take these recommendations into account by using large-scale samples.

Methods

Participants

A total of 709 individuals (52% females, $M_{\text{Age}} = 48.76$, $SD_{\text{Age}} = 15.20$) between 19 and 86 years took part in the experiment, which was conducted online as part of a series of several experiments. Participants from the general population of Germany were recruited via a panel provider and were paid approximately 50 eurocents for their participation. Sample size was determined using G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). Based on an α -error probability of 0.05, a power ($1-\beta$) of 0.8 and an expected small effect size ($\rho = 0.1$, based on the meta-analysis of Blanken et al., 2015), a sample size of about 750 participants was suggested as being appropriate.

Materials and experimental design

Experiment 1 was part of a series of four independent experiments. Including declaration of consent, introduction and personal questions it took around seven minutes ($Mdn_{\text{Duration}} = 6.97$) to complete the entire questionnaire. To ensure high data quality, two quality check items related to an experiment not reported here were included in the first half of the questionnaire (i.e., “What were the costs of the product seen?”). 12.25% of people were excluded from all analyses because they answered at least one of the two quality check items incorrectly.

Participants read a short story telling them that on their way to work they caught sight of a campaign message concerning the recycling of plastic bottles in Germany (“Imagine that on your way to work you catch sight of the following advertisement:”). We then showed them a fictitious advertisement including the following text: “Recycling plastic bottles in Germany: Every year, more than 90% of plastic bottles are recycled in Germany. 25’000 tons of plastic



bottles are disposed in the household waste.” Participants learned that after reading the campaign message they performed a first PEB related to the recycling of plastic bottles (e.g., “On your way home, you picked up a discarded plastic bottle and recycled it”). The scenario continued by telling the participants that a few days later they had the opportunity to show a second PEB. Varied between participants, the second PEB was either similar to the first behavior (i.e., also related to the recycling of plastic bottles, such as “recycle a plastic bottle at your workplace”) or dissimilar (environmentally friendly, but from a different behavioral domain, such as “use the lid while cooking a meal”). Scenarios were adapted from items and behaviors used in previous work on pro-environmental behavior (Attari, DeKay, Davidson, & De Bruin, 2010; Kaiser & Wilson, 2000; Lee, Kim, Kim, & Choi, 2014). The following items were used: “*pick up a discarded plastic bottle on your way home and properly recycle it*”, “*clean up the local forest from discarded plastic bottles*” as first or second behaviors and “*recycle a plastic bottle at your workplace*”, “*organize a recycling station at your company*”, “*buy organic food*”, “*use the lid while cooking a meal*” as second behaviors only.

Participants were asked to indicate the likelihood that they would show the second PEB (each participant only saw one second PEB). The response was assessed using a scale from 1 (*very unlikely*) to 7 (*very likely*). At the end of the experiment, participants were additionally asked to indicate the affect triggered by the campaign message on a scale from 1 (*very negative*) to 7 (*very positive*), (“What feeling has the advertising triggered in you?”).

We conducted a pretest to ensure that the similarity of the behaviors was perceived as intended. Fifty-one individuals who did not participate in the main experiment ($M_{\text{Age}} = 32.47$, $SD_{\text{Age}} = 8.87$, 59% female) rated all pairs of behaviors regarding their similarity (“How similar do you rate the following two behaviors?”) on a scale from 1 (*very different*) to 7 (*very similar*). As expected, behaviors classified as similar were perceived to be more similar ($M = 4.93$, $SD = 1.24$, 95% CI [4.58, 5.28]) than dissimilar behaviors ($M = 3.31$, $SD = 1.47$, CI [2.90, 3.73]), $t(50) = 8.748$, $p < .001$, $d = 1.23$, CI [.86, 1.59]).

Results

To assess the influence of the similarity of the two behaviors on the willingness to show the second PEB, we conducted an independent samples t -test comparing the two experimental conditions (similarity of behaviors: similar/dissimilar). Confirming our



hypothesis, people were significantly less willing to show a similar subsequent PEB ($M = 4.64$, $SD = 1.81$, 95% CI [4.45, 4.83]) compared to a dissimilar one ($M = 4.92$, $SD = 1.82$, CI [4.73, 5.11]), $t(707) = 2.043$, $p = .042$, $d = .15$, CI [.01, .30].

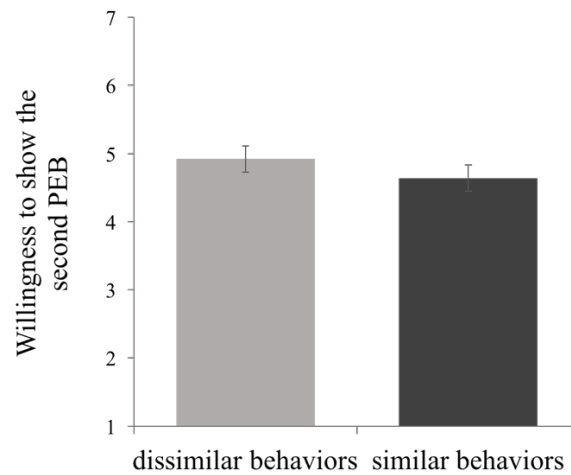


Figure 1. Willingness to show a second PEB after having performed a first PEB. The indicated willingness to show a second, similar PEB was smaller than the willingness to show a second, dissimilar behavior. Vertical bars represent 95% confidence intervals.

Discussion

Consistent with our hypothesis, participants reported that they would be less willing to show a second PEB after having fictitiously performed a first PEB if the two behaviors were similar, compared to when the behaviors were not similar to each other. This pattern of results is consistent with the notion that people perform a mental bookkeeping of their behavior, similar to mental accounting processes observed in the financial domain (Thaler, 1980; 2008): they mentally keep track of their PEBs so that performing an initial PEB can influence the willingness of showing a future PEB. Importantly, this process is influenced by the similarity of the items in the sequence of PEBs.

These results suggest that when the behaviors were similar, the respective mental account was already “full” after the first PEB, and participants consequently allowed themselves not to show a second PEB. This process was not possible when the two behaviors were dissimilar. Thus, similar behaviors may have been *morally fungible*, in contrast to dissimilar behaviors, consistent with the notion that people use different mental accounts to keep track of their PEBs. Even though the result supports our hypothesis, it is important to



mention that the effect size is too small to be practically meaningful. We treat this issue in-depth in the general discussion.

While this experiment explores conditions under which an initial PEB results in a reduction of the willingness to show further PEBs, the necessity to promote more sustainable lifestyles (IPCC, 2014) calls for the development of interventions which may reduce such negative spillover effects. In the second experiment, we addressed this issue. Built on the argument that decisions based on negative affect are especially prone to negative spillover (Truelove et al., 2014), we investigated the impact of affect on the willingness to show a second PEB. Furthermore, we examined whether (i) campaign messages framed to elicit negative affect are especially likely to stimulate mental bookkeeping and thus result in negative spillover across similar PEBs, and (ii) campaign messages framed to elicit positive affect may be a means to avoid negative spillover across similar PEBs.

Experiment 2

The relevance of affect and emotion as determinants of environmentally relevant behavior has been gaining more attention in recent years (Brosch, Patel, & Sander, 2014). Research has shown that individuals feeling more worried about the environment (Lee & Holden, 1999) or more guilty about a lack of action (Bamberg & Möser, 2007; Homburg, Stolberg, & Wagner, 2007; Kals & Maes, 2002; Thøgersen, 2006) are more likely to show PEBs. These observations are consistent with emotion regulation theories positing that people have a tendency to avoid negative feelings (e.g., regret and sadness) and increase positive ones (e.g., happiness and joy). People experiencing negative feelings are motivated to reduce this affective deficit through mood-elevating actions such as pro-social behaviors (Cialdini et al., 1987). Interestingly, individuals experiencing a negative affective state followed by affective relief have been shown to be less likely to show a subsequent altruistic behavior than individuals not experiencing affective relief (Cialdini, Darby, & Vincent, 1973). This finding is consistent with the notion that negative affect can motivate moral behavior in the short run, but can reduce long-term moral behavior, thus finally boosting negative spillover (Truelove et al., 2014).

Positive affective states have been shown to enhance the probability of acting pro-socially (Manucia, Baumann, & Cialdini, 1984) or pro-environmentally (Harth, Leach, &



Kessler, 2013) as well. These effects have been interpreted in two different theoretical frameworks, suggesting distinct underlying mechanisms (Miller, 2009). According to the mood maintenance theory, positive affect triggers the desire to maintain this positive mood, with pro-social or pro-environmental behaviors being one option to maintain this state (Miller, 2009; Schaller & Cialdini, 1990). A second perspective does not consider the maintenance of a positive mood as the primarily goal of acting pro-socially, but rather conceptualizes pro-social actions as concomitants of the positive state (Cialdini, Kenrick, & Baumann, 1982; Manucia et al., 1984). That is, positive affect leads to cognitive changes such as an increased optimism about the future (Masters & Furman, 1976) or a recall of rewards of past good deeds (Isen, Shalcker, Clark, & Karp, 1978), which in turn promote pro-social behavior. A subsequent PEB can therefore be seen as a causal byproduct of positive affect, rather than an immediate consequence. Both theoretical perspectives are consistent with the expectation that positive affect would motivate moral behavior both in the short and in the long run, thus potentially reducing negative behavioral spillover.

In Experiment 2, participants were again presented with a scenario in which they encountered a campaign message related to environmental protection. They were then informed that after encountering this message, they performed a first PEB related to the recycling of plastic bottles, and were asked to rate to what extent it was likely that they would later show a second PEB. Identical to Experiment 1, the second PEB was either similar or dissimilar to the first one. In contrast to Experiment 1, we experimentally varied whether the campaign message was framed to elicit negative or positive affect.

We hypothesized that the campaign inducing positive affect will result in a higher willingness to show a second PEB. In particular, we expected this effect to be mediated by the level of affect perceived by the participant. Finally, we wanted to explore whether the affect-inducing environmental campaigns would influence the impact of behavioral similarity and thus modulate mental bookkeeping effects.

Previous research on determinants of behavioral consistency and spillover in the environmental domain has pointed out an important role of people's environmental self-identity (Van der Werff, Steg, & Keizer, 2014). It was shown that reminding people of past good deeds strengthens their environmental self-identity and encourages further PEBs. Affect and self-identity are conceptually and empirically strongly interlinked (Brown & Taylor,



1986; McConnell, Rydell, & Brown, 2009). In our task, we additionally assessed peoples' environmental self-identity, in order to evaluate whether the effects of our affect manipulation (positive/negative campaign) can be explained by changes in peoples' self-identity only.

Methods

Participants

In total 1418 people (54% females, $M_{\text{Age}} = 48.93$, $SD_{\text{Age}} = 15.23$) between 19 and 92 years of age took part in the experiment, which was conducted online. Participants from the general population of Germany were recruited via a panel provider and were paid for their participation. Determination of sample size was calculated as in Experiment 1.

Materials and experimental design

Structure, including duration ($Mdn_{\text{Duration}} = 6.84$), remuneration and quality check items were identical to Experiment 1. Similar to Experiment 1, participants read a short story telling them that on their way to work they caught sight of a campaign message concerning the recycling of plastic bottles in Germany. In the positive condition, the message displayed in the fictitious advertisement was framed with the intention to induce a positive affect ("You are a world champion! Thanks to you, more than 90% of all plastic bottles are recycled in Germany, more than in any other country. Thank you very much!"). In the negative condition, the message was framed with the objective to induce negative affect ("Your behavior harms the environment! Every year, 25'000 tons of plastic bottles are disposed in the household waste and cannot be recycled properly this way."). Both messages were supplemented by matching pictures. For the positive campaign, pictures showed a butterfly sitting on someone's hand, four people's hands with their thumb up and a cartoon of a smiling earth. In the negative condition, participants saw a turtle eating a piece of plastic, a bunch of plastic waste on a beach and a cartoon of an ailing earth. Afterwards, the procedure was identical to Experiment 1: Participants learned that, after reading the campaign message they performed a first PEB related to the recycling of plastic bottles. In a final step, participants were presented with a second PEB which was either similar or dissimilar to the first behavior. Identical to Experiment 1, the similarity of the behaviors (similar/dissimilar) was varied between participants. Participants were asked to indicate the likelihood that they would show the second PEB. The response was assessed using a scale from 1 (*very unlikely*) to 7 (*very likely*).



At the end of the experiment, participants were asked to indicate the affect triggered by the campaign message on a scale from 1 (*very negative*) to 7 (*very positive*), (“What feeling has the advertising triggered in you?”). Environmental self-identity was measured using three items (“Acting environmentally-friendly is an important part of who I am”, “I am the type of person who acts environmentally-friendly”, “I see myself as an environmentally-friendly person”) developed by Van der Werff, Steg and Keizer (2013). Participants rated each item on a scale, ranging from 1 (*totally disagree*) to 7 (*totally agree*).

Results

Manipulation check: Self-reported affect and environmental self-identity

The campaign message had the desired effect on participants’ self-reported affect, as revealed by an independent sample t-test, $t(1416) = 19.47, p < .001, d = 1.03, 95\% \text{ CI } [.92, 1.14]$. As expected, people who saw the positive message rated their affect as more positive ($M = 5.14, SD = 1.11, \text{ CI } [5.06, 5.22]$) than people who saw the negative message ($M = 3.84, SD = 1.39, \text{ CI } [3.74, 3.94]$). To test that both campaign messages changed participants’ affect in the desired direction, we compared mean values of Experiment 2 with the neutral campaign from Experiment 1. As expected, the negative message led to a more negative affect ($p < .001$), and the positive message to a more positive affect ($p < .001$) as compared to the neutral campaign ($M = 4.29, SD = 1.21, F(2, 2124) = 200.73, p < .001, d = .87, \text{ CI } [.77, .96]$). Importantly, participants’ environmental self-identity was not influenced by the campaign messages; no difference in reported environmental self-identity between the positive ($M = 5.41, SD = .99, \text{ CI } [5.34, 5.48]$) and the negative ($M = 5.38, SD = .94, \text{ CI } [5.31, 5.45]$) campaign conditions was observed ($t(1405) = .684, p = .494, d = 0.04, \text{ CI } [-.07, .14]$).

The impact of self-reported affect on the willingness to show a second PEB

We calculated a mediation analysis in order to assess the extent to which self-reported affect acted as a link between the campaign message and the willingness to show a subsequent PEB. Most importantly, the relationship between campaign message and willingness to show a second behavior was mediated by the self-reported affect, as revealed by a significant indirect effect of campaign message on the willingness to show a second PEB via self-reported affect ($\beta_2\beta_3 = .20, p < .001, 95\% \text{ CI } [.15, .25]$). Moreover, as Figure 2 illustrates, the campaign message had a strong influence on the self-reported affect ($\beta_1 = .65, p < .001, \text{ CI }$



[.59, .72]), in that self-reported affect was more positive in the positive campaign condition as compared to the negative campaign (see also manipulation check). Furthermore, more positive affect was related to a higher willingness to show a second PEB ($\beta_2 = .30, p < .001$, CI [.23, .37]). Overall, these findings suggest that a positive campaign message induced a more positive affect, which enhanced people's willingness to show the second behavior. The campaign message had a negative direct effect on the willingness to show a second PEB when self-reported affect was included in the model ($\beta_3 = -.17, p = .002$, CI [-.27, -.06]). However, no direct effect of campaign ($\beta_3 = .03, p = .533$, CI [-.06, .12]) was found when self-reported affect was excluded from the model, which suggests that there was no impact of the campaign message per se on behavior change. Instead, these results support the assumption that self-reported affect acts as the key mediator between the environmental campaign and the reported behavior.

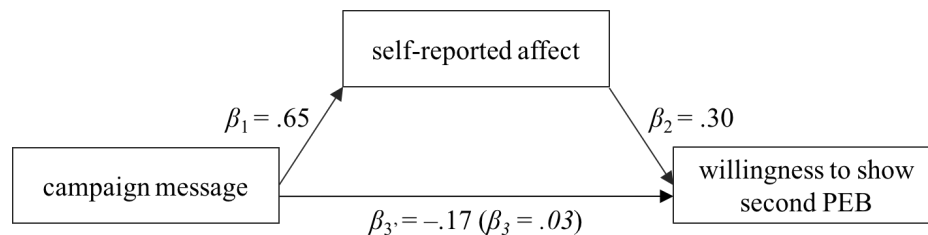


Figure 2. Self-reported affect mediates the relationship between campaign framing and willingness to show a second PEB.

The impact of campaign message and PEB similarity on willingness to show second PEB

After confirming the important role of affect on participants' willingness to show a second PEB, we aimed to examine whether the affect-inducing campaigns influenced the mental bookkeeping processes observed in Experiment 1. We conducted a 2 X 2 (campaign message [negative vs. positive] X similarity of the first and second PEB [similar vs. dissimilar]) ANOVA in order to assess the influence of message framing and PEB similarity on participants' reported willingness to show a second PEB. That is, we tested whether a positively framed campaign message may act as an intervention to promote a subsequent pro-environmental behavior. Replicating the findings of Experiment 1, participants indicated a smaller willingness to show a similar second PEB ($M = 4.73, SD = 1.76, 95\% \text{ CI } [4.60, 4.86]$) than a dissimilar one ($M = 4.93, SD = 1.84, \text{ CI } [4.79, 5.07]$), as illustrated by a main effect of



similarity, $F(1, 1414) = 4.53, p = .033, d = .11, CI [.09, .22]$. Most importantly, a statistically significant interaction of *similarity* and *campaign message*, $F(1, 1414) = 4.92, p = .027, \eta^2 = .004, CI [.00, .01]$, revealed that this effect was driven by participants exposed to the negative message, but was not observed in participants exposed to the positive message (see Figure 3).

Simple effects showed that, while participants exposed to the negative campaign message indicated a smaller willingness to show a second, similar PEB ($M = 4.59, SD = 1.82, CI [4.40, 4.78]$) as compared to a second, dissimilar PEB ($M = 5.01, SD = 1.78, CI [4.82, 5.19]$; $F(1, 1414) = 9.44, p = .002, d = .01, CI [.00, .02]$), the willingness to show these two PEB types did not differ for participants exposed to the positive campaign ($M_{\text{similar}} = 4.86, SD_{\text{similar}} = 1.68, CI [4.68, 5.05]$; $M_{\text{dissimilar}} = 4.85, SD_{\text{dissimilar}} = 1.91, CI [4.67, 5.04]$; $F(1, 1414) = .004, p = .950, d = .00, CI [.00, .00]$). These results support the assumption that positively framed campaign messages can prevent negative behavioral spillover in a sequence of similar PEBs.

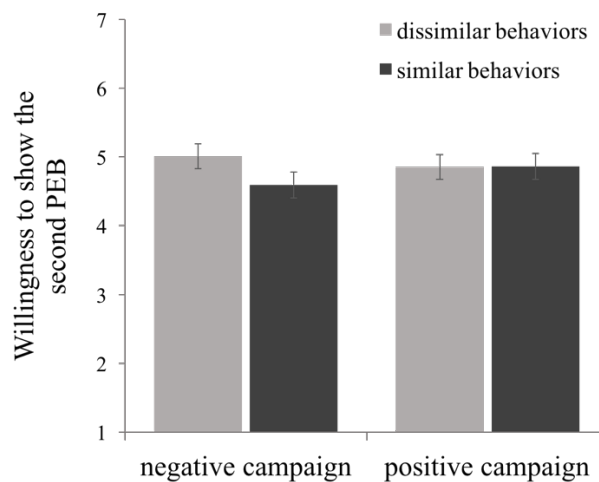


Figure 3. Willingness to show a second PEB after having performed a first one for the experimentally varied negative and positive framed campaign message conditions. For the negatively framed campaign message, the indicated willingness to show a second, similar PEB was smaller than the willingness to show a second, dissimilar behavior. No such difference was detected for the positive framed campaign message. Vertical bars represent 95% confidence intervals.

Discussion

In Experiment 2, we investigated the role of affectively framed campaign messages in the context of sequences of PEBs. First, we showed that self-reported affect mediated the relationship between campaign message and willingness to show a fictitious second PEB.



Participants experiencing more positive affect after reading an affect-based campaign message reported a higher willingness to show a second PEB after having performed a first one, indicating that positive affect may play an important role in promoting long-term eco-friendliness.

Interestingly, the mediation model showed that the affective campaign message had a positive indirect effect on the willingness to show the second behavior via experienced affect. In contrast, the direct effect of campaign on willingness to perform a second PEB was non-significant and turned to a significant negative effect when experienced affect was included in the model. Taking into account the strong correlation between campaign message and self-reported affect, this pattern speaks for a possible suppressor effect (MacKinnon, Krull, & Lockwood, 2000; Paulhus, Robins, Trzesniewski, & Tracy, 2004).

Second, replicating the results from Experiment 1, participants reported that they would be less likely to show a second PEB after having performed a first PEB if the two behaviors were perceived as similar, compared to when behaviors were not similar to each other. Extending these findings, results indicate that an affective campaign message framing can moderate this effect: While a negative message framing led to a negative spillover effect similar to the one observed in Experiment 1, a positive message framing reduced this effect. Participants were equally likely to show the second PEB independent of the two behaviors' similarity. Thus, results suggest that a positively framed campaign message may help mitigating the adverse effects of mental bookkeeping mechanisms and thus reinforcing more enduring pro-environmental behavior. While research previously provided evidence for the general effects of positive affect on PEB (Harth, Leach, & Kessler, 2013), the present research may serve as a starting point for future research investigating the processes underlying the influence of affect on behavioral spillover. Similar to Experiment 1, the practical relevance of the findings is severely restricted due to the small effect sizes.

General discussion

Even though people are being more educated and sensitized concerning climate change and related issues (Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015), there is still substantial need to develop more eco-friendly lifestyles in order to effectively counter climate change (IPCC, 2014). To ensure that individuals act environmentally friendly in the long-



term, it is important to take into account sequential effects concerning the interdependency of consecutive pro-environmental behaviors. Behavioral spillovers take place when performing an initial behavior either boosts or inhibits the likelihood of showing a subsequent one. In this manuscript, we investigated the influence of a mental bookkeeping of past behaviors on the willingness of showing future behaviors. This approach is based on an integration of the social-psychological literature of moral self-regulation and insights from behavioral economics concerning mental accounting mechanisms. In two experiments, findings indicate that once individuals have performed a first PEB, they are less willing to show a second one if it is similar to the first one as compared to when it is less similar. While this finding is in line with previous studies on moral licensing, which show that an initial moral behavior can be used as an excuse to act less morally in the aftermath (Blanken, Van de Ven, Zeelenberg, & Meijers, 2014; Girod & de Haan, 2009; Maimaran & Goldsmith, 2011; Margetts & Kashima, 2016; Schütte & Gregory-Smith, 2015), it additionally points out the importance of the characteristics of the types of behaviors in the sequence.

Similar to financial deposits on mental accounts (Thaler, 2008), deposits of moral credit may have been fungible for similar behaviors (credited to the same moral account), while not fungible for dissimilar behaviors (credited to different moral accounts). Together, these results point to the usefulness of integrating concepts from the mental accounting literature into moral self-regulation theory: In itself, latter would not have expected differences as a function of the similarity of the behaviors, given that participants from both experimental groups would have experienced a positive change in their self-concept.

A second issue addressed in the present work was the role of affect in behavioral spillover effects. Many campaigns using affect and emotions are focusing on negative emotional appeals, trying to induce fear or guilt (Banerjee et al., 2013; Brennan & Binney, 2010; Huhmann & Brotherton, 2013; Mair, 2011). In their theoretical framework of spillover effects, Truelove and colleagues (2014) emphasize that negative affect may be especially likely to induce negative spillover, as people may show an initial PEB in order to reduce the negative affect, but then afterwards not feel motivated any more to show subsequent behaviors. Here we present first evidence indicating that also positive affect may play a role in determining whether one shows a subsequent PEB. More positive affect – induced through



a positively framed campaign message – was related to a higher willingness to show a second PEB than negative affect induced by a negatively framed campaign message.

Comparing the impact of neutrally, negatively and positively framed campaign messages on subsequent PEBs indicates that the affective content of an environmental campaign may influence behavioral spillover. While under the negatively and neutrally framed message similarity-based negative spillover was observed, this effect was not found under the positive message framing, supporting the notion that positive affect may motivate moral behavior both in the short and in the long run.

Importantly, while the results statistically support the concept of a mental bookkeeping of PEBs and the idea of affect as a mediator in terms of null hypothesis significance testing (NHST), the effect sizes can be considered as too small to be of practical relevance in the context of intervention development (for a discussion of the drawbacks of NHST see: Cumming, 2013). This is in particular true in light of opportunity costs that need to be taken into account when developing interventions in practice. That is, the practical implementation of a positively framed campaign message as examined here is accompanied by forgoing potentially more effective strategies, such as social norm-based strategies, which have been shown to be effective in changing behavior (Alló & Loureiro, 2014; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). Nevertheless, it is possible that replications using more robust measures such as multi-item instead of single-item measures (see discussion below) or examining actual behavior in more realistic settings might reveal larger effects. Further, the influence of affective campaigning may potentially cumulate over time (Prentice & Miller, 1992), which could be tested in an experimental setting incorporating extended sequences of behaviors. Thus, we highly encourage researchers to advance the present findings by means of future studies.

Beside the small effect sizes, the results observed across the two experiments are somewhat qualified by the hypothetical character of the task and the fact that in everyday life behaviors are probably often not as clearly related to each other as in the scenarios used in our task. Based on this reasoning, the ecological validity of our findings may be questioned. However, the novelty of our approach in the context of spillover effects justifies to a certain degree the use of highly controllable online experiments addressing hypothetical behaviors. Speaking in favor of the validity of our findings, in their meta-analysis Blanken and



colleagues (2015) report no difference between studies including actual or hypothetical behaviors. However, given the role of the intention-behavior gap frequently observed with regards to PEBs (Kollmuss & Agyeman, 2010), it would be important to replicate the experiment in the field in future research, with real behaviors instead of reported likelihoods and intentions.

Additionally, single-item measures as used here can be considered as less reliable than multi-item measures. Even though single-item measures have been shown to be appropriate measures in different fields such as clinical studies (Hoeppner, Kelly, Urbanoski, & Slaymaker, 2011), research on marketing (Ang & Eisend, 2017; Bergkvist & Rossiter, 2007), and personality (Spörrle & Bekk, 2014), other studies report weak reliabilities for single-item measures of about .60 (e.g., Wanous, Reichers, & Hudy, 1997). Additionally, using single-items measures can weaken construct validity, given that the examined variance could be specific to the behavior at hand rather than the domain of PEBs. That is, some people might not consider cleaning up a local forest, because they live in an urban area without immediate access to a forest. Similarly, some behaviors may have been perceived as easier or more attractive than others. Under these conditions, the specific characteristics of the given behavior may have potentially influenced the willingness to perform the action. Future studies using multi-item measures (e.g., the scales developed by Kaiser & Wilson, 2000 or McConaughy, 2014) can address this issue.

Concerning the results on affect and PEBs, two other alternative explanations need to be addressed more specifically. First, psychological reactance seems like a potential explanation for the reported findings. People may have been more willing to perform a dissimilar behavior after being “forced” to show the first behavior. However, experiencing psychological reactance is strongly connected to perceiving negative affect (Dillard & Shen, 2005), while we did find no evidence for increased negative affect in the “similar” conditions². Moreover, psychological reactance is linked to the cognitive process of counterarguing (Rains, 2012). A measure of this could be included in future studies for a more differentiated analysis of the role of reactance in this process. Second, it is possible that the

² An independent samples *t*-test assessing the influence of the similarity of the two behaviors (similar/dissimilar) on self-reported affect showed no difference between the two experimental conditions: similar behaviors: $M = 4.44$, $SD = 1.41$, 95% CI [4.34, 4.54]; dissimilar behaviors $M = 4.54$, $SD = 1.43$, CI [4.43, 4.65]; $t(1416) = 1.237$, $p = .216$, $d = .07$, CI [−.04, .17].



positive campaign message in Experiment 2 may have been interpreted as a descriptive norm, as relative outcome information is given (“90% of all plastic bottles are recycled” in the positive condition versus “25’000 tons of plastic bottles are disposed in the household waste” in the negative condition). However, given the successful manipulation of people’s affect, and the result of the mediation analysis showing the link between experienced affect and reported behavioral intentions, it is unlikely that norms account for all of the explained variance. We rather assume that norms, as well as psychological reactance processes, may interact with affect and highly encourage further studies tackling this issue.

Previous research has shown that activating people’s environmental self-identity by reminding them of past environmental behaviors can increase the likelihood to show future PEBs (Van der Werff et al., 2014). It is unlikely that this can account for the findings reported here, as our analysis shows that environmental self-identity was not affected by the affective framing of the campaign messages. Our findings do however raise the possibility that the effects linked to strengthening one’s environmental self-identity observed in the study by Van der Werff, Steg and Keizer (2014) may (at least partly) be attributed to increases in positive affect related to the activation of positive aspects of one’s self-identity. Future empirical research should investigate this possibility. Future research could furthermore include behaviors with a negative environmental impact, testing the hypothesis that a first behavior may not only reduce the likelihood of showing a second PEB, but also encourage subsequent environmentally harmful behavior. In addition, it would be desirable to consider individual factors as potential moderators in more detail. Even though individual differences are to a certain degree addressed by controlling for environmental self-identity, more detailed analyses are necessary.

Taken together, our results indicate that behavioral similarity may play a role in spillover effects. People may be more willing to use an initial PEB to omit a second, similar PEB, as compared with a second, dissimilar PEB. This is consistent with the notion of a mental bookkeeping of past pro-environmental behaviors similar to mental accounting in the behavioral economics literature (Thaler, 1980; 2008). This effect was offset by a positively framed campaign message. Our results point out a possible psychological mechanism regulating behavioral spillover. Regarding the significance of our results in the context of practical applications, the small size of the effects obtained here suggests that findings are



rather negligible with no meaningful impact for intervention design in practice. This is relevant since opting for a specific intervention strategy in practice is potentially accompanied by the opportunity costs of forgoing more efficient ones. Given the small effect sizes obtained here and in other studies of this kind, replication studies are strongly encouraged.



3.2. Study 2: Call it by a green name! Green labeling of income increases the willingness to invest in environmentally friendly products

Given the societal challenge of developing more sustainable consumption patterns in the face of climate change, there is an increasing need to develop strategies that can lead to more sustainable individual purchase decisions. Across an online experiment (Experiment 1) and a field experiment (Experiment 2), we tested whether attaching a green label to an income (which was either earned through work or gained as a windfall) increases the likelihood that the income is spent on environmentally friendly products. The products were either environmentally friendly or not, and were of utilitarian or hedonistic character. Supporting our hypothesis, participants receiving a green-labeled income were more likely to purchase environmentally friendly and in particular in utilitarian environmentally friendly products. The effect was independent of participants' biospheric value orientations. Taken together, our results demonstrate that green labeling may be a cost-effective way to boost purchases of energy-efficient appliances and could, for example, be applied by governments or companies when refunding taxes respectively when paying bonuses.

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Introduction

Climate change is one of the biggest challenges of our time as it not only endangers the global environment, but is also likely to threaten political stability and social peace (Burke, Miguel, Satyanath, Dykema, & Lobell, 2009; IPCC, 2014). While most individuals report that they are concerned about environmental issues, many do not actually show pro-environmental behaviors consistent with this concern, a phenomenon known as value-action gap or attitude-behavior gap (Kollmuss & Agyeman, 2010). Overcoming this gap and promoting more eco-friendly behavior patterns is thus an important challenge for behavioral scientists. In order to encourage eco-friendly behavior, both promoting one-shot investment actions (such as purchases of energy-efficient LEDs) as well as motivating continuous curtailment behavior patterns (such as consistently switching off the lights when leaving a room) will be needed (Burger et al., 2015). While a one-shot investment action requires an initial monetary commitment, the potential long-term saving effects over the lifetime of energy-efficient household appliances are often quite large. More precisely, it has been estimated that motivating consumers to consistently purchase the most energy-efficient household appliances can lead to significant energy savings, ranging from 21% of the final electricity consumption in the residential sector in the European Union by 2020, up to savings of 50% in a longer period (Atanasiu & Bertoldi, 2010; De Almeida, Fonseca, Schlomann, & Feilberg, 2011). Given these stakes, multiple strategies have been developed which aim at increasing the sales of energy-efficient appliances. In addition to the “classical” public policy strategies based on the provision of information (e.g., information campaigns³) or financial incentives (e.g., tax credits, rebates and other incentives⁴), a number of recent intervention strategies try to “nudge” individuals towards the purchase of energy-efficient appliances. Introduced by Thaler and Sunstein (2012), a nudge refers to a slight change in the decision situation (the “choice architecture”) which aims at increasing the likelihood of a certain behavior without restricting the number of choice options or changing the economic incentive structure. The concept of nudging is considered a promising approach for governments and enterprises to motivate individuals towards more environmentally friendly purchases and behaviors (Burger et al., 2015). Nudging strategies applied to the promotion of the purchase

³ See e.g., <http://www.parlons-chauffage-electrique-moderne.fr/>

⁴ See e.g., <https://energy.gov/savings>



of energy-efficient household devices include, among others, the use of eco-labels (Heinzle & Wüstenhagen, 2012; Sammer & Wüstenhagen, 2006), the emphasis of information about life cycle costs (Heinzle, 2012; Kaenzig & Wüstenhagen, 2010), and the implementation and communication of social norms (Schubert & Stadelmann, 2015).

Interestingly, most approaches trying to promote the purchase of energy-efficient appliances focus on the characteristics of the products to be sold. To our knowledge, so far no nudging strategy has been developed that focuses on the “income side”, i.e. uses knowledge about the psychological mechanisms surrounding the use of money to understand how a certain income can be made more likely to be used to purchase green products. Previous research suggests that the labeling of a source of income matters. In the United Kingdom, elderly people receive a supplement for heating purposes during wintertime. This “Winter Fuel Payment” is a supplement that is basically a direct, unconditional cash transfer (i.e. the money can be spent on anything), but that is given a name pointing to a distinctive purpose. On average, households spent 42% of the winter fuel payment on fuel, whereas households would be expected to spend only 3% of the payment on fuel if it were treated as unlabeled cash (Beatty, Blow, Crossley, & O'Dea, 2014; Lange, Moro, & Rahman, 2015). Thus, the claim that “money is money no matter where it is earned” does apparently not hold true in reality. The reason for this is that people often mentally organize financial transactions into differently labeled “mental accounts”, which significantly influence how the money is used (Thaler, 1999; 2008). As a result, money loses its fungibility, meaning that money from one account cannot be easily spent on something related to another account. This observation is contrary to the assumptions of early economic models which posited source independence, implying that the value of a certain income is independent from the conditions under which it was obtained (Loewenstein & Issacharoff, 1994). Previous research has revealed that distinctive mental accounts depend on the purpose individuals plan to spend the money on (Zelizer, 1989). For instance, many people have a fixed monthly budget for grocery shopping while keeping a savings jar for the next holiday trip. In addition to that, it has been shown that mental accounts are also often created on the basis of the source of the money (McGraw, Tetlock, & Kristel, 2003). Income which is received as a gift or a windfall (and thus not associated with “serious” work) is more likely to be spent on hedonistic products such as vacations or luxury items, whereas money earned through work is more likely to be used for



utilitarian purposes, such as buying a tax book (Helion & Gilovich, 2014; Henderson & Peterson, 1992; O'Curry & Strahilevitz, 2001). Similarly, money won in a football bet is more likely to be used to go eat at a restaurant, whereas a tax refund is more likely to be used to repay debts (O'Curry, 1997). In other words, the source of money as well as how money is labeled determine how we spend it.

The question arises whether these mental accounting mechanisms can be leveraged in order to promote more energy-efficient purchase decisions. Specifically, following the work of Beatty et al. (2014), we hypothesize that labeling a specific income as “green” will lead to an increased purchase of energy-efficient products. Money labeled as green should be mentally assigned to a green account and therefore should be more likely to be spent on energy-efficient appliances than on appliances high on energy consumption.

More specifically, as previous research points to a matching principle of income and spending based on “seriousness” (Helion & Gilovich, 2014; Henderson & Peterson, 1992; O'Curry, 1997; O'Curry & Strahilevitz, 2001), not only the matching of “greenness” between money and its spending, but furthermore a matching between the seriousness of the income and the product function seems plausible. In view of the growing perception of climate change as a serious issue (GlobeScan, 2016), one may thus furthermore expect that a green labeling will not only boost the purchase of environmentally friendly products in general, but that the perceived seriousness of the topic of climate change and the resulting need of environmental protection will specifically boost purchases of “serious” environmentally friendly products, i.e. products which focus on utilitarian aspects, and rather less purchases of environmental products with pronounced hedonistic attributes.

Taken together, we hypothesized that income labeled as green is more likely to be spent on environmentally friendly products than on non-environmentally friendly products, in particular when they are utilitarian. We furthermore investigated whether income received as a windfall is more likely to be spent on hedonic as compared to utilitarian products also in the context of purchases of energy-efficient products. In order to answer these research questions, we performed an online experiment (Experiment 1) and a field experiment (Experiment 2).

Furthermore, we addressed the issue of the generalizability of the nudge with regards to different population segments. In previous research on the profiles of “green consumers”, several consumer clusters have been identified which are characterized by differences in



socio-demographic factors, but also differences in environmental concerns and values (Finisterra do Paço, Barata Raposo, & Filho, 2009; Park & Lee, 2014). Moreover, previous studies on pro-environmental behavior have pointed out the importance of values, and especially of a biospheric value orientation as a predictor of pro-environmental intentions, preferences and actions. People with stronger biospheric values base their actions more on its consequences for the environment (De Groot & Steg, 2010; Van der Werff, Steg, & Keizer, 2013). Furthermore, stronger biospheric values are related to a higher reported importance of green product attributes (Schuitema & Groot, 2015) and environmentally friendly consumption in general (Gilg, Barr, & Ford, 2005). Given this already high baseline of environmental behavior in individuals with high biospheric values, it is thus possible that no additional improvement may be obtained by the green labeling intervention due to a ceiling effect. Alternatively, a green labeling might work especially well in this population, as the respective values may be primed by the label. As a third option, green labels and biospheric values might not interact, resulting in a nudge that would be universally effective, independent of peoples' value orientation. In Experiment 1, we thus additionally assessed our participants' biospheric values in order to evaluate whether the impact of a green labeling intervention would depend on this individual difference.

Experiment 1

The objective of Experiment 1 was to test the hypothesis that a green label for a given income can enhance individuals' willingness to use this income to purchase environmentally friendly products, particularly utilitarian environmentally friendly products. Participants were presented with one out of four fictitious scenarios, in which they received 100 Euros that were either described as remuneration for work or as a windfall, and either labeled as green or not. On the product side, we varied whether the product was utilitarian or hedonic and whether it had green or non-green attributes. Each participant was asked to indicate the willingness to spend the 100 Euros for one out of the four products.



Methods

Participants

Participants from all over Germany were recruited via a panel provider. 1'701 individuals (52% females, $M_{\text{Age}} = 49.07$, $SD_{\text{Age}} = 15.17$) between 19 and 92 years completed the online questionnaire and were paid for their participation. The research was approved by the ethics committee of the University of Geneva.

Materials and experimental design

Following the instructions and depending on the condition to which they were randomly assigned to, participants read one out of four short fictitious stories. Each story included the receipt of an amount of money, which was framed either as remuneration for work or a windfall, and was either labeled as green or not. The *green work* condition focused on a reward for a previous green behavior ("Imagine that your employer paid you 100 EUR in cash, because you had decided to install a recycling station for paper, plastic and aluminum at your workplace."), the *non-green work* condition focused on a behavior which was not explicitly environmentally friendly ("Imagine that last month you did some overtime work, which was paid to you in cash [100 EUR]."). Similarly, the *green windfall* condition focused on a Christmas bonus related to a green purchase ("Imagine that you received a green Christmas bonus in cash [100 EUR] from your employer, which is meant to be spent on an ecologically friendly purchase for your own home."), the *non-green windfall* condition focused on a Christmas bonus which was not explicitly related to an environmentally friendly behavior ("Imagine that you received a Christmas bonus in cash [100 EUR] from your employer.").

After having read the introduction, participants were randomly presented one out of four products, each of them worth 100 Euros. Products were either utilitarian or hedonistic and either environmentally friendly or not. The product characteristics were presented in a short description. The products were a set of ten LED bulbs as a *utilitarian environmentally friendly product* ("On your way home, you pass by a store, promoting sets of ten LED bulbs reduced to 100 Euros. At home, you're still using your old lightbulbs, which you could replace now. The life expectancy and luminance are similar to the old light bulbs, but the power consumption is much lower."), a microwave as a *utilitarian non-environmentally*



friendly product (“On your way home, you pass by a store, promoting microwaves from different producers reduced to 100 Euros. You don’t own a microwave yet. It could be used to heat up meals, however has an increased energy consumption.”), a solar speaker as a *hedonistic environmentally friendly product* (“On your way home, you pass by a store promoting solar speakers reduced to 100 Euros. The battery can be recharged by implemented solar panels. You could use the solar speaker amongst others to listen to your favorite music with friends.”) and a luxurious showerhead as a *hedonistic non-environmentally friendly product* (“On your way home, you pass by a store promoting luxurious shower heads reduced to 100 Euros. These luxurious shower heads have an increased water consumption, but promise a unique shower experience.”). In addition to the short text, participants saw a photo representing the corresponding product.

Finally, participants were asked to indicate the likelihood of buying the product (e.g., “What is the likelihood of you spending the 100 Euros earned by working overtime on the new shower head?”), repeating the respective source of the money and the product. The response was assessed using a Likert scale from 1 (*very unlikely*) to 7 (*very likely*).

We conducted a pretest to ensure that the products’ environmental friendliness and function were perceived as intended. Forty individuals ($M_{\text{Age}} = 27.81$, $SD_{\text{Age}} = 2.68$, 65% female) who did not take part in the main experiment rated all products regarding their environmental friendliness (1 = *not at all environmentally friendly* to 6 = *very environmentally friendly*) and function (1 = *very utilitarian* to 6 = *very hedonistic*). The meaning of both terms was explained to the participants in the pretest. Repeated-measure ANOVAs revealed that, as expected, the shower head ($M = 1.95$, $SD = .90$) and the microwave ($M = 2.28$, $SD = 1.01$) were perceived as less environmentally friendly than the LED ($M = 4.38$, $SD = 1.19$) and the solar speaker ($M = 4.50$, $SD = 1.56$), $F(1, 39) = 180.284$, $p < .001$, $\eta^2_p = .822$. Furthermore, the LEDs ($M = 1.60$, $SD = .78$) and the microwave ($M = 1.93$, $SD = .97$) were perceived as more utilitarian than the solar speaker ($M = 4.03$, $SD = 1.17$) and the shower head ($M = 5.28$, $SD = 1.22$, $F(1, 39) = 227.217$, $p < .001$, $\eta^2_p = .854$).

Biospheric values were assessed two weeks before the main experiment, using the items from Steg, Perlaviciute, van der Werff and Lurvink (2014) (e.g., “RESPECTING THE EARTH: harmony with other species”, “PREVENTING POLLUTION: protecting natural resources”). Participants rated each value on how important it is as a guiding principle in their



life. Responses were assessed using a scale from 0 (not important at all) to 7 (supreme importance), with the additional possibility of indicating -1 for items that were opposed to their guiding principles.

Results

To assess the influence of the source of income, the label of the income, and the products characteristic on the willingness to spend the 100 Euros, we conducted a $2 \times 2 \times 2 \times 2$ (*source of income* [work vs. windfall] $\times$ *income label* [green vs. non-green] $\times$ *product function* [utilitarian vs. hedonistic] $\times$ *product environmental impact* [environmentally friendly vs. not environmentally friendly]) between-subjects Analysis of Variance (ANOVA).

Overall, participants were more willing to purchase environmentally friendly ($M = 3.39$, $SD = 1.85$) as compared to non-environmentally friendly products ($M = 2.51$, $SD = 1.62$), as shown by a main effect of *product environmental impact* ($F(1, 1685) = 120.997$, $p < .001$, $d = .51$). Furthermore, participants were more willing to purchase utilitarian ($M = 3.43$, $SD = 1.89$) as compared to hedonistic products ($M = 2.47$, $SD = 1.55$), as pointed out by a main effect of *product function* ($F(1, 1685) = 145.879$, $p < .001$, $d = .56$). Money earned through work ($M = 3.04$, $SD = 1.84$) was more likely to be spent than money received as a windfall ($M = 2.87$, $SD = 1.74$), as shown by a main effect of *source of income*, ($F(1, 1685) = 4.595$, $p = .032$, $d = .09$). Finally, money with a green label ($M = 3.20$, $SD = 1.86$) was more likely to be spent than money without a green label ($M = 2.70$, $SD = 1.69$), as indicated by a main effect of *income label*, ($F(1, 1685) = 38.890$, $p < .001$, $d = .28$).

Confirming our hypotheses, participants were more likely to spend green-labeled income on environmentally friendly products ($M = 3.75$, $SD = 1.89$) than income not explicitly labeled as green ($M = 3.03$, $SD = 1.74$, interaction *income label* $\times$ *product environmental impact*, $F(1, 1685) = 7.846$, $p = .005$, $\eta^2_p = .005$). This interaction was subsumed under a three-way interaction of *income label*, *product function* and *product environmental impact*, which revealed that this effect was mainly driven by utilitarian environmentally friendly products ($F(1, 1685) = 7.165$, $p = .008$, $\eta^2_p = .004$, Figure 1).

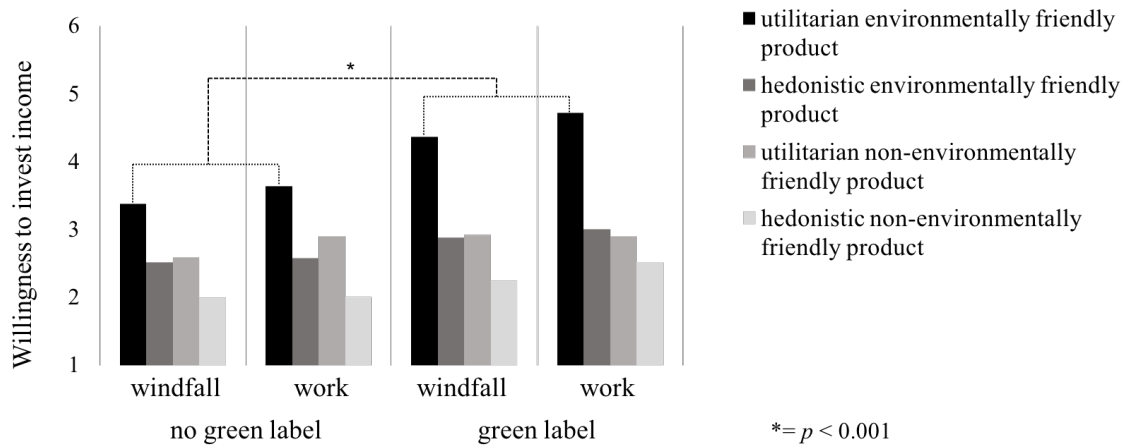


Figure 1: Willingness to spend an income on a utilitarian environmentally friendly product was enhanced by a green labeling of the income.

Analysis of simple effects showed that willingness to purchase a utilitarian environmentally friendly product was higher for participants receiving income with a green label as compared to participants receiving income without such a label, whereas no such difference was found for the utilitarian non-environmentally friendly product (utilitarian environmentally friendly product: $M_{\text{green label}} = 4.55$, $SD_{\text{green label}} = 1.82$; $M_{\text{no green label}} = 3.51$, $SD_{\text{no green label}} = 1.76$, $F(1, 1685) = 42.978$, $p < .001$; utilitarian non-environmentally friendly product: $M_{\text{green label}} = 2.92$, $SD_{\text{green label}} = 1.75$; $M_{\text{no green label}} = 2.74$, $SD_{\text{no green label}} = 1.68$, $F(1, 1685) = 1.137$, $p = .286$). In contrast to previous works, no interaction between income source and product function was observed, $F(1, 1685) = .484$, $p = .487$.

In order to test for an influence of biospheric value differences on decision-making as a function of the labelling intervention in the task, we calculated a linear regression, predicting the influence of *biospheric values*, *income label*, *product environmental impact* and the interactions of the three factors on the willingness to spend the 100 Euros. Replicating the results from the ANOVA, the regression analysis showed that green labeled income ($\beta = .14$, $p < .001$) and positive environmental impact ($\beta = .24$, $p < .001$) were associated with increased willingness to purchase. While higher biospheric values were associated with an increased willingness to purchase ($\beta = .06$, $p = .017$), we did not observe an interaction between biospheric values and income label, indicating that the effect of labeling the income



was observed independently from participants' value orientation ($\beta = .004, p = .855$). Moreover, participants with higher biospheric values were more likely to purchase environmentally friendly products ($\beta = .08, p = .001$), and green labels especially effective for environmentally friendly products ($\beta = .07, p = .005$). The three-way interaction did not reach statistical significance ($\beta = -.02, p = .309$).

Discussion

Consistent with our expectations, individuals reported a higher willingness to spend green-labeled income on environmentally friendly products than income without a green label. As hypothesized, this was particularly true for utilitarian environmentally friendly products. These findings are consistent with previous research from behavioral economics showing that depending on the source, people put income into different mental accounts, which then influences the way the money is used (Thaler, 1999; 2008). Pointing out the potential of this effect for future interventions, the green label nudge was observed independently of participants' biospheric value orientation, which suggests that it may operate on people with high and low explicit interest of acting in an environmentally friendly manner alike.

While this experiment provides first evidence for a green labeling nudge and its overall effectiveness, its potential merits for interventions in practice remains uncertain, as the task consisted of a fictitious scenario. We approached this issue in Experiment 2, by replicating our main finding in a more ecologically valid setting.

Experiment 2

The objective of Experiment 2 was to replicate the main result from Experiment 1 – that a green labeling of income can increase purchases of utilitarian environmentally friendly products – in a real-world field setting. We aimed at keeping all experimental variables as close to Experiment 1 as possible. However, in contrast to Study 1, participants had to actually carry out a work task in the “work” conditions of Study 2 and saw all four products instead of only one. The work task was labeled as green or not. In the “windfall” conditions, participants received a bonus (labeled as green or not) and thus could skip the work task in order to directly advance to the choice task. In the choice task, participants were asked to



choose one out of the four products used in Study 1 and had the opportunity to win the chosen product in a lottery. Both changes, applying an actual work task as well as providing the opportunity to actually win the chosen product, increased ecological validity in Study 2.

Methods

Participants

Participants were recruited at an open house organized by the University of Geneva. At this event, several hundred people participate each year, and a large number of research groups from various faculties present their research in an easily accessible manner⁵. Potential participants were approached and asked if they would like to participate in a prize-draw, with the possibility to win a product of their choice. No information or indications concerning the particular experiment were visible for participants until they began completion of the study. Only adults were included in the final sample, resulting in a total of 330 participants between 18 and 91 years (59% females, $M_{\text{Age}} = 42.64$, $SD_{\text{Age}} = 15.34$).

Materials and experimental design

Each participant began by spinning a wheel of fortune. Matching the field they met, they were randomly assigned to one of four conditions. In the *green work* condition, participants had to perform a work task on the computer, which consisted of two separate parts. In the first part, different waste items had to be virtually dragged and dropped into the matching recycling category. Participants could only continue after having performed this task correctly. We then told participants that if they watched five randomly presented advertisings clips for 15 seconds each, we would moreover transfer an unspecified amount of money to an environmental organization. The advertisings referred, for example, to a zoo, a watch brand and a crayons brand, and were kept as neutral as possible. The purpose of these two tasks was to give participants the impression to contribute to the protection of the environment by performing several work tasks. In the *non-green work* condition, participants had to drag various colored forms into their matching category. Subsequently, they viewed the same advertisings as participants from the *green work* condition; however, no connection to

⁵ <http://www.ville-ge.ch/lanuitdelascience/presse.html>



an impact on the protection of the environment was made. In the *non-green windfall* conditions, participants were informed that they received a free ticket allowing them to continue directly to the prize draw, without having to perform any further task. In the *green windfall* condition, participants received the information that their ticket is meant to be spent on an environmentally friendly product, but that they are nevertheless free to choose any product they want. Afterwards, participants conducted the choice task. They were asked to choose one out of the four products they would like to win in case their lottery ticket was drawn in the prize draw. The presented products were identical to Experiment 1. At the end of the study, we provided information about the study and its objectives.

Results

We first calculated a multinomial logistic regression with *product choice* as dependent variable and *source of income*, *income label* and their interaction as predictors. Given that the results from Experiment 1 pointed to a potential difference between the to utilitarian products, we chose the non-environmentally friendly utilitarian product (microwave) as the reference category (see Field, 2010). Contradicting our assumptions, however, the overall model showed no statistical significance for *source of income* ($\chi^2(3) = 1.004, p = .800$), *income label* ($\chi^2(3) = 3.366, p = .339$) or their interaction ($\chi^2(3) = 1.004, p = .638$).

A look at the individual parameter estimates did however reveal that *income label* marginally predicted whether someone chose the utilitarian environmentally friendly or non-environmentally friendly product, ($b = .756$, Wald $\chi^2(1) = 3.165, p = .075$). Thus, a green label marginally promoted environmentally friendly choices⁶. To follow up on this observation, we conducted a binary logistic regression for each product separately. The dependent variable was whether participants did or did not choose the specific product, *source of income*, *income label* and their interaction were included as predictors. Table 1 shows the results of the four regression analyses. The analyses show, congruent with the results of the multinomial logistic regression, that *income label* had a marginally significant impact on the likelihood to choose a utilitarian environmentally friendly product, indicating that participants receiving income with a green label were more likely to choose such a product ($\beta = .65, p = .079$). This finding replicates the main finding of Experiment 1, and, given that we specified a

⁶ Statistical significance of all other individual parameter estimates $> .230$.



directed hypothesis, a one-tailed p -value ($p_{\text{one-tailed}} = .040$) may be considered (Cho & Abe, 2013), which would be consistent with traditional cut-offs of statistical significance. No other statistically significant effects were detected.

Table 1. Individuals receiving green-labeled income more often chose the utilitarian environmentally friendly product

	predictors	B	$SE\ B$	Odds Ratio	95 % CI for Odds Ratio	p
<i>utilitarian environmentally friendly</i>	constant	−1.49	.30	.23	—	< .001
	income label	0.65	.37	1.92	0.93, 3.96	.079
	source of income	0.55	.39	1.74	0.81, 3.73	.154
	income label x source of income	−0.61	.51	.54	0.20, 1.47	.230
	$R^2 = .02$ (Nagelkerke). Model $\chi(3) = 3.80, p = .284$					
<i>utilitarian non-environmentally friendly</i>	constant	−2.01	0.36	.13	—	< .001
	income label	−.54	.53	.59	0.21, 1.65	.312
	source of income	−.03	.50	.97	0.36, 2.60	.953
	income label x source of income	−.02	.36	.98	0.22, 4.40	.981
	$R^2 = .01$ (Nagelkerke). Model $\chi(3) = 2.06, p = .560$					
<i>hedonic environmentally friendly</i>	constant	.43	.24	1.53	—	.069
	income label	−.30	.31	.74	0.40, 1.36	.332
	source of income	−.38	.33	.69	0.36, 1.30	.249
	income label x source of income	.49	.44	1.62	0.68, 3.86	.273
	$R^2 = .01$ (Nagelkerke). Model $\chi(3) = 1.54, p = .673$					
<i>hedonic non-environmentally friendly</i>	constant	−2.29	.40	.10	—	< .001
	income label	.02	.53	1.02	0.36, 2.88	.971
	source of income	−.03	.56	.97	0.32, 2.92	.959
	income label x source of income	−.13	.77	.88	0.20, 3.98	.870
	$R^2 < .01$ (Nagelkerke). Model $\chi(3) = 0.10, p = .992$					



Discussion

In Experiment 2, we set out to replicate in a more realistic setting the observation that a green label enhances the likelihood of spending an income on a utilitarian environmentally friendly product. Bearing in mind the marginal statistical significance, we were able to show once more that people who received an income that was labeled as green were more willing choose an utilitarian environmentally friendly product as compared to those receiving an income without such a label. This finding lends further support to the idea that a green label plays an important role when it comes to purchase decisions of energy-efficient appliances. Potentially limiting factors are reviewed in the general discussion.

General discussion

Even though most people are concerned about climate change (GlobeScan, 2016), they often act in a non-environmentally friendly manner. This discrepancy between concerns/internal values and behavior can be attributed to the value-action gap (Kollmuss & Agyeman, 2010). Complementing previous research by focusing on the income used to acquire a product rather than on the product per se, we studied whether labeling a windfall or a work-related income as green could enhance consumers' spending on environmentally-friendly products and thus help to overcome this gap.

Across an online experiment (Experiment 1) and a field experiment (Experiment 2), we found evidence that attaching a green label to a windfall or work-related income augments people's willingness to purchase environmentally friendly products, in particular when these products have a utilitarian function. These findings are in line with our hypotheses that individuals strive to keep the domain and the seriousness of money and its spending in accord (Helion & Gilovich, 2014; Henderson & Peterson, 1992; O'Curry & Strahilevitz, 2001) and that as a consequence, the purchase of a (serious) utilitarian environmentally friendly product is particularly promoted by a green labeling. The results are consistent with the concept of mental accounting, which suggests that money is more likely spent on something matching its label (Thaler, 1999; 2008). Whereas this has been shown in various contexts (Helion & Gilovich, 2014; Henderson & Peterson, 1992; O'Curry & Strahilevitz, 2001), we demonstrate here that it is also an effective lever to push people towards environmentally friendly purchases and energy-efficient appliances in particular. Our results support the assumption



that people adapt their purchases as a function of the label of a specific income. We therefore provide further evidence for the presence of mental accounting in daily life and its impact on everyday decisions. Our findings speak against the notion of source independence posited by early economic models (Loewenstein & Issacharoff, 1994).

Importantly, we found the intervention to be effective across individuals varying broadly with regards to their biospheric value orientation. This is essential information in the context of intervention design, when broad ranges of individuals are targeted. One reason for the observed independence could be that green labels might steer people's attention towards the environmentally friendly options, which in turn may affect their preferences and choices. Such a signpost mechanism would be similar to the function ascribed to values (Steg, 2016). Thus, values may not add any further behavioral influence in this case, resulting in the observation that all individuals are nudged similarly and independently from their biospheric values towards an environmentally friendly behavior. However, this conclusion remains somewhat speculative for now.

Several practical implications can be derived from the results. For instance, many countries require their taxpayers to submit a tax declaration each year. Given the existence of a large number of possible refundable tax credits, many households are eligible for such tax refunds from the government. In view of the ambitious climate targets that countries aim to achieve, our results suggest that such tax refunds from the government could either be labeled as “green” or “ecological” tax refunds, or at least be completed with a note on how to spend this additional income in favor of the environment. Desirable purchases that may be promoted in such a context may be, for example, purchases of energy-efficient residential appliances, the installation of solar photovoltaic systems to produce electricity, or thermal insulation of one's home. In addition to that, some countries, including Switzerland, have introduced a CO₂ levy, which is an incentive tax that has been imposed since 2008 (Swiss Federal Office for the Environment, 2017). About two thirds of the generated revenue from this CO₂ levy is redistributed to the general public mainly through a reduction of the health insurance costs. However, overall awareness of the reimbursement of the CO₂ levy via the health insurance is rather low (Ebers & Wüstenhagen, 2016). Our results suggest that the visibility of the reimbursement of the CO₂ levy should be enhanced, e.g. by separately paying out the reimbursement and explicitly labeling it as “ecological reimbursement of the CO₂ levy”.



Furthermore, our results could be translated into practice by actors at the level of companies. Suppose a company is earning profits and wishes to return some of these profits to its shareholders or to pay their employees a bonus. Relabeling a shareholder dividend or an employee bonus as a “green” dividend or bonus could help to make beneficiaries rethink how to spend the additional income and consider spending the money on environmentally friendly products. A further practical application on the side of businesses could be that (electronics) retailers attach a green label to their available coupons and loyalty discounts, to be redeemed for the purchase of energy-efficient products. More application opportunities are a state “green” lottery, at which money can be won for a house renovation, “green” life insurance paid out at pension age or green-labeled heritages. Importantly, adding a label is almost free of costs and, as shown by our findings, effective across all levels of biospheric value orientation.

In both experiments, label effects were independent from whether people had to work for the money or got it as a windfall without any effort. Based on previous work, we expected that money earned through work is more likely to be spent on utilitarian products in general, while money received as a windfall is more likely to be spent on hedonistic products (Helion & Gilovich, 2014; Henderson & Peterson, 1992; O'Curry & Strahilevitz, 2001). Possible methodological reasons for our failure to replicate this result are the relatively short working task and the fact that participants were free in their choice whether they wanted to participate in our experiment or not. Due to the voluntary nature, the task may have lost some of its work characteristic. Nevertheless, during the course of Experiment 2 participants from the working condition did realize that others could directly continue to the lottery, which should have made the working task less pleasant.

The findings are to be interpreted in the light of some limitations. As already discussed, the results of Experiment 2 only meet statistical significance, when a one-sided significance value was applied. Even though this could be perceived as justified by the directed hypothesis, it could also be interpreted as “cherry picking” for significance. Because the field experiment was conducted in a natural setting, several factors were left non-controllable, potentially influencing statistical significance. For example, participants could have interacted with each other and were aware of other conditions. The work condition was rather unpleasant, potentially leaving participants with negative feelings. This is especially the



case because participants were aware of other people going straight to the lottery. However, exactly these reasons one might as well argue that the findings illustrate a strong underlying mechanism with robust effects across various situations. Moreover, the observed effect sizes were rather small in both experiments. Given the fictitious character of the task in Experiment 1 and the potential influence of undesired non-controllable factors in Experiment 2, this is not surprising. However, translating the odds ratio of 1.92 from Experiment 2 into real life data, one may project that the yearly investment of CHF 162 million in LED in Switzerland (Swiss Federal Office of Energy, 2016) could be enhanced to up to CHF 311 million per year by adding a green label. This calculation exercise nicely demonstrates how a small effect can be meaningful in real life.

Taken together, our results show first evidence that a green label can ‘nudge’ people to spend a particular income on environmentally friendly products. Given that individuals keep their freedom of choice, in that they can decide autonomously how to spend the income, our intervention meets the requirements to be classified as a nudge. Importantly, a green labeling nudge is not only a cost-efficient approach, but as suggested by our findings also effective across people with different attitudes concerning nature and the environment. Our findings yield direct recommendations for a cost-effective step towards overcoming the value-action gap.

Future studies approaching in more detail the underlying psychological mechanism may increase the understanding of how label affect people’s decision making and help to appropriately apply green labels in practice.



3.3. Study 3: Actions that matter: Specific environmental impact knowledge and core values shape mental representations and moral evaluations of environmental actions

Global climate change can be mitigated by adopting a more environmentally friendly lifestyle on the individual level. This requires that individuals become sensitive to the environmental impact of their actions. We tested the effect of an online intervention providing information about the environmental impact of a number of actions on participants' mental representations and moral judgments of these actions. Using multidimensional scaling, we showed that the intervention led to a more differentiated mental representation of actions based on their impact. We also found evidence for more differentiated moral judgments after the intervention. High biospheric values were associated with deontological black-and-white thinking which diminished participants' sensitivity to environmental impact, while egoistic values were associated with a dissociation between mental representations and moral judgments: Egoistic participants learned which behaviors were more impactful, but did not update their moral judgments.

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Introduction

Climate change is a major problem of our time, not only affecting the environment, but also expected to contribute to social problems such as political instability and resource conflicts (IPCC, 2014). Even though these consequences will directly or indirectly affect each individual, human actions are to a large extent environmentally unfriendly and sum up to an unsustainable lifestyle. This is especially unsatisfactory given that a considerable reduction of carbon emissions could be achieved by consequently realizing a small number of highly effective behaviors. More than 120 million tons respectively 7.4% of greenhouse gas emissions in the United States could be saved each year with the help of already existing strategies and without the need for new regulatory measures (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009). For example, replacing existing car fleets with more efficient models would lead to a drastic emission reduction. One-shot investment actions are often more effective than continuous curtailment behaviors such as covering short distances by foot or bicycle. However, both types of behavior combine to make up for the most effective action pattern, and both are needed (Dietz et al., 2009).

Adopting highly effective behavioral changes on the individual level requires that individuals are sensitive to the environmental impact of their actions. They need to know which actions are most effective and thus particularly desirable. However, knowledge related to the environment has been shown to be generally low (Attari, DeKay, Davidson, & Bruine de Bruin, 2010), indicating that providing specific knowledge about the impact of environmental actions might be a promising intervention strategy.

In addition to increasing environmentally relevant knowledge, it is highly relevant to ascertain that the acquired knowledge translates into a motivation to act. Classic theories of environmental behavior emphasize that environmentally friendly behavior is strongly motivated by a personal moral obligation to act (Steg & Vlek, 2009; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Thus, people need not only to have knowledge about highly effective behaviors, but should additionally perceive these behaviors as morally more desirable. This has been confirmed by research focusing on climate change as an ethical and moral issue (Broome, 2008), showing that moral evaluations are an important factor influencing pro-environmental behaviors (Knez, 2016; Steg & Vlek, 2009). Thus, in order to examine the relevance of environmental knowledge and knowledge-based interventions, it is



necessary to investigate their effects on direct antecedents of environmentally friendly behavior such as moral judgments.

Whether provided knowledge will be taken into account and translated into moral judgments and motivations is strongly determined by an individual's core values (Bolderdijk, Gorsira, Keizer, & Steg, 2013). Information is considered in a more open-minded manner if consistent with one's values (Kahan, Jenkins Smith, & Braman, 2011) and arguments are evaluated more positively if confirming prior beliefs (Edwards & Smith, 1996). Activating environmental values leads to evaluations of products as more environmentally friendly, even in the presence of explicit product information (Hahnel, Ortmann, Korcaj, & Spada, 2014).

Taken together, providing individuals with specific knowledge about the environmental impact of their actions might be a promising tool to initiate behavior change. In the present research, we provided participants with information about the environmental impact (low vs. high) of a variety of relevant behaviors and investigated whether this knowledge intervention affected participants' mental organization of these actions using the Multidimensional Scaling (MDS) methodology. We moreover tested whether the intervention affected how participants evaluate these actions in terms of their moral desirability. Given the influence of core values on information acquisition and judgment, we expected intervention effects to vary as a function of participants' values.

Knowledge and mental representations

Various person-related and situational determinants have been discussed as potential levers to motivate people toward sustainable behavior (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014). Amongst these, poor education has been put forward as one cause of unsustainable behavior and a profound education resulting in better knowledge been suggested as one solution to increase sustainability (Orr, 2004). However, reviews suggest that one's general knowledge about environmental issues has only little impact on environmentally friendly behaviors (Kollmuss & Agyeman, 2010). Nonetheless, more recent research suggests that a more differentiated view of distinctive forms of knowledge is required when seeking for an impact of knowledge on environmental behavior (Fielding & Head, 2012). According to a classification by Kaiser and Fuhrer (2003), environment-related knowledge can be divided into four types. Besides knowing how the environmental system



works (*declarative knowledge*) and what the motives and intentions of others are (*social knowledge*), the knowledge of how to achieve a specific conservation goal (*procedural knowledge*) and the awareness of different ecological consequences (*effectiveness knowledge*) are crucial. Both procedural and effectiveness knowledge relate to specific actions, i.e., knowing how one can achieve a goal and knowing how effective an action is. Such action-specific knowledge is related to responsible environmental behavior, indicating that specific knowledge about the effectiveness of certain actions can not only foster problem awareness, but also lead to behavior change (Hempel, 2014). Supporting the relevance of action-specific knowledge, missing self-efficacy has been identified as one major barrier between knowledge and behavior change, referring to the fact that individuals often perceive that a change in their own individual behavior is not sufficient to mitigate climate change (Hempel, 2014). Indeed, teaching knowledge about effective action strategies has been shown to result in more conservation behavior and less behavior with negative environmental impact compared to a control group (Asch & Shore, 1975).

People store information about the world in a structured way in their memory systems and retrieve the information as needed to guide their interactions with the environment (Grimm, 2014). Acquiring specific behavioral knowledge can be expected to have an impact that is observable at the level of an individual's mental representations of the world. Previous research shows that the mental representations of specific domains tend to vary with one's level of expertise. For example, using MDS it was shown that the mental organization of knowledge and skills differs between experienced soldiers and novices (Hubal, 2009). In a different domain, more experienced bank clerks used more dimensions to represent the concept of money, demonstrating a higher degree of mental differentiation for money compared to a student sample (Lotto, Rubaltelli, Rumiati, & Savadori, 2006).

Linking mental representations to concrete choices and behaviors, the concept of *mental accounting* from the behavioral economics literature refers to the fact that people create a number of different mental categories to organize their consumption activities, for example, to divide their incomes and expenditures across different budgets (Heath & Soll, 1996; Thaler, 1999). Variations in the organization of mental accounts can have a large impact on behavior. For instance, participants are more likely to buy a ticket at the box-office, if they previously lost a bank note than if they lost a pre-purchased theater ticket (Tversky &



Kahneman, 1981). Thus, people stop spending money in a specific domain once the respective mental account has been depleted, even though they might still have financial resources at their disposition, violating the classic economic notion of fungibility of money (Thaler, 1999). In a recent study, it was tested whether mental accounting principles can be similarly applied to pro-environmental behaviors (Chatelain et al., 2018). Indeed, participants were shown to be slightly less willing to perform a second pro-environmental behavior after having performed a first one if the similarity between the behaviors was high, suggesting that people categorize their environmental behaviors according to mental accounts and use these categories to justify behavioral compensation mechanisms. A more differentiated mental representation of environmental actions based on acquired knowledge about their impact may thus lead to increased pro-environmental action by (i) allowing for the selection of more impactful behaviors, and (ii) reducing potential negative spillover effects (Truelove, Carrico, Weber, Raimi, & Vandenberg, 2014).

The relationship of environmental knowledge, morality, and core values

The complexity and abstractness of global climate change serve as an additional contributing factor to the identified gap between knowledge and behavior. While knowledge about the issue often exists, it sometimes fails to evoke feelings of personal responsibility and moral relevance. Climate change has an impact in particular on impoverished countries (IPCC, 2014). For Western civilizations, however, it primarily constitutes an abstract issue, with severe effects expected rather for future generations. This psychological distance may lead to the perception that oneself and one's in-group are unaffected, reducing the moral obligation to act (Markowitz & Shariff, 2012). Overcoming these barriers by increasing the moral relevance of acting against climate change could effectively promote pro-environmental behavior (Markowitz & Shariff, 2012). In the present research, we examined whether providing action-specific knowledge also influences individuals' judgments of the moral relevance of the respective actions.

The moral evaluation of environmental actions strongly links to an individual's core values. Individuals differ in their appreciation of nature and the degree to which they value environmentally friendly behaviors. Individuals are more likely to act environmentally friendly when they endorse biospheric values and less likely to do so when they endorse



egoistic values (Steg, Bolderdijk et al., 2014). Intuitively, one could assume that people with strong biospheric values have better environmental knowledge and are more capable to differentiate between low and high impact environmental behaviors. However, knowledge and biospheric values are not positively related (Bolderdijk et al., 2013). Moreover, consistent with a deontological reasoning style, differential sensitivity to the effectiveness of actions is smaller in individuals high in biospheric values (Bartels, Bauman, Cushman, Pizarro, & McGraw, 2015). Individuals using a deontological reasoning style place less relevance on the costs and benefits as well as the overall consequences of a behavior, but base their moral judgments on defined rules and principles (Gamez-Djokic & Molden, 2016). For example, individuals who apply deontological principles judged it unacceptable that companies buy pollution rights even if this measure would result in an overall reduction in pollution (Bartels et al., 2015) and more likely rejected a cap-and-trade program, which would have led to positive overall environmental benefits (Sacchi, Riva, Brambilla, & Grasso, 2014). It closely links to the concept of *sacred* values (Tetlock, 2003), which refers to the idea that individuals carry values that are inviolable and inaccessible to compromises. In this line, environment-related sacred values have been associated with a reluctance towards trade-offs and an unwillingness to accept any incentives to change behavior (Tanner, 2009). Thus, higher biospheric values can be expected to be negatively related to a differentiation of low and high impact behavior. This pattern should encompass the mental organization of these actions as well as judgments of their moral desirability, which can rather be expected to be based on a pronounced differentiation of environmentally friendly versus unfriendly behaviors, relatively independent of the impact strength of these actions.

Egoistic values are related to a strong emphasis on the personal costs and benefits of environmental behaviors. It should therefore be important for egoistic individuals to distinguish accurately between behaviors with different impacts and only act environmentally friendly if the perceived benefits exceed the costs. However, even though people with higher egoistic values are expected to distinguish between high and low impact behaviors at the level of mental representations, previous research points toward a more homogeneous moral evaluation for these individuals. People with strong egoistic values do not see climate change as a moral matter, but rather as question of individual beliefs (Knez, 2016). Environmentally friendly actions in themselves are thus not seen as a moral imperative, but are only considered



as moral if they satisfy the intrinsic needs of the individual (Schroeder, Roskies, & Nichols, 2010). Following this rationale, egoistic individuals can be expected to differentiate stronger between low and high impact environmental behavior at the level of mental representations, but to differentiate less at the level of moral judgments.

In addition to general effects of values, the question arises whether egoistic and biospheric values moderate the effects of knowledge interventions. Previous research has shown that values act as a filter that biases which information is acquired and how it is interpreted (Hahnel et al., 2014). Moreover, people have been shown to focus in particular on characteristics of environmentally relevant behaviors that are central for their core values (Steg, Perlaviciute, Van der Werff, & Lurvink, 2014). We therefore considered the possibility that the impact of our knowledge implementation may additionally be influenced by an individual's predominant values. Biospheric values are expected to strengthen the impact of the intervention on mental representations and/or moral judgments, as these values should increase the focus on environmentally relevant issues. Egoistic values, on the other hand, are expected to decrease the impact of the intervention, as the focus here is more on an individual's self-interest.

The current study

We investigated the impact of a knowledge intervention centered on the environmental impact of a set of environmentally relevant actions on participants' mental organizations of these actions as well as their moral evaluations. The task included twelve mobility-related behaviors which had either a high or low environmentally friendly or harmful impact. In the experimental condition, these aspects were made salient and explicit, while in the control condition only general information was given (for an example see Figure 1, the complete set of behaviors can be found in the Appendix). In order to assess the mental representations of the different actions after the intervention, participants rated all pairwise combinations of the twelve behaviors regarding their environmental similarity. Using MDS, we analyzed each participant's individual organization of the actions in a multidimensional space (Grimm, 2014; Markman, 2012). Thus, we computed the extent to which each participant bases its mental organization of the actions on their environmental impact, or alternatively on their environmental friendliness/unfriendliness in general. In addition to the similarity ratings, we



assessed participants' moral judgments of the individual actions. To this end, participants were asked to rate the twelve behaviors regarding their moral desirability in a follow-up questionnaire. In order to avoid potential priming effects, participants completed this second questionnaire one week after the first.

We hypothesized that the knowledge implementation would lead to a stronger differentiation based on the impact of the behavior both concerning mental representations (*Hypothesis 1a*) and morality judgments (*Hypothesis 1b*). Moreover, we expected core values to impact mental representations and moral evaluations: Participants with higher biospheric values should differentiate less between high and low impact behaviors concerning both their mental representations (*Hypothesis 2a*) and their morality judgments (*Hypothesis 2b*). Participants with higher egoistic values should differentiate more between high and low impact behaviors at the level of their mental representations (*Hypothesis 3a*), but have a more homogeneous moral evaluation (*Hypothesis 3b*). Finally, we expected interactions between knowledge intervention and core values in that effects of the intervention were expected to be strengthened by biospheric values (*Hypothesis 4a*) and weakened by egoistic values (*Hypothesis 4b*).

Methods

Participants. Participants from Germany were recruited via a panel provider and financially compensated for their participation. The study was based on two units (duration in minutes: $Mdn_{study1} = 19.42$, $Mdn_{study2} = 7.98$). In total, 510 participants (51% females), between 19 and 80 years completed the first questionnaire ($M_{Age} = 44.68$, $SD_{Age} = 15.29$). Out of this sample, 409 individuals (48% females, $M_{Age} = 48.72$, $SD_{Age} = 15.07$) between 19 and 80 years completed the second study unit about one week later ($M = 8.61$ days; $SD = .64$ days). Several months before completing the first unit, participants had filled in a self-report measure of values (Steg, Perlaviciute et al., 2014). The research was approved by the ethics committee of the University of Geneva. To ensure data quality, two quality check items were included in the questionnaire (i.e., “Please click on “9 very similar” to confirm that you are actually reading the questions”). Due to incorrectly answered quality check items 8.88% of participants were excluded from the dataset.



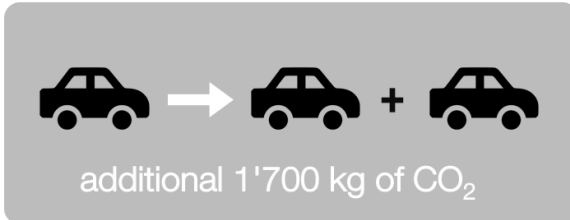
Experimental design and materials. The study was based on a factorial between-subjects design with the factor *knowledge implementation* (knowledge implementation vs. control condition) and the continuous independent variables *biospheric values* and *egoistic values*. Dependent variables were *similarity ratings* and *moral judgments*.

Knowledge implementation. Participants were randomly assigned to the knowledge implementation or the control condition. All participants were given the task to study twelve mobility related behaviors, which were either environmentally friendly or unfriendly (*impact direction*) and had either low or high environmental impact (*impact strength*). Behaviors were based on previous studies (Dietz et al., 2009; Kaiser & Wilson, 2004), and phrased such that the precise amount of CO₂ saved or the amount of additional CO₂ emitted could be determined for each behavior in kilograms per year. Each of the four categories (environmentally friendly high impact behavior, environmentally friendly low impact behavior, environmentally harmful high impact behavior, environmentally harmful low impact behavior) consisted of three individual behaviors (see Appendix for a complete list of the behaviors).

Examples for the experimental group were “Replacing a 12-year-old car (e.g. VW Golf 3) with a modern compact car (e.g. VW Polo) saves about 1700 kg of CO₂ per year” as an *environmentally friendly high impact behavior*, “Consequently turning of your engine when stopping in front of a red traffic light saves about 85 kg of CO₂ per year” as an *environmentally friendly low impact behavior*, “Doing the daily commute (50km distance) by car instead of train produces about 1500 kg of CO₂ per year” as an *environmentally harmful high impact behavior* and “Driving with insufficient tire pressure produces about 30 kg of additional CO₂ per year”, as an *environmentally harmful low impact behavior*. All behaviors were illustrated by icons depicting the particular action (see Figure 1).

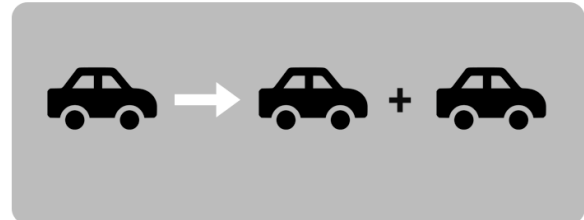


Experimental group:



Buying a second car (VW Polo) for the family produces about 1'700 kg of additional CO₂ per year

Control group:



Buying a second car (VW Polo) for the family

Figure 2: Example of an environmentally harmful high impact behavior, presented to the experimental group (left panel) and the control group (right panel).

Participants in the experimental group learned about the impact of a behavior and the exact amount of saved or additionally produced CO₂, while participants in the control condition were only presented with the general environmental impact without any numeric information. Thus, they were only informed whether the behavior was environmentally friendly or unfriendly, but did not receive any information about the respective strength of the environmental impact.

To control whether the learning process was successful, participants from both conditions were asked to indicate for all twelve behaviors whether they were environmentally friendly or unfriendly and whether the behaviors had high or low impact on the environment. To reinforce learning, in the experimental condition attention was drawn to incorrectly indicated behaviors and participants had to repeat the task until they performed it without error. No feedback was provided to the control group. The number of correct answers in the first response attempt for each trial was recorded for each participant in order to check whether the experimental manipulation effectively increased relevant knowledge.

Similarity ratings. The mental representations of the different behaviors were assessed using similarity ratings. To this end, we presented each possible pair-wise combination of the 12 behaviors (i.e. in total 66 combinations) and asked participants to indicate the extent to which the presented pairs of behaviors are similar in terms of their environmental friendliness (“How similar do you rate the two behaviors concerning their environmental friendliness?”). Following the recommendations by Borg, Groenen and Mair (2013), we used a Likert scale ranging from 1 (*not similar at all*) to 9 (*very similar*).



Morality judgments. In order to assess differences in moral judgments, participants rated the extent to which they perceive the twelve behaviors task as being moral or not (“How moral do you rate the following behavior?”). Ratings were based on a bipolar scale ranging from –3 (*very immoral*) to 3 (*very moral*).

Individual value differences. Biospheric and egoistic value orientation were assessed using the items from Steg, Perlaviciute and colleagues (2014) (biospheric values, e.g.: “RESPECTING THE EARTH: harmony with other species”, egoistic values, e.g.: “AUTHORITY: the right to lead or command”). Participants rated each value concerning how important it is as guiding principle in their life. Responses were assessed using a scale from 0 (*not important at all*) to 7 (*supreme importance*), with the possibility of indicating –1 for items which were opposed to their guiding principles.

Procedure. In the first questionnaire unit, participants read the instructions and provided informed consent. Participants were then randomly assigned to one condition and learned about the behaviors and their impact either in a more specific (experimental condition) or in a more general manner (control condition). Participants then rated all behavior pairs with respect to their similarity. About one week after the first study unit, participants answered a second questionnaire, assessing the morality judgments for all twelve behaviors.

Data analysis

Similarity ratings. To map the similarity ratings into a multidimensional space, we used the proximity scaling function (PROXSCAL) from SPSS 24 with an initial Torgerson configuration⁷ and set the iteration criteria as suggested by Borg and colleagues (2013). In line with our assumption of the two underlying dimensions *impact direction* (environmentally friendly vs. unfriendly) and *impact strength* (low vs. high), a scree-plot of stress measures indicated a large improvement in fit from an one-dimensional to a two-dimensional solution (Stress-1 reduction = .132), and a smaller improvement for a three-dimensional solution (Stress-1 reduction = .062). Based on these results, we chose a two-dimensional solution with a Stress-1 value of 0.226. We applied a weighted Euclidian scaling model (INDSCAL) to gain

⁷ Additional analyses showed no differences in stress measures when using a user-provided starting configuration instead of a random one.



more insights into interindividual differences in similarity ratings. This analysis allowed us to obtain individual weight scores for each of the two dimensions. Figure 2 illustrates the results of the MDS analysis across all participants, illustrating that participants used the dimensions *impact direction* (environmentally friendly vs. unfriendly) and *impact strength* (low vs. high) to organize their mental representation of the different behaviors. Given that a stronger weighting of the impact strength resulted in a weaker weighting of the impact direction, for subsequent analyses we calculated a ratio of the two redundant dimension-weights for each participant, hereafter referred to as the *priority of impact strength*. A higher value represents a stronger weighting of the impact strength dimension as compared to the impact direction dimension for the individual similarity judgments.

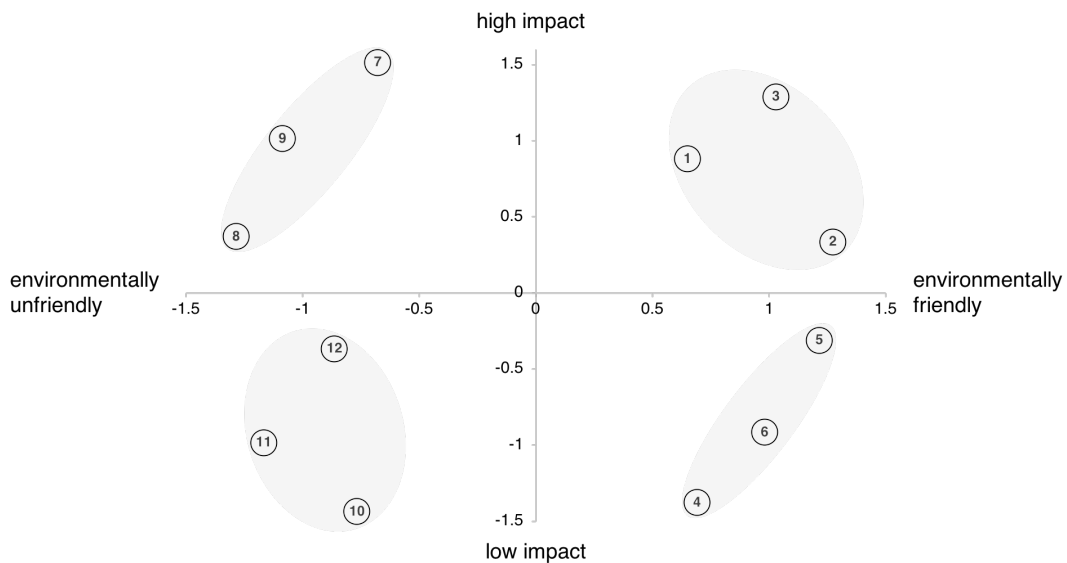


Figure 3: MDS-map across all participants illustrating that participants used the two dimensions *impact direction* (environmentally friendly vs. unfriendly) and *impact strength* (low vs. high) in their mental organization of the different behaviors. Numbers in circles refer to the specific behaviors mentioned in the Appendix.

Morality judgments. To assess to what extent participants morally differentiate between the different types of behaviors, two indices were derived from participants morality judgments. *Moral differentiation of impact direction* refers to the extent to which someone takes into account whether a behavior is environmentally friendly versus unfriendly in their moral judgments. This score was computed by subtracting the individual mean moral rating of environmentally harmful behaviors from the mean moral rating of environmentally friendly



behaviors ([mean moral rating of all environmentally friendly behaviors] – [mean moral rating of all environmentally harmful behaviors]). *Moral differentiation of impact strength* refers to the extent to which someone takes into account the impact strength of an environmentally relevant behavior (both positive and negative) in their moral judgments. This was computed by summing up the absolute differences between high and low impact environmentally friendly ([mean moral rating of all environmentally friendly high impact behaviors] – [mean moral rating of all environmentally friendly low impact behaviors]) and environmentally harmful behaviors ([mean moral rating of all non-environmentally friendly low impact behaviors] – [mean moral rating of all non-environmentally friendly high impact behaviors]).

Results

Supporting the effectiveness of our manipulation, an independent samples *t*-test showed that participants from the experimental condition classified more behaviors correctly ($M = 11.85$, $SD = .75$) into one of the four categories (environmentally friendly/unfriendly and high/low impact) than participants from the control condition ($M = 6.51$, $SD = 1.91$, $t(407) = 36.88$, $p < .001$, $d = 3.68$). To assess the influence of the knowledge implementation as well as of biospheric and egoistic values on the dependent variables similarity ratings and moral judgments, we conducted two independent path analyses using *R*-package *lavaan 0.5-20* (Rosseel, 2012).

Similarity representations. In the first model, we tested the assumption that the factors knowledge implementation, biospheric values and egoistic values influence the mental representations of environmentally relevant behaviors. Furthermore, we tested whether the expected relationship between knowledge implementation and similarity ratings was moderated by participants' biospheric and egoistic values (see Figure 3). Participants in the knowledge implementation group had higher values on the similarity rating ratio score ($\beta = .053$, $p = .002$), indicating that the knowledge implementation led to a stronger weight of the impact strength of a behavior (*Hypothesis 1a confirmed*). Similarly, participants with high egoistic values were more likely to base their similarity judgments on impact strength ($\beta = .027$, $p = .030$, *Hypothesis 3a confirmed*). In contrast, participants with high biospheric values were more likely to base their similarity judgments on the direction of the impact of a behavior



(environmentally friendly vs. environmentally unfriendly, $\beta = -.035$, $p = .007$, *Hypothesis 2a confirmed*). The effect of the specific knowledge implementation on the weight ratio was neither moderated by participants' biospheric values ($\beta = -.003$, $p = .839$, *Hypothesis 4a rejected*) nor their egoistic values ($\beta = .008$, $p = .516$, *Hypothesis 4b rejected*).

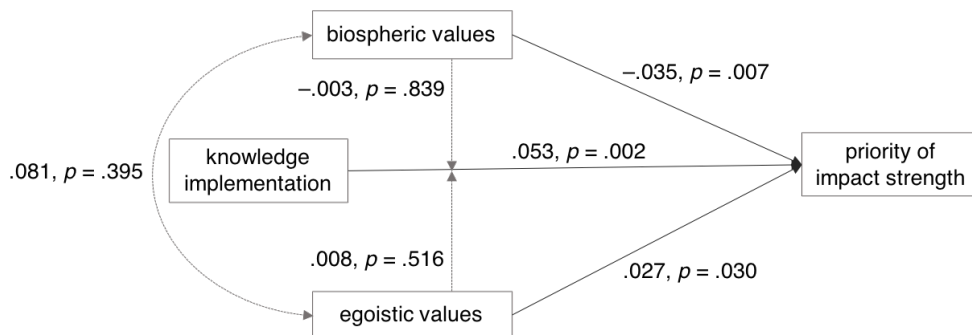


Figure 3: Specific knowledge and egoistic values are related to a higher, biospheric values to a smaller relative importance of the impact strength of an environmentally relevant behavior on individual mental representations.

Morality judgments. In the second model, we tested the assumption that our knowledge implementation task as well as biospheric values and egoistic values influence participants' moral judgment of environmentally relevant behaviors. Furthermore, we tested whether the expected relationship between knowledge implementation and morality judgments is moderated by participants' biospheric and egoistic values (see Figure 4). Knowledge implementation was linked to a more pronounced moral differentiation regarding environmentally friendly versus harmful behaviors ($\beta = .109$, $p = .040$) as well as a more pronounced moral differentiation regarding high and low impact behaviors ($\beta = .132$, $p = .036$, *Hypothesis 1b confirmed*). That is, the implementation task resulted in a stronger moral separation of environmentally friendly versus harmful as well as high versus low impact behaviors. Higher egoistic values were related to a less pronounced moral differentiation between high and low impact behaviors ($\beta = -.145$, $p = .008$), while no effect of egoistic values on the moral differentiation between environmentally friendly and unfriendly behaviors was observed ($\beta = -.054$, $p = .156$, *Hypothesis 3b partially confirmed*). Egoistic values moreover moderated the impact of the knowledge implementation on the moral differentiation between low versus high impact behaviors ($\beta = -.101$, $p = .046$, *Hypothesis 4b partially confirmed*) in that the impact of the knowledge implementation only



was statistically significant for people with low egoistic values ($\beta_{-1SD} = .274, p = .004$) but not for people with high egoistic values ($\beta_{+1SD} = -.002, p = .980$). Finally, higher biospheric values were related to a more pronounced moral differentiation regarding environmentally friendly versus unfriendly behaviors ($\beta = .229, p < .001$). No effect of biospheric values on the moral differentiation between high versus low impact behaviors was observed ($\beta = -.005, p = .900$, *Hypothesis 2b partially confirmed*).

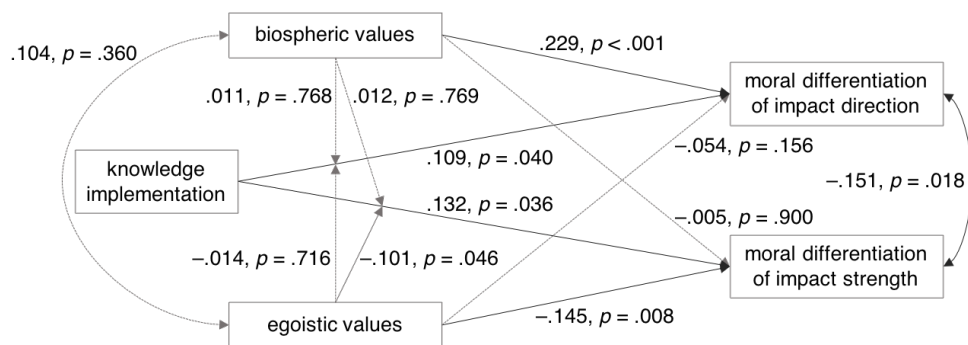


Figure 4: Specific knowledge increases the moral differentiation between environmentally friendly versus harmful behaviors as well as between high versus low impact behaviors. Biospheric values increase the moral differentiation between environmentally friendly versus harmful behaviors, while egoistic values decrease the moral differentiation between high versus low impact behaviors.

Discussion

Efficient behavioral strategies are needed to counter climate change and reduce the risk of detrimental consequences on nature and humans (IPCC, 2014). Encouragingly, simply by applying the most efficient energy strategies people can significantly contribute to the mitigation of climate change (Dietz et al., 2009). This requires that individuals are sensitive to the environmental impact of their actions and translate this knowledge into a motivation to act. Moral obligation has been put forward as a prerequisite for the motivation to act pro-environmentally, meaning that individuals should perceive environmentally friendly acts with a high impact as morally more desirable than actions with a low impact (Steg & Vlek, 2009; Stern et al., 1999). We studied whether an action-specific knowledge intervention strategy can improve individuals' capabilities to conceptually and morally distinguish between behaviors



with different environmental impacts. Results illustrate that the intervention led to a more differentiated mental knowledge organization and to more differentiated moral judgments.

More specifically, after participants learned about the environmental impact of a variety of actions, the mental representation of the actions depended more strongly on their impact strength. This is essential, as pro-environmental behaviors with a strong impact are especially effective in countering climate change. Importantly, the moral evaluation of the behaviors similarly changed after the knowledge intervention: After having learned about the specific environmental impact, people morally distinguished more between environmentally friendly and unfriendly behaviors as well as between high and low impact behaviors in their moral judgments. Thus, highly effective behaviors were simultaneously perceived as more morally desirable – an important antecedent of environmental actions (Markowitz & Shariff, 2012; Steg & Vlek, 2009).

Our findings confirm the assumption that action-specific knowledge interventions can promote sustainability by giving people an understanding of the environmental impact of different behaviors. The results are moreover consistent with earlier results suggesting that experts have more differentiated mental representations than novices (Hubal, 2009). They contradict a recently published study concluding that energy consumption is not an important factor in people's mental categorizations relevant to domestic energy use, implying that energy consumption should thus not be the focus of messages aiming at behavior change (Gabe-Thomas, Walker, Verplanken, & Shaddick, 2016). Our results rather suggest that it is possible to create a mental differentiation based on environmental impact, and that communicating information about behavior change should instead focus on the consequences of specific actions. Linking our results back to the research literature on mental accounting, our intervention may influence behavior by creating a more refined system of mental accounts, thus increasing the mental and moral distance between high and low impact behaviors. Although the exact effects of more differentiated environmental accounts on behavior need to be investigated empirically, the notion that distinctive accounts affect individual behavior is a central result of mental accounting research (Tversky & Kahneman, 1981). Thus, increasing the conceptual separation between desirable and less desirable behaviors on the cognitive level may translate into behavior by (i) facilitating behavior selection and (ii) impeding compensatory licensing mechanisms (Truelove et al., 2014).



We moreover investigated the role of biospheric and egoistic core values in the context of knowledge organization and moral judgment concerning the impact of environmental actions. Both biospheric and egoistic values directly affected the organization of mental representations as well as moral judgments. Participants high on biospheric values based their similarity representation more on the impact direction and less on the impact strength. This suggests that they apply a kind of “black-and-white thinking” by categorizing a behavior either as environmentally friendly or unfriendly, without taking the environmental impact of the behavior into account. This is in line with previous research showing that individuals with high biospheric values do not necessarily have better environmental knowledge than non-environmentalists (Bolderdijk et al., 2013). A similar effect was observed concerning the moral judgments of these participants. This suggests that the black-and-white thinking translates to judgments of “good” and “bad” as well, linking to a deontological reasoning style (Bartels et al., 2015). Intriguingly, such a reasoning pattern is unlikely to result in the best pro-environmental outcome (Sacchi et al., 2014). These findings identify individuals with high biospheric values likewise as a potential target group for more refined knowledge implementation strategies, given that the capacity to clearly identify the environmental impact of one’s actions is key to reduce one’s individual footprint.

Contrary to this, individuals with high egoistic values based their mental organization of environmental actions to a larger extent on the impact strength, consistent with a focus on personal costs and benefits rather than on the outcomes for the environment (Steg & De Groot, 2012). At the same time, they differentiated less between high versus low impact behaviors in their moral judgments. That is, climate change is not perceived as a moral topic in this population and actions that mitigate collective environmental issues are not necessarily perceived as morally relevant (Knez, 2016). These results emphasize the relevance of adapting messages and interventions targeting individuals with high egoistic values. To allow these individuals to link their knowledge with moral considerations, messages need to be adapted, for example by emphasizing the relevance of global environmental issues for the self (Bain et al., 2016).

Contrary to our expectations, the effect of the knowledge intervention on the mental organization of environmental actions was independent of participants’ biospheric and egoistic core values. That is, participants learned to the same degree about the environmental



impact of the actions, independent of their values. Thus, a broad public may be reached by intervention strategies focusing on the transmission of specific impact knowledge. Various approaches to implementing action-specific knowledge are conceivable. Possible communication channels are newsletters, workshops, or mass media campaigns (Abrahamse, Steg, Vlek, & Rothengatter, 2005). However, the results moreover show that the effects of the intervention on moral judgment were to a certain extent moderated by individual core values, in that people with high egoistic values did not change their moral evaluation of high versus low impact behaviors after the intervention. While this finding is in line with the notion that values act as an information processing filter (Bolderdijk et al., 2013), it emphasizes the need for combining knowledge-based interventions with additional instruments that help translate acquired knowledge into motivation for action.

Limiting the interpretation of our findings, no actual behavior change was measured. Thus, it remains unclear to what extent the changes in mental representations and moral evaluations would be translated into everyday actions. Another limiting factor is the fact that the long-term effect of action-specific knowledge interventions are underinvestigated, while several studies question the longevity of similar approaches (Schultz, 2002; Stern, 1999). However, given that the morality ratings were conducted one week after the intervention took place, our findings speak for a certain degree of persistency of the applied knowledge intervention.

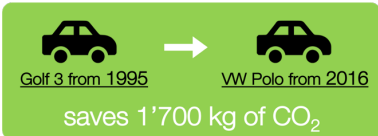
Taken together, the present research examined how action-specific knowledge interventions conveying the environmental impact of everyday actions can effectively change individuals' mental representations and moral judgments. This approach is promising as changing specific high impact environmental actions is an effective means to tackle global environmental issues such as climate change. Moreover, adopting a few specific actions rather than an entire chain of multiple environmental actions is more feasible in everyday life, which should make an actual behavioral impact more likely.



Appendix: Complete list of behaviors used in the experiment

Experimental group

Environmentally friendly high impact behavior (more than 1 ton of CO₂ emissions prevented)

- 1 "Replacing a 12-year-old car (e.g., VW Golf 3) with a modern compact car (e.g., VW Polo) saves about 1'700 kg of CO₂ per year"

- 2 "Covering distances of up to 15 km (about 10'000 km per year) with an electric bicycle instead of a car saves about 1'400 kg of CO₂"

- 3 "Conducting a meeting with a Portuguese company via Skype instead of flying from Bremen to Lisbon and back saves about 1'200 kg of CO₂"


Environmentally friendly low impact behavior (less than 150 kilograms of CO₂ emission prevented)

- 4 "Driving the car without the air conditioning on despite high temperatures saves about 70 kg of CO₂ per year"

- 5 "Working from home every Friday instead of going to the office by car (20 km distance) saves about 140 kg of CO₂ per year"

- 6 "Consequently turning off your engine when stopping in front of a red traffic light saves about 85kg of CO₂ per year"


Environmentally harmful high impact behavior (more than 1 ton of additional CO₂ emissions)

- 7 "Flying from Frankfurt to Tenerife for your vacation instead of driving to the Baltic Sea produces about 1'500kg of additional CO₂ "

- 8 "Doing the daily commute (50km distance) by car instead of train produces about 1'500 kg of CO₂ per year"




- 9 "Buying a second car (VW Polo) for the family produces about 1'700 kg of additional CO₂ per year"



Environmentally harmful low impact behavior (less than 150 kilograms of additional CO₂ emissions)

- 10 "Driving with insufficient tire pressure produces about 100 kg of additional CO₂ per year"



- 11 "Driving with an unused roof rack produces 100 kg of additional CO₂ per year"



- 12 "Driving to the bakery every Saturday morning by car instead of by bike (4km distance) causes 30 kg of additional CO₂ per year"

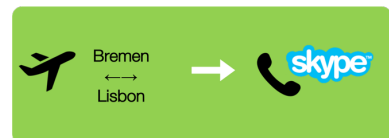
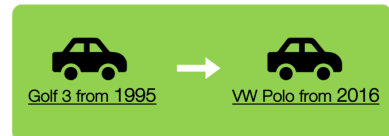




Control group

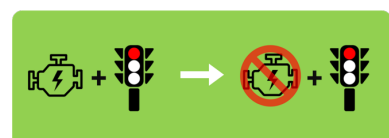
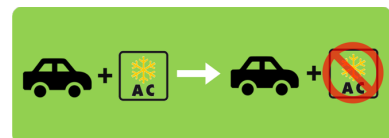
Environmentally friendly high impact behavior

- 1 "Replacing a 12-year-old car (e.g., VW Golf 3) with a modern compact car (e.g., VW Polo)"
- 2 "Covering distances of up to 15 km (about 10'000 km per year) with an electric bicycle instead of a car"
- 3 "Conducting a meeting with a Portuguese company via Skype instead of flying from Bremen to Lisbon and back"



Environmentally friendly low impact behavior

- 4 "Driving the car without the air conditioning on despite high temperatures"
- 5 "Working from home every Friday instead of going to the office by car (20 km distance)"
- 6 "Consequently turning off your engine when stopping in front of a red traffic light"



Environmentally harmful high impact behavior

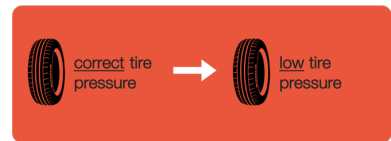
- 7 Flying from Frankfurt to Tenerife for your vacation instead of driving to the Baltic Sea"
- 8 "Doing the daily commute (50km distance) by car instead of train"
- 9 "Buying a second car (VW Polo) for the family"



Environmentally harmful low impact behavior



10 "Driving with insufficient tire pressure"



11 "Driving with an unused roof rack"



12 "Driving to the bakery every Saturday morning by car instead of by bike (4km distance)"





4 Integrative review and discussion of potential applications of mental accounting mechanisms in the energy sector

The objective of the review paper presented here was to review relevant literature on mental accounting and point out its relevance for decisions and behaviors in the energy sector. We illustrate possible strategies of mental accounting to promote energy conservation which may serve to guide the development of practical applications.

Study 4: Mental accounting mechanisms in energy-relevant decisions and behaviors: Current state of knowledge and insights for the energy sector

Mental accounting refers to a set of mechanisms describing the fact that people create mental budgets to organize their resource use and to create linkages between specific acts of consumptions and specific payments. These mechanisms can have a large impact on decisions and behaviors, interfering with rational choices as defined by normative economic principles. Until now mainly investigated in the context of financial decision-making, these mechanisms also have a major potential in the context of the development of behavioral interventions (*nudges*) to promote environmental sustainability. In this paper, we review the literature on mental accounting, illustrate how mental accounting mechanisms are relevant for decisions and behaviors in the energy domain, and discuss how they can be integrated into intervention strategies to increase energy conservation. These include, among others, practical strategies aiming to limit energy consumption and undesired spillover and rebound effects, but also strategies to increase donations and investments into energy-efficient technologies. Intervention strategies based on mental accounting mechanisms are cost-effective and relatively easy to implement. They may be of interest for policy makers, non-governmental organizations, and the industry.

Chatelain, G., Conte, B., Hahnel, U. J. J., & Brosch, T. (2018). *Mental accounting mechanisms in energy-relevant decisions and behaviors: Current state of knowledge and insights for the energy sector*. Manuscript submitted for publication.



Introduction

Imagine the following scenario: Your employer surprisingly offers you a “green” bonus which is meant to be used for environmentally friendly investments, but which you can spend any way you want. You consider that you might replace your old car by investing the money in a new energy-efficient model. One advantage would be that, given its lower consumption and the money you would save, you could use the new car more often than your old gasoline guzzler, for example to cover short distances in town. After playing with this idea for a moment, you decide that it’s more important to first plan your upcoming vacation, and you take the tram to the next travel agency. By paying the ticket with your debit card, you automatically donate a few cents to an environmental organization. While planning your trip with the travel agent, you mention that as you have not yet travelled by plane this year, you could allow yourself to choose the plane as a means of transport for your next vacation.

The series of events outlined above may remind you of some of your own experiences, but in particular they serve to illustrate a number of important effects of mental accounting mechanisms (Thaler, 1999). Mental accounting refers to the fact that people create mental budgets to organize and keep track of their resource use and to create linkages between specific acts of consumptions and specific payment. By ascribing financial transactions to separate mental accounts, people strive to keep revenues and expenditures in balance (Thaler, 1985; 1999). Metaphorically speaking, these accounts are comparable to saving jars dedicated to specific purposes (e.g., “rent”, “food”, or “leisure”). This principle of mental organization has far-reaching consequences on decision-making and consumer behavior, which previously have been described mainly in a financial context, but may also represent a promising lever for intervention development in the energy sector.

As described in the introductory anecdote, an income provided with a green label has been shown to be more likely to be invested into environmentally friendly products (Chatelain, Hille, Hahnel & Brosch, 2018). Thus, a “green bonus” can indeed be assumed to be used to buy an energy-efficient car rather than to be invested in an off-road SUV, which contradicts the traditional economic view that money is fungible and that its use should not depend on its source.

Mental accounting mechanisms moreover operate at a more general level to guide sequences of behavior by allowing individuals to balance out the consequences of a series of



their actions (Chatelain et al., 2018). For example, having engaged in a pro-environmental action may lead an individual to feel licensed to not engage in a subsequent one, or even to engage in an environment-harming behavior, a phenomenon referred to as negative spillover (Thøgersen & Crompton, 2009). These behavioral licensing patterns are one underlying mechanism of rebound effects at the population level (Nilsson, Bergquist, & Schultz, 2017). Rebound effects refer to the phenomenon that savings due to improved energy efficiency can provoke an increased utilization and thus cancel out efficiency gains (Herring & Sorrell, 2008). Thus, newly purchased energy-efficient cars may indeed be used more frequently than their predecessors.

While relevant amounts of money are booked on mental accounts dedicated to the specific purchase, very small amounts “fall through” this net and are not linked to specific accounts, making them less likely to be booked as a real expense (Gourville, 1998). This mechanism is leveraged in the context of micro-donations. Micro-donations refer to small, often automatically effected, charitable contributions (Beard, 2014). For example, commuters in London can sign up for to voluntary micro-donations, spending a small amount of money each time they use their debit or credit card to buy a ticket. Without negatively affecting the donor, these small contributions can add up to a considerable sum over time.

Finally, mental accounting mechanisms implement a budget function, helping an individual to limit their expenses in specific domains (Antonides, De Groot, & Van Raaij, 2011; Heath & Soll, 1996). Here mental accounting acts as a self-regulation mechanism, helping to avoid overspending and keeping accounts in balance (Thaler, 1999). These balancing mechanisms encompass “budgets” beyond monetary resources (Krishnamurthy & Prokopec, 2010; Rajagopal & Rha, 2009). Thus, whether you allow yourself to travel by plane or not may depend on the balance of the mental account related to the number of your previous flights.

In sum, research indicates that mental accounting mechanisms have a pervasive influence on decision-making and behavior, and may also constitute a powerful lever to optimize energy-related choices. Classic strategies to promote energy conservation and sustainability have mainly focused on legal and economic instruments, such as emission taxes or subsidies for emission reductions (Goulder & Parry, 2008). Mental accounting has the potential to play a role in soft behavioral interventions, in line with the growing popularity of



so called “nudges” (Lades, 2014; Thaler & Sunstein, 2012). Nudges are simple and relatively low-cost modifications of the decision context, designed to change behaviors without relying on coercive measures that limit freedom of choice (Thaler & Sunstein, 2012).

The present paper aims to point out the state of knowledge concerning mental accounting mechanisms and to identify practical insights and intervention strategies for the energy sector. To this end, we draw on evidence-based results from studies on mental accounting that show how it affects behaviors in an environmental and non-environmental context. We discuss the most relevant mental accounting mechanisms and illustrate how they are linked to energy-relevant decisions. Finally, we propose practical strategies that policy makers, non-governmental organizations and industry may employ to promote energy conservation.

Mechanisms of mental accounting and potential energy-relevant strategies

Various mental accounting mechanisms have been described in the literature, with the amount of research dedicated to the individual mechanisms varying greatly (see Antonides & Ranyard, 2017, for an overview). In the following, we review and discuss the mental accounting mechanisms that may have the largest impact on promoting sustainable behavior in the energy sector, covering studies from both financial and non-financial contexts. An overview of the core mental accounting principles and related strategies for the energy sector is provided in Table 1.

Creating mental accounts: Separate mental concepts relevant for energy consumption

In times of online banking, very few of us will still have a shelf of jars at home to organize our expenses. However, online banking accounts offer the option to create subaccounts and dedicate them to different purposes (e.g., checking, savings, rent), allowing us to plan, for example, how much money we want to save for our next vacation and therefore should not spend otherwise. The option to create various online subaccounts nicely reflects how we internally categorize resources by employing multiple mental accounts.

One key observation of the mental accounting literature is the fact that the resources booked onto different mental accounts are not fungible. That is, money in one account cannot be perfectly substituted for money in another account, contradicting central economic



principles (Dhimi, 2016). For example, financial savings due to lower gas prices have been found to be spent on higher quality gasoline (Hastings & Shapiro, 2013). Classic economic reasoning based on utility maximization would expect that the money be spent on other items with higher utility. However, illustrating the lack of fungibility, money saved in the context of gasoline purchases is likely to be spent in the context of the mental “gasoline budget”. Similarly, retailer-specific gift cards increased consumers’ preferences for products they perceived to be typical for that retailer, even though the gift card could be used on less typical products as well (Helion & Gilovich, 2014). The non-fungibility of resources does not only apply to money. For example, time saved by postponing an activity is more likely to be spent on other work-related activities when a work-related activity was postponed, but spent on another amusing activity when a non-work related activity was postponed (Rajagopal & Rha, 2009).

Topical similarity also has an effect on balancing out the consequences of a sequence of actions. For example, individuals who imagined having performed a first pro-environmental behavior were less willing to perform a second one if it was similar to the first, an effect that was not observed if the two behaviors were dissimilar (Chatelain et al., 2018). Similarly, individuals who had helped to maintain a local forest subsequently donated less to a local association promoting sustainable land management than individuals who did not contribute their work (Clot, Andriamahefazafy, Grolleau, Ibanez, & Méral, 2015). Thus, as long as they are available, resources on one mental account tend to be spent within the topical domain. Importantly, if separate behaviors are “grouped” onto the same mental account, resources invested on one behavior (e.g., work to maintain a forest) will be considered equivalent to resources needed for a second behavior (e.g., donating for the same cause).

The notion that fungibility exists within, but not between, mental accounts can be an important lever in the context of sustainable behavior and energy conservation strategies. For example, the rebound effect can be interpreted as being based on the fungibility between “money saved by higher energy efficiency due to an investment” and “money used to buy more gasoline for a higher number of trips with the new car”. Similarly, negative spillover may occur between different behaviors booked on an “environmental behavior account”, e.g., “I’m buying mainly local products” and “I have the right to go on vacation by plane”. Thus, one strategy of preventing these compensatory resource allocations could be to increase the



differentiation of relevant mental accounts by highlighting the distinctiveness of different domains of environmentally relevant behaviors (e.g., household energy consumption, mode of transport, purchase behavior, see also Maimaran & Goldsmith, 2011). Ideally, this would create a mental organization that makes it more difficult to compensate between different non-similar behaviors. Consistent with the notion that it is possible to change mental accounts by knowledge provision, a recent study showed that teaching individuals about the CO₂-related consequences of a set of different environmental behaviors led to a more differentiated mental organization of environmental actions, and to the perception of actions with high positive environmental impact as more morally desirable than actions with low positive impact (Chatelain, Hahnel, Hille, & Brosch, 2018).

Budgetary features of mental accounts: Propose a limit to energy consumption

Whether it is our explicit income level which restricts our expenses or an implicit self-imposed limit on chocolate consumption (Krishnamurthy & Prokopec, 2010), budgets affect a wide range of our behaviors, ranging from household financial management (Antonides et al., 2011) to time allocation between work and non-work activities (Rajagopal & Rha, 2009). Here mental accounts operate as a self-regulation tool: when a limit is set for a specific account, people adapt their behavior to maintain the balance within that mental budget (Thaler, 1999).

Thus, providing people with a mental budget concerning their energy consumption or CO₂ emissions may be a viable tool to reduce consumption and counteract rebound effects. Supporting the effectiveness of such a strategy, proposing an individual carbon allowance budget was found to increase people's willingness to reduce their annual mileage, turn down the room thermostats, and reduce their dairy consumption (Parag, Capstick, & Poortinga, 2011). Similar results were reported when the personal carbon allowance was based on a reduction of 20% to 40% of participants' actual carbon footprint (Capstick & Lewis, 2010). Implementing budgets, calculated based on the maintenance of an environmentally friendly lifestyle which still allows sustaining individual well-being, may moreover be an especially efficient approach to avoid unnecessary increases in energy use due to rebound effects (see Alcott, 2014).



Given that people's knowledge about the environmental impact of their behaviors is rather low (Arcury & Johnson, 1987; Attari, DeKay, Davidson, & De Bruin, 2010; DeChano, 2006), precise feedback about their current energy use and overall budget state would be indispensable (Krishnamurthy & Prokopec, 2010). An automated online feedback mechanism may be implemented using smart meters measuring electricity consumption and heating at home, purchase data linked to loyalty cards measuring purchase-related energy consumption (such as emissions created by the production of purchased meat), and individual GPS data tracking transportation-related emissions. A higher-level feedback system such as a smartphone application could be used to merge information about the energy consumption from different domains and across time. However, given the importance of segregating different behaviors (see previous section), the different domains should be presented separately (instead of only one global budget), to emphasize the non-fungibility of savings in the different domains.

Similar budget-plus-feedback mechanisms may be leveraged to support future renewable energy scenarios that are built on the exchange of energy resources. For instance, intelligent charging technology for electric vehicles charge and discharge the batteries as a function of the energy available in the energy grid. This scenario requires that users allow the systems to provide energy in times of high demand in the grid rather than merely optimizing one's own energy demand (i.e., unidirectional charging only). Thus, users' "charging budget" needs to represent both received and provided energy to make an optimization on the grid level feasible.

An integrated smartphone feedback solution might furthermore be a channel to communicate individually tailored suggestions on how to improve one's actions. For example, individuals with excessive energy use at home may be presented with recommendations on how to lower domestic energy demand (Gölz & Hahnel, 2016). Such a system can also easily be adapted to other technological innovations and future energy scenarios. For instance, in future decentralized peer-to-peer energy networks aiming to optimize energy distribution on the low-voltage grid level, providing feedback on energy flows at the group level could assist homeowners in employing a "group energy account" (Ecker, Hahnel, & Spada, 2017). The budget of such a mental account could be based on the exchange of energy within the entire



network and thus might increase homeowners' willingness to provide self-generated energy to the network (e.g., by setting fair selling prices).

Guiding features of mental accounts: Give money a label

If you ever thought, “I will use my birthday money for something special I would not buy every day”, you displayed a fundamental mechanism of mental accounting. This mechanism further illustrates the missing fungibility of income on different accounts: the mental account on which you book an income determines how you spend it. For example, your plans for how you want to spend an income can create distinct mental accounts (Zelizer, 1989). In addition to that, distinct mental accounts are also created on the basis of the source of the money (McGraw, Tetlock, & Kristel, 2003). Income which is received as a gift or a windfall (and thus not associated with “serious” work) is more likely to be spent on hedonistic products such as vacations or luxury items, whereas money earned through work is more likely to be used for utilitarian purposes, such as buying a tax book (Helion & Gilovich, 2014). Money won in a football bet is more likely to be used to go eat at a restaurant, whereas a tax refund is more likely to be used to repay debts (O'Curry, 1997). In other words, the source of money determines how we spend it.

Even arbitrary labels given to an income can influence what it is spent on. In the United Kingdom, elderly people receive a supplement for heating purposes during wintertime. This “Winter Fuel Payment” is basically a direct, unconditional cash transfer (i.e. the money can be spent on anything), but is given a name pointing to a distinctive purpose. On average, households spent 42% of the winter fuel payment on fuel, whereas households would be expected to spend only 3% of the payment on fuel if it were treated as unlabeled cash (Beatty, Blow, Crossley, & O'Dea, 2014; Lange, Moro, & Rahman, 2015). In the same vein, a study showed that giving consumers a free €8 voucher labeled “beverages” increased spending on beverages compared to a voucher labeled “gourmet” (Abeler & Marklein, 2008). Applying this effect to the environmental domain, a recent study found evidence that money labeled as “green” income is more likely to be spent on the purchase of environmentally friendly products (Chatelain, Hille et al., 2018).

Thus, labeling an income the proper way may enhance the likelihood that it is invested in a manner consistent with energy conservation goals. For example, tax credits, which are refunded every year to numerous households, may be labeled to promote energy-efficient



purchases, and complemented with concrete suggestions on how the money could be invested in energy-efficient devices. Similarly, energy savings could be re-framed as “green savings” on electricity bills, increasing the likelihood that the savings are reinvested in a pro-environmental manner. At the level of companies, relabeling a shareholder dividend or an employee bonus as a “green” could help to make beneficiaries rethink how to spend the additional income and consider investing the money in environmentally friendly products. Electronics retailers may attach a green label to their available coupons and loyalty discounts, to be redeemed for the purchase of energy-efficient products.

Importantly, only incomes that are perceived as an actual gain instead of a return to a previous wealth state, are readily reinvested (Epley & Gneezy, 2007). Especially in the context of tax credits, it is thus important that the returns are perceived as a bonus rather than a return of one’s own money. This could be achieved by framing the payment independent from the initial tax payments by presenting it as federal program to promote sustainability.

Labelling effects can moreover be leveraged to promote consecutive patterns of energy efficient actions. For instance, highlighting the profit gained from an installed photovoltaic system or the money saved due to the adaption of an energy efficient car could be labeled as energy efficiency incomes, making investments in consecutive energy efficient measures (e.g., energy storage system) more likely. Moreover, this measure would counteract negative spillover effects that occur when the investment in new technologies licenses individuals to subsequently commit environmentally harmful actions (i.e., using revenue from a photovoltaic system to purchase an energy inefficient sports car).

Bypassing mental accounts: Consider the physical appearance of money

Whether we pay our bus ticket by debit card, by using a CHF 100 note, or by scraping together our last coins, most of us would probably agree that the value of the money remains the same, independent from its physical appearance. Surprisingly, how we spend money differs significantly between its physical forms (Runnemark, Hedman, & Xiao, 2015). This has been linked to the fact that, depending on its physical features, money is differently ascribed to mental accounts and spent accordingly (Tessari et al., 2011).

The *pennies-a-day-effect* describes the fact that breaking up an expense from a one-time expense to a series of small ongoing payments often leads to a higher acceptance of the



expense, even though the overall amount stays the same. This has been explained by the notion that very small amounts of money are booked onto specific mental accounts dedicated to small ongoing expenses or are not booked on accounts at all, reducing consumers' price sensitivity (Gourville, 1998). This approach is leveraged in the domain of micro-donations, referring to small, recurring, often automatically effected charitable contributions (Beard, 2014). Somewhat similar to the pennies-a-day effect, the *denomination effect* refers to the finding that lower-value notes are spent more readily than higher-value notes (Raghubir & Srivastava, 2009). This effect has been explained with the fact that higher-value notes are only spent in accordance with their ascribed mental account, while lower-value notes are less restricted to one account (Raghubir & Srivastava, 2009). Similarly, US\$1 in the form of a bank note has been shown to be valued higher than US\$1 in the form of coins (Tessari et al., 2011). Thus, the perceived value of money differs as a function of its physical form. This is expressed by the finding that individuals are willing to pay more for the same product when paying with coins than banknotes. Furthermore, people underestimate the amount of money at their disposal when it consists of coins, whereas they overestimate the same amount in form of banknotes (Tessari et al., 2011). Finally, the *plastic effect* refers to the finding that individuals show higher willingness to pay when using a debit card than when paying with cash (Prelec & Simester, 2001).

These effects may be leveraged to promote energy efficiency behaviors, purchases, and potentially donations to sustainable causes. For example, individuals withdrawing money from a cash machine or using a debit card to pay a purchase might by default be asked whether they would like to donate a small amount to the promotion of renewable energies. Building on the pennies-a-day effect, bike-sharing services may become more attractive by charging their rental fees per minute instead of per hour or day. Energy providers may propose their customers to use a small percentage of the electricity price for investments in renewable energy (as already done, for instance, by Elektrizitätswerke Schönau, 2017).

Emotion regulation via mental accounts: Make gains more joyful and payments less painful

One major principle guiding human life is that we seek to avoid negative feelings and increase positive ones. This principle is also reflected in the way people use their mental accounts to buffer the emotional impact of financial transactions. Simply put, we strive to



mentally integrate and segregate multiple outcomes in order to maximize the positive feeling resulting from the outcomes (Thaler, 1999).

The mental accounting mechanism of *hedonic editing* states that individuals psychologically segregate gains and integrate losses to enhance the positive effects of experiencing gains and buffering the negative effects related to losses (Thaler & Johnson, 1990). This mechanism can be explained by the value function proposed in prospect theory (Kahneman & Tversky, 1979), which implies that the emotional impacts of gains and losses are reference dependent, i.e. depend on the distance from zero. As a consequence, the positive feelings associated with two gains that are mentally integrated are lower than if they were segregated. In short, it is more pleasant to win CHF 20 twice than CHF 40 once. Similarly, losses that are mentally integrated should be experienced less negatively than if they were segregated. This means, it should be less unpleasant to lose CHF 40 once than CHF 20 twice. While empirical data supports the principle that people tend to segregate gains (for example, people prefer experiencing positive events on different days, Linville & Fischer, 1991), people do not always integrate losses, especially if the combined losses at some point become too big to handle (Thaler, 1999). Furthermore, people tend to mentally combine the experience of small losses with large gains (to achieve a net positive feeling) and to segregate large losses from small gains (to at least experience the positive feeling elicited by the gain, instead of having it overshadowed by the loss).

With regard to sustainability strategies, these mental combination strategies can be leveraged to increase the attractiveness of investment decisions into renewable energy technology such as photovoltaic and energy storage systems. A major problem of these investments is the discrepancy between high initial costs and small daily gains that accumulate to overall revenue after years. To allow potentially buyers to use their mental accounting mechanisms to optimize positive feelings, potential subsidies should be listed separately from the overall costs, as not to be overshadowed. To emphasize the perceived size of potential subsidies, they should be framed in the context of the installation price only (e.g., “20% of the cost of the PV system”). Conversely, to decrease the perceived size of the investment costs, they should be put in relation to the overall cost of the house (e.g., “only 1% of the total cost”). Simply put, costs should be put in relation to larger reference values and savings should be placed in relation to smaller reference values. Effectuated savings, such as



small daily gains due to self-generated energy, should be highlighted and presented separately. Before purchase this can be implemented in the informational material. After purchase daily informational updates on the energy monitoring system should be provided. To give potential owners a further opportunity for hedonic editing, they should be given the option of initially leasing a system with a later purchase option. In doing so, the costs should be experienced as less painful. Using these strategies may significantly increase the salience of the long-term financial benefits of renewable energy systems and decrease potential reluctance to invest due to high initial costs.

General Discussion and recommendations

In this article we examined mental accounting mechanisms and their potential for the energy sector. Table 1 summarizes the key mechanisms, together with suggestions for practical strategies.

These strategies are likely to be important for tackling various aspects of decisions and behaviors relevant for the energy sector, such as reducing compensatory spillover behavior and rebound, limiting one's overall energy consumption, promoting sustainable investments, increasing willingness to donate and changing the perceived costs of energy-efficient investment. Encouragingly, most of the derived strategies would not only be cost-effective but also easy to apply. For example, relating the investment costs of a solar system to the overall costs of a new house instead of presenting them as an individual position only requires only a minor adaption, but would make the offer look more attractive. Changing the label of money gained from a private photovoltaic system can be effectuated by adapting existing energy monitoring systems without requiring additional technology. Furthermore, mental accounting strategies are mostly unimposing and thus stand in contrast to traditional strategies focusing on legal and economic instruments (Goulder & Parry, 2008). This is an important issue, as classic approaches are often compulsory and thus may provoke intentional countervailing actions (Debnam & Just, 2017).



Table 1: Summary of mental accounting mechanisms and proposed energy relevant intervention strategies

Mental accounting mechanism	Example	Energy-relevant strategies
<i>Creating mental accounts: Separate mental concepts relevant for energy consumption</i>		
People create mental accounts to keep track of their resource use	Money saved in a specific context is more likely reinvested into purchases from the same context	Highlight the distinctiveness of different energy-relevant behaviors to minimize negative spillover and rebound
Resources within one account are perceived as fungible, resources between accounts are not		Provide information on differences in the environmental impact of energy-relevant behaviors
<i>Budgetary features of mental accounts: Propose a limit to energy consumption</i>		
Mental accounts work as self-regulation tool, so that when an account limit is set, people adapt their behaviors to stay within the budget	People strive to keep income and expenditures in balance	Propose individual carbon budgets, provide feedback allowing to track consumption, give tailored behavioral suggestions
<i>Guiding features of mental accounts: Give money a label</i>		
The mental account on which an income is booked determines how the money is spent	Income labeled as “green” is more likely to be spent on environmentally friendly products	Label tax refunds as “energy-efficient” or “green”, complement with suggestions for green investments Reframe energy savings as “green savings” to increase likelihood of pro-environmental reinvestments
<i>Bypassing mental accounts: Consider the physical appearance of money</i>		
Depending on its physical features, money is differently ascribed to mental accounts and spent accordingly	Small, distributed expenses are less painful than larger ones, debit card spending is less constrained than cash	Ask customers using card payment for small donations to promote renewable energies Charge mobility offers (e.g., bike rental) per minute instead of per hour or by day
<i>Emotion regulation via mental accounts: Make gains more joyful and payments less painful</i>		
Individuals strive to mentally integrate and segregate multiple outcomes so that the resulting feeling is as positive as possible	Gains are separated to maximize positive feeling. Small losses are integrated with larger gains to overshadow the negative feeling associated with the loss	Enhance attractiveness of renewable technology investments by separately presenting potential savings and subsidies Present subsidies relative to the smaller reference value (e.g., 20% of PV installation), present installation cost relative to larger reference value (e.g., 1% of house price)



Importantly, the strategies suggested here are not intended to replace already existing policy instruments but should rather complement them to increase the overall effectiveness of the instruments. For example, subsidies paid to house owners for installing a solar system may remain unchanged, however, their salience and attractiveness may be enhanced by a promotion strategy taking into account insights from mental accounting research.

The strategies proposed here may not only be realized by policy makers, but also by non-governmental organizations or industry. One question that needs to be discussed is whether influencing individual's decision-making towards a specific outcome is ethically acceptable or questionable (Rebonato, 2014). However, in the context of the interventions proposed here, individuals retain, at any given moment, their freedom of choice. In addition, in the context of our media-rich society, individuals are constantly being pushed towards certain outcomes desired by external actors (Sunstein, 2015). This can range from the strategic placement of an energy-saving bulb in the supermarket to federal investment subsidies for renewable technologies. Thus, in the end the ethicality of intervention approaches based on the mental accounting mechanisms outlined here, and nudging approaches in general is in the responsibility of the practitioner. It is up to them to make sure that an intervention is in the interest of an individual as well as that of society. Moreover, citizens generally support nudging interventions when the instrument has legitimate goals that aim to benefit society (Reisch & Sunstein, 2016). Promoting renewable energies and energy efficiency can be considered as serving such a purpose, while mere corporate or stakeholder profits do not.

Before putting mental accounting based interventions into practice, it is necessary to carefully weigh the benefits and disadvantages. As with any other intervention, the intervention strategies outlined here need to be evaluated with an eye on opportunity costs. Implementing such a strategy means potentially forgoing more efficient ones. However, even initial small effects can have convincing advantages. Across time and situations small effects can sum up to larger ones; and small effects on big numbers can be attractive (Prentice & Miller, 1992). For example, a labeling strategy is not only almost free of costs, but would affect a large number of people, recurring on a daily base. In order to be able to reliably evaluate the relevance of a specific intervention, it would be essential to conduct evaluation studies including alternative strategies in the design. As an example illustrating this approach,



Parag and colleagues (2011) report a higher effectiveness of a mental budgeting strategy compared to an alternative strategy, in that a budget was more effective in influencing individuals' willingness to change their behavior than a carbon energy taxation. Aside from studies comparing the effectiveness of different intervention approaches, new research investigating the impact of mental accounting principles directly in the domain of energy-related behavior is needed. The present review can serve as a starting point for this new research avenue.



5 Final integration and conclusion

In this research project, we have empirically and theoretically explored the potential of mental accounting to promote sustainable behavior and energy conservation. In this final section, we summarize and critically discuss the studies realized for the present research project and give an outlook on future research.

In the first empirical study (section 3.1) we provided experimental evidence that mental accounting takes place in an environmental domain. Focusing on a balancing mechanism of mental accounting, we found that people are less willing to engage in a second behavior if it is similar to a previous one than if it is less similar. This supports the assumption that individuals mentally keep a record of past behaviors and try to keep the related environmentally friendly and non-friendly behaviors in balance. The results are in line with previous studies suggesting mental accounts for specific environmental fields of behaviors (Maimaran & Goldsmith, 2011; Schütte & Gregory-Smith, 2015). They should be taken into consideration as a possible mechanism influencing behavioral spillover, namely, how a first behavior can change the likelihood to enact a second behavior (Truelove, Carrico, Weber, Raimi, & Vandenberg, 2014). In a follow-up experiment testing for a moderating influence of affect, we found that positive affect induced by a campaign message increased the willingness to perform a subsequent pro-environmental behavior and mitigated the compensatory effect induced by the behaviors similarity. This yields direct recommendations for campaigns aiming at the promotion of environmental behavior, which should focus on affectively positive messages to promote the longevity of the stimulated behavior change.

In a second empirical study (section 3.2), we found evidence that adding a green label to a windfall or income earned through work can boost the purchase of environmentally friendly products. This is in line with a fundamental mental accounting assumption that money is spent in conformity with its label (Thaler, 1999). Essentially, we found the intervention to be effective across individuals varying broadly with regards to how much they value the environment. This indicates that a broad range of individuals would be targeted by a labeling intervention. Strengthening the significance of our findings, similar effects were found both in an online experiment and a field study. This shows that participants not only indicated a willingness how they would act, but rather supports an actual more pro-environmental behavior. Intriguingly,



applying a green label as a strategy to promote pro-environmental behavior would not only be low on costs, but could easily be implemented in various situations, such as tax paybacks or bonuses paid by employers. Additional application possibilities are pointed out in the review paper (section 4).

Our third empirical paper (section 3.3) suggests that mental accounts are not something static, but rather dynamic and, for example, shaped through knowledge. We found that individuals who, after a knowledge intervention, had a more specific understanding of a particular behaviors environmental relevance, differentiated mentally and morally more between these behaviors. This suggests that mental accounts vary between individuals, which could further affect the mental accounting mechanisms. Yet, studies on mental accounting mechanisms and individual characteristics are sparse (Zhang & Sussman, 2017). In a similar context, a better knowledge of financial products and investment was positively linked to mental budgeting. A more pronounced mental budgeting was thereby expressed by individuals being more likely to reserve money for different expenses, trying to stay within a self-made budget or compensate overspendings (Antonides, de Groot, & van Raaij, 2011). Interestingly, Antonides and colleagues (2011) further report a link between higher education and less mental budgeting. This indicates that the moderating effect of a general education differs from specific context related knowledge. They interpret their findings that a higher education is linked to more analytic thinking and less cognitive heuristics. Thus, it seems as though more knowledge is not something positive in every situation and it would be interesting to further study the impact of knowledge on actual behavior. As a further factor moderating mental budgeting, Antonides and colleagues (2011) report that people who are more long-term oriented engage more in mental budgeting. This is interpreted as showing that mental budgeting is costly in the short term, and therefore avoided by impatient consumers. Similarly, saving goals are positively related to mental budgeting and wealthy households practice less mental budgeting compared to less wealthy respondents, indicating that there is less need to keep control of expenditures. In another study focusing on a labeling effect, Kim and Jang (2014) report that individuals that were highly materialistically oriented and had a strong desire for prestige and social comparison were affected by a label. They were more likely to engage in status consumption such as luxury coffee, when the income source was “parents money” compared to “earned money”. Thus, even though we found a green labeling strategy to be effective across people with different biospheric



values, other individual characteristics might be critical. For example, it is thinkable that people with a lower income are less affected by such label, as they are probably more concerned covering their basic needs.

Taken together, the three empirical studies suggest that individuals have environmental-specific mental accounts where they keep track of past behaviors and that a labeling strategy could be applied to steer individuals towards investments into energy-efficient appliances. Furthermore, we show that mental accounts are dynamic and affected by a knowledge intervention. Even though our empirical findings are in line with mental accounting and suggest its mechanisms are effective to encourage sustainable behavior, its implementation is not recommended in every case. One critical factor to consider are the effect sizes observed in the experiments, which, from an absolute point of view are only small. Thus, opportunity costs, that is the risk of a mental accounting approach taking up space for a more efficient intervention, must be considered. For example, it is possible that an alternative strategy such as communicating social norms would be a stronger approach. Social norms have been shown as effective in encouraging individuals towards pro-environmental behaviors. Complementing one's electricity bill with information on neighbors' energy consumption led to a decrease in energy consumption by up to 2.4% (Costa & Kahn, 2013). However, in the case of missing more effective alternatives, even small effects can be highly relevant. On the one hand, the relative ease and inexpensiveness related to mental accounting interventions can make them attractive. Furthermore, considering the potential number of repetitions over time, effects can sometimes be expected to be cumulative over time and become substantial in the long-term (Prentice & Miller, 1992). For example, not only is a green label probably easy to implement, but it could be applied across various situations (see section 4) and not only once, but repeatedly, resulting in a meaningful effect. These factors must be taken into account when implementing strategies suggested in the conceptual review.

In the review paper presented in the report we reviewed the literature on mental accounting, discussed its relevance for behaviors and decisions in the energy sector, and outlined how they could be put into practice to promote energy conservation. We proposed, for example, strategies to increase donations and investments into energy-saving technologies, but also listed ideas to limit energy consumption and undesired spillover and rebound effects. These



strategies would not only be cost-effective but also easy to implement. For example, labeling tax refunds as “energy-efficient” requires only minor changes. Such interventions could not only be of interest for policy makers, but also for non-governmental organizations and the industry. In light of these broad applications, the question arises whether directing individuals towards a desired direction is morally acceptable (Rebonato, 2014). Countering such objection, not only do individuals retain, at any given moment, their freedom of choice, but furthermore they have always been pushed towards a desired outcome (Sunstein, 2015). For example, products to be promoted have long been presented more prominently in their retail (Moye & Kincade, 2002), and paid subsidies are per se coupled to a certain desired investment behavior. Thus, in the end it is up to the practitioner to ensure that an intervention’s purpose is in the interest of an individual as well as that of society.

Our thesis has direct implications for practice and the proposed practical strategies could be implemented across the energy sector and help to promote energy conservation. Nevertheless, future studies are needed to ensure the effectiveness of the recommended strategies and to clarify in more detail the meaning of mental accounting for the energy sector. In particular, we suggest future research to primarily focus on strategies that bear the highest saving potential or are quickly applicable. In the housing sector, by far the highest potential emission reduction would be by individuals changing to fuel-efficient cars (Dietz, Gardner, Jonathan, Stern, & Vandenberg, 2009). Relying on mental accounting strategies, this change could be encouraged by displaying how much a new energy-efficient car would cost per day or presenting the potential savings separately from its costs (see section 4). This is one example, from many, of the application and practical use of the findings presented in this thesis. The present thesis can thus be seen as a basis for further research that opens up the opportunity for new strategies promoting energy conservation.

At present, no concrete follow-up research is being conducted at the current time at the University of Geneva. However, given the interesting results obtained during this project, it is probable that future projects will return to the subject.



6 Non-published studies

As is common in the scientific research process, some experiments that we conducted over the past three years yielded null results or were simple replications of previous studies and therefore lacking scientific novelty. Even though such results may not be appropriate for stand-alone publication, they are of much value for the progress and consolidation of research. Two studies including, in total, four experiments are reported in more detail.

6.1. Absolut versus relative presentation of monetary savings

The objective of this study was to examine how different presentations of savings in energy costs affect decisions to invest in energy-efficient products. For this purpose, the effect of absolute and relative savings on the willingness to purchase a product from various price categories was assessed. Based on previous works, we expected that, dependent from the product price and the potential monetary savings, either the absolute or relative saving would lead to a higher willingness to purchase the presented product (Bartels, 2006; Darke & Freedman, 1993; DelVecchio, 2005; T. B. Heath, Chatterjee, & France, 1995). Derived from prospect theory (Kahneman & Tversky, 1979), we anticipated relative presentations (e.g., 50% of EUR 12) of savings to be more attractive than their corresponding absolute presentation (e.g., EUR 6 of EUR 12) when the potential saving was only small. On the contrary, when an absolute saving was large (e.g., EUR 600 of EUR 1200), we expected it to be more attractive than its relative presentation (e.g., 50% of EUR 1200). The reason for this is because the reference price is clearly defined for the relative presentation, whereas the absolute savings could be put in relation to a much larger reference price (e.g. a weekend shopping trip), and thus appear less relevant when it was only small. As an additional experimental factor, the savings were presented for one year only or summed up for 15 years. This provides a control whether savings are perceived in general more attractive when presented over a period of 15 years. Table 1 shows the complete 3 x 3 x 2 between-subjects research design including the three factors; *display of savings* (absolute vs. relative vs. absolute/relative), *price category* (LED bulbs vs. refrigerator vs. car) and *period of time* (1 year vs. 15 years). In addition, for each product we included a control group without any display of potential savings.



Table 2: Complete 3 x 3 x 2 between-subjects research design

Presentation of savings	Period of time	products		
		LED	Refrigerator	Car
absolute	per year	6.-	30.-	600.-
	over 15 years	90.-	450.-	9'000.-
relative	per year	50%	50%	50%
	over 15 years	50%	50%	50%
relative & absolute	per year	50% & 6.-	50% & 30.-	50% & 600.-
	over 15 years	50% & 90.-	50% & 450.-	50% & 9'000.-
control group		—	—	—

We asked 2127 participants from Germany ($M_{\text{Age}} = 48.87$, $SD_{\text{Age}} = 15.22$, 53% female) how likely it was on a scale from 1 (*very unlikely*) to 7 (*very likely*) that they would purchase the product presented to them. Accompanying the fictitious advertising, participants read a short story referring to the presented product (E.g., “Imagine you are about to purchase a new refrigerator because your current model uses too much energy [energy costs per year are about EUR 60]. An online comparison of several models suggests to you the following model with a life expectancy of 15 years.”). Figure 1 represents the condition for the refrigerator as the product of choice, with the display of absolute savings for a one-year period.

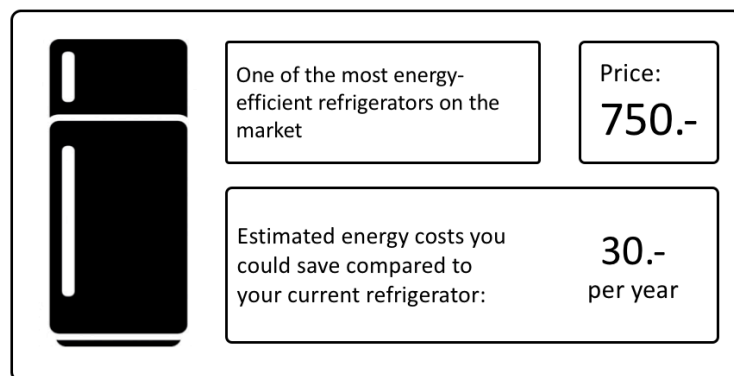


Figure 4: Refrigerator as the product of choice, with the display of absolute savings for a one-year period

We conducted a 3 x 3 x 2 (presentation of savings [absolute vs. relative vs. absolute/relative], price category [LED bulbs vs. refrigerator vs. car] and period of time [1 year



vs. 15 years]) ANOVA in order to assess the influence of the different presentations of potential savings, the various price categories and the two time periods on the reported likelihood to purchase the presented product. Contrary to our expectations, no effect of the *presentation of savings* ($F(2, 1790) = .07, p = .933$) and the interactions *presentation of savings* x *period of time* ($F(2, 1790) = .13, p = .883$), *presentation of savings* x *price category* ($F(4, 1790) = .93, p = .445$) and *presentation of savings* x *price category* x *period of time* ($F(4, 1790) = .23, p = .922$) on the purchase decision could be found. Meaning that it made no difference whether the savings were presented in absolute, relative, or absolute and relative manner, and per year or summed up over 15 years. We conducted two follow-up experiments, to rule out explanatory variables not taken into account in the first study.

A first follow-up experiment with a sample of 208 people ($Md_{Age} = 35\text{--}44$) was conducted and the factor *energy label* (energy label vs. no energy label) added as a variable of interest. An energy label was included, as it has been shown to be important in influencing consumers shopping behavior towards more energy-efficient choices (Heinzle, 2012; Heinzle & Wüstenhagen, 2012). We adapted the research design to a 2 x 2 between-subjects design including the factors *display of savings* (absolute vs. relative) and *energy label* (energy label A++ vs. no energy label). For simplicity, only one price category (i.e., refrigerator) was included. The advertisings were identical to the previous experiment, however the type of question was changed to “How attractive do you rate the following offer?”, in order to exclude it as a reason for the non-findings in the first experiment. Participants had the possibility to give between 1 and 7 points, depending on the perceived attractiveness of the offer. Figure 2 shows the condition including a relative saving and an energy label.

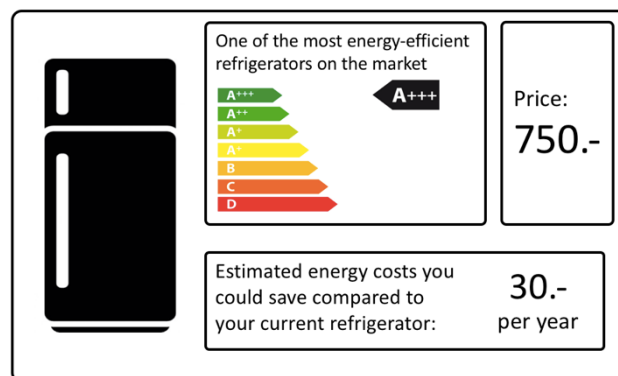


Figure 5: Display of relative savings including an energy label



We conducted a 2 x 2 (display of savings [absolute vs. relative] and energy label [energy label vs. no energy label]) ANOVA in order to assess the influence of the different presentations of potential savings and the presence of an energy label on the attractiveness of a promotional offer. Similar to the first experiment, effects of *presentation of savings* ($F(1, 204) = 2.80, p = .096$), *energy label* ($F(1, 204) = 2.35, p = .127$), or their interaction ($F(1, 204) = 1.70, p = .193$) had no impact on the attractiveness of an offer.

In a second follow-up experiment, we varied the framing of the potential savings between participants. One half of the participants saw the savings of energy costs framed as a gain (e.g., “Save CHF 16 per year”) and the other half saw it as a loss (“Pay CHF 78 per year”). From framing theory we know that, depending on how an outcome is verbalized, preferences alter (Kahneman & Tversky, 1984). We further included the factor *period of time* (1 year vs. 15 years) and *display of savings* (absolute vs. relative), resulting in a 2 x 2 x 2 between subject design. The type of response was adapted to a choice format and the product costs were adapted, such that a cheap refrigerator entailed lower savings and a more expensive refrigerator entailed higher savings. Furthermore, we used more realistic illustrations and brand names. Figure 3 shows two conditions including the absolute savings and costs over 15 years respectively.

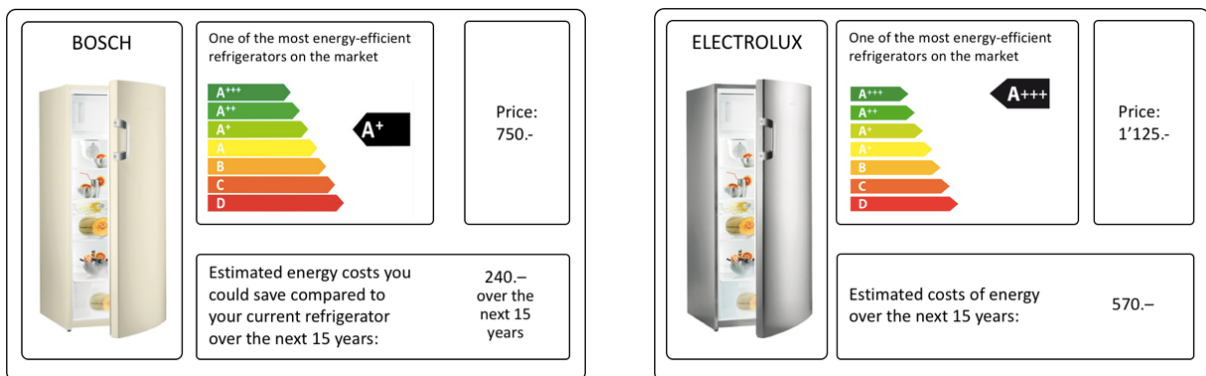


Figure 6: The left figure shows the absolute savings over the next 15 years whereas the right figure refers to the absolute costs over the next 15 years

A total of 249 participants ($M_{Age} = 28.45, SD_{Age} = 10.29$, 58% female) were approached in the street and asked which refrigerator they would prefer. A tablet was used, such that the choice could be made anonymously. Results of a binary logistic regression indicate that



the factors and their interactions didn't predict which refrigerator the participants chose (all p -values $> .325$). Even when additional analyses were conducted including only participants who were planning to purchase a new refrigerator in the next five years in, no differences were found.,

In sum, the three experiments did not support the hypothesis, that absolute and relative monetary savings of energy-efficient products are perceived differently and that this affects purchase decisions. Even though, the results suggest labels promoting energy-efficient products to be ineffective in shaping individuals' decisions, further research would be needed to shed more light on the matter. It is possible that the advertisings were too abstract and participants not interested in reading the task in detail. Thus, situations involving real purchase behavior could lead to different conclusions. However, the outcomes demonstrate the need for in-depth evaluations of new interventions and that one cannot take a positive intervention outcome as granted.

6.2. Replication of a classic mental accounting experiment

The objective of this study was to replicate a classic mental accounting experiment from Tversky and Kahneman (1981), showing that people refer a price reduction to the product's original price. For this, we asked 426 participants ($M_{\text{Age}} = 48.09$, $SD_{\text{Age}} = 15.40$, 56% female) if they were willing to make a 20-minute trip to purchase a calculator, which was on sale for EUR 10 instead of EUR 15 in a first condition, and for EUR 120 instead of EUR 125 in a second condition. Replicating the results from the original experiment, we expected that a saving of EUR 5 would be more attractive in the first situation due to the smaller reference price. Two different response formats were applied: the dichotomous format (yes vs. no) used by the original study and a more differentiated 7-level scale from 1 (*very unlikely*) to 7 (*very likely*). Each participant only saw one condition and one response format. Regarding the dichotomous response scale, participants who could save EUR 5 from 15 were more willing to make the travel than participants saving EUR 5 from 125 supporting our hypothesis ($\chi^2(1, 211) = 3.85, p = .050$). The 7-level scale showed a trend ($t(211) = 1.26, p_{\text{one-sided}} = .105$) in the desired direction, when a one sided significance-value was applied. The findings support the results of the original experiment. It is probable, that an adaptation of the used values to current price levels would have yielded more convincing results.



7 References

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