

Behavior Change Towards a Sustainable Lifestyle – Effects of Interventions and Psychological Factors on Pro-Environmental Behaviors

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Behavior Change Towards a Sustainable Lifestyle – Effects of Interventions and Psychological Factors on Pro-Environmental Behaviors

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To my grandchildren William, Selma and Walter

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Abstract

Climate changes due to human-caused global warming are serious challenges for the planet. Changes in individual human behavior towards more pro-environmental actions are thus highly necessary. Human behavior is complex, however, and promoting behavior change requires a solid understanding of how people behave in different situations and contexts.

Previous research has pointed out several reasons why people do not behave in accordance with our knowledge about the threat of climate change. Besides structural barriers, other reasons may be related to psychological barriers, such as beliefs, values, and social norms, which limit us in adopting more pro-environmental choices and behaviors. The overall aims of this thesis were to investigate the effects of interventions on energy conservation and ecological food consumption in promoting pro-environmental behavior, to explore the experiences of an energy-saving intervention from the perspective of the participants, and to investigate how values, attitudes, and other psychological factors predict pro-environmental behavior and pro-environmental intentions.

This thesis is built on four studies. The first study was a survey, where an investigation was made of the predictive power of value orientation, awareness of consequences, environmental concern, moral judgment competence, locus of control, and sense of coherence, on eight pro-environmental behaviors and behavioral intentions. The results showed that only the value type universalism predicts pro-environmental behaviors and behavioral intentions, with attitudes, awareness of consequences for the biosphere, and environmental concern for the biosphere as intermediate or transmitting variables. The results indicate that found determinants of one single behavior may not be applied to other behaviors as dependent variables. Thus, a separate analysis for every type of both actual and intentional lifestyle might have been more successful in confirming these independent variables as determinants of pro-environmental behaviors and behavioral intentions.

The second study was a randomized quasi-experimental field study. This field intervention investigated the effect of feedback on residential electricity use in households. For a period of eight weeks, differentiated energy use for daily domestic behaviors was monitored by 15 residents via an internet-based system. Feedback based on Relational Frame Theory was used to enhance motivation for energy conservation, and follow-up studies analyzed the maintenance of change for another three months. Psychological factors, including values, attitudes, moral judgment competence, locus of control, and

sense of coherence, were simultaneously assessed by web surveys. No significant effects of the feedback on reduction of energy use were found. The small sample size, and the fact that warm water energy use was not monitored, were discussed as explanatory factors.

In the third study, semi-structured interviews were conducted among eight households having participated in the intervention in the second study. The interview transcripts were subject to qualitative content analysis with the purpose of exploring the experiences of the participants. Those experiences were, on the one hand, described as a struggle to overcome internal and external barriers as well as feelings of contradiction and ambivalence, representing the limitations imposed by participating. On the other hand, there were also descriptions of feelings of ability and motivation, and interaction between satisfaction and improvements, representing the opportunities available to a participant in this kind of intervention. These results support the importance of specific strategies in developing the design of future interventions for promoting residential energy conservation.

Finally, in the fourth study, an experimental field study was conducted to investigate the effects of behavioral interventions, commonly known as nudges, in promoting the consumption of organic fruits and vegetables. The consumption of both organically and conventionally produced fruits and vegetables was measured during four days (one day every other week) in a grocery store, where consumers were exposed to informational messages in combination with either emotional images or social norm messages. Measurements of daily consumption without exposure to nudges were carried out during four other days (one day every other week, alternated with the nudging days). The results showed that the proportion of sold organic products in the total sale of the selected fruits and vegetables was slightly higher during nudging days when price differences between conventional and organic products were low. This limited effect of nudging disappeared when the price of organic products was considerably higher than the price of conventionally produced products. The results indicate that there is a need to take measures to compensate for the prevailing differences in price between organic and conventional products. Such measures are, for example, the application of a combination of all available nudging tools to strengthen the effects of nudging, as well as collecting psychological data from the participants to be aware of their attitudes towards choices of organic products.

Taken together, the overall findings of the studies in this thesis confirm the complexity of behavior and of behavior change. Many questions remain

unanswered and suggestions on how to develop the research on these issues are discussed.

Keywords: values, attitudes, moral judgment competence, locus of control, sense of coherence, pro-environmental behavior, energy conservation, feedback, Relational Frame Theory, motives and barriers to behavior change, food consumption, organically produced food, nudging

Summary in Swedish

Klimatförändringar på grund av global uppvärmning som är förorsakad av människan är allvarliga utmaningar för planeten. Det är därför nödvändigt att människans individuella beteende förändras mot att bli mer miljövänligt. Människans beteende är emellertid komplicerat, och främjande av beteendeförändringar kräver en gedigen förståelse för hur människor beter sig i olika situationer och sammanhang.

Tidigare forskning har visat på flera skäl till varför vi människor inte beter oss i överensstämmelse med vår kunskap om hotet från klimatförändringarna. Förutom strukturella hinder, kan det finnas andra skäl relaterade till psykologiska hinder såsom övertygelser, värderingar och sociala normer, vilka begränsar oss när det gäller att anpassa oss till mer miljövänliga val och beteenden. Övergripande syften med denna avhandling har varit att undersöka hur olika interventioner påverkar energibesparing i bostäder och konsumtion av ekologisk mat i syfte att främja miljövänligt beteende, att utforska upplevelserna av en intervention för energibesparing utifrån deltagarnas perspektiv, samt att undersöka hur värderingar, attityder och andra psykologiska faktorer kan förutsäga miljövänligt beteende och intentioner till miljövänligt beteende.

Avhandlingen innehåller fyra studier. Den första är en enkätundersökning, i vilken den predicerande styrkan av värderingsorientering, medvetenhet om konsekvenser, miljöhänsyn, moralisk bedömningskompetens, kontroll-lokus och känsla av sammanhang undersöktes med avseende på åtta miljövänliga beteenden och beteendeintentioner. Endast värderingstypen universalism predicerade avsedda beteenden, med attityderna medvetenhet om konsekvenser för biosfären och miljöhänsyn för biosfären som medierande variabler. Detta skulle kunna indikera att påvisade bestämningsfaktorer för ett enda beteende förmodligen inte kan tillämpas för andra beteenden som beroende variabler. Således skulle separata analyser för varje typ av beteende kunna ha varit mer framgångsrika i att bekräfta de undersökta variablerna som bestämningsfaktorer för miljövänligt beteende och beteendeintentioner.

Den andra studien är en randomiserad kvasi-experimentell studie. Denna fältstudie undersökte effekten av feedback på energiförbrukningen i bostäder. Under en period av åtta veckor registrerades differentierad förbrukning av hushållsel, avseende vardagliga beteenden i hemmet, för 15 hushåll via ett internetbaserat system. Feedback baserad på Relational Frame Theory användes för att öka motivationen till att spara energi och uppföljningar analyserade vidmakthållandet av eventuella förändringar under ytterligare

tre månader. Psykologiska faktorer, såsom värderingar, attityder, moralisk bedömningskompetens, kontroll-lokus och känsla av sammanhang mättes med hjälp av web-enkäter. Inga signifikanta effekter av feedback på energiförbrukningen kunde fastställas. Den begränsade storleken på urvalet samt faktum att förbrukningen av varmvatten inte kunde registreras diskuterades som förklarande faktorer.

I avhandlingens tredje studie genomfördes semi-strukturerade intervjuer bland de åtta hushåll som deltagit fullt ut i den andra studiens intervention. De transkriberade intervjuerna blev föremål för kvalitativ innehållsanalys i syfte att utforska deltagarnas upplevelser. Å ena sidan beskrevs dessa upplevelser som en kamp för att övervinna inre och yttre hinder samt känslor av motsägelse och ambivalens, vilket kan ses som uttryck för de krav som en intervention ställer på deltagarna. Å andra sidan beskrevs även känslor av förmåga och motivation, ett samspel mellan tillfredsställelse och framsteg som representerar de möjligheter som erbjuds deltagare i denna typ av intervention. Resultatet understryker vikten av att ta hänsyn till specifika strategier när nya interventioner för energibesparing i bostäder ska utformas.

Slutligen, i den fjärde studien, genomfördes en experimentell fältstudie där beteende-interventioner med hjälp av nudges användes i syfte att främja konsumtionen av ekologisk frukt och grönsaker. Under fyra dagar (en dag varannan vecka) mättes konsumtionen av såväl ekologiskt som konventionellt producerad frukt och grönsaker i en livsmedelsaffär där konsumenterna exponerades för information i kombination med emotionella bilder eller budskap som stimulerade sociala normer. Den dagliga konsumtionen utan exponering av nudges registrerades under fyra andra dagar (en dag varannan vecka, växelvis med nudging-dagarna). Proportionen av sålda ekologiska produkter, i jämförelse med den totala försäljningen av de utvalda frukterna och grönsakerna, var något högre under dagar med nudging om skillnader i pris mellan konventionella och ekologiska produkter var små. Denna begränsade effekt av nudging försvann när priset för ekologiska produkter var betydligt högre än priset för konventionellt producerade produkter. Resultaten av den här studien antyder att det finns ett behov att vidta åtgärder för att kompensera för de rådande skillnaderna i pris mellan ekologiska och konventionella produkter. Detta kan göras, till exempel, genom att applicera en kombination av alla tillgängliga verktyg för nudging för att förstärka effekten av nudging, liksom att samla personliga data från konsumenterna för att få kunskap om deras attityder gentemot val av ekologiska produkter.

Sammantaget bekräftar de övergripande resultaten i studierna i denna avhandling komplexiteten i det mänskliga beteendet och i förändring av beteende. Många frågor kvarstår obesvarade och förslag på hur man kan utveckla forskningen inom avhandlingens område diskuteras.

Sökord: värderingar, attityder, moralisk bedömningskompetens, kontrolllokus, känsla av sammanhang, miljövänligt beteende, energibesparing, feedback, Relational Frame Theory, motiv och hinder för beteendeförändring, matkonsumtion, ekologiskt odlad mat, nudging

List of papers

- Study I. Weimer, K., Ahlström, R., Lisspers, J., & Lipsanen, J. (2017). Values, attitudes, moral judgment competence, locus of control and sense of coherence as determinants of pro-environmental behaviors and behavioral intentions. *Journal of Multidisciplinary Engineering Science and Technology*, 4(5), 2568- 2583
- Study II. Weimer, K., Ahlström, R., & Lisspers, J. (2018). Challenges in evaluating intervention effects of feedback on residential energy conservation in a field setting. *Centre for Consumer Science, School of Business, Economics and Law at University of Gothenburg*, CFK-rapport 2018:1, ISSN 1653-7491
- Study III. Weimer, K., & Ahlström, R. (2018). Experiences of reducing household energy consumption – a qualitative analysis of a field study. Manuscript submitted.
- Study IV. Weimer, K., Esteves, F., & Ahlström, R. (2018). The effect of nudging in promoting the consumption of organic fruits and vegetables. Manuscript submitted.

Preface

It was our fault, and our very great fault — and now we must turn it to use. We have forty million reasons for failure, but not a single excuse. So the more we work and the less we talk the better results we shall get . . .

Rudyard Kipling, "The Lesson," 1901

1. Introduction

Global climate change (GCC) has received growing attention in recent years and the increased awareness and knowledge of GCC point to enormous global problems caused by climate changes in the near future (Intergovernmental Panel on Climate Change [IPCC], 2014; Stern, 2007). Climate changes due to human-caused global warming are thus serious challenges to the planet. As the emissions of greenhouse gases clearly correlate with planetary warming patterns, the human-induced GCC can be mitigated by reducing greenhouse gas emissions (Koger & Winter, 2010; Vlek & Steg, 2007). Therefore changes in individual human behavior towards more pro-environmental actions are highly necessary in order to diminish climate changes and promote environmental sustainability (Clayton et al., 2015; Gifford, Kormos, & McIntyre, 2011).

Human behavior, however, is complex and promoting behavior change requires a solid understanding of how people behave in different situations and contexts (Gifford & Nilsson, 2014). Many people are concerned about climate change and its impacts on the environment and sustainability, but very few are engaged in enough mitigating behavior to limit the greenhouse gases and other environmental problems in a sufficient manner. We have to raise the question why we do not behave in accordance with our knowledge about the threat of climate change. One reason may be structural barriers, which are beyond the control of the individual, such as economic restrictions that limit one's ability to purchase solar panels or living in an area where public transport does not exist offering an alternative to driving. Other reasons may be related to psychological barriers, such as beliefs, values, and social norms, which limit us in adopting more pro-environmental choices and behaviors (Clayton, 2012; Gifford, 2011). In addition, to achieve climate-related policies and individual behavior change, the development, evaluation, and implementation of interventions that target direct and indirect sustainability, are required (Gifford, 2014).

The overall aims of this thesis were to investigate the effects of interventions on energy conservation and ecological food consumption in promoting pro-environmental behavior, to explore experiences of an energy-saving intervention from the perspective of the participants, and to investigate how values, attitudes, and other psychological factors predict pro-environmental behavior and pro-environmental intentions.

In the following sections of this chapter, an introduction to the human-environment relation will be given together with different dimensions of environmental behavior, theoretical models for predicting and promoting behavior change, and descriptions of interventions to promote pro-environmental behavior.

Interaction between humans and the global environment

Human activities and environmental problems

Humans have expended natural resources and altered the environment throughout the history of humanity. The consequences of human activities have been threatening the survival of the entire biosphere (the global ecosystem and all inhabitants) for centuries (Koger & Winter, 2010). Current human practices are not sustainable, which means that the consequences of our actions and the limitations of resources will make it impossible for future generations to meet their needs. Human activities, such as agriculture, forestry, transportations, and industrial production based on the burning of fossil fuels, have affected the ecosystems in a partly negative way. Environmental problems, such as global warming, urban air and water pollution, the decline of biodiversity, and desertification, are the result of human behavior (Gardner & Stern, 2002; Koger & Winter, 2010; Vlek & Steg, 2007). According to the International Panel on Climate Change, it is clear that global climate change (GCC) will affect ecosystems both directly and indirectly via flooding, drought, wildfires, insect proliferation, land use changes, and the disruption of natural systems (IPCC, 2014). The IPCC (2014) has also predicted significant public health costs caused by climate change. People in many countries are likely to suffer or die from associated malnutrition, starvation, disease, and injury due to extreme weather. There is a growing consensus among climate scientists that human activities in fact contribute to GCC and that mitigation efforts are needed. In its most recent report, the IPCC (2014) predicted that humans may not be able to adapt to the long-term negative consequences of GCC without sufficient efforts in reductions of greenhouse gas emissions.

Climate change and psychological contributions

Human interactions with the climate occur at all levels of social organization, but so far research has focused largely on institutional actors (e.g., governments, industries) and on the technological, demographic, and economic trends that drive climate change. Factors that influence decisions

and behavior at the individual level have received significantly less attention (Clayton et al., 2015). Individual behavior, however, is important and ultimately drives societal change via the adoption of technologies and support for policies. To be able to respond effectively to climate change, we have to examine how people perceive climate change, what factors influence mitigation and adaptation behaviors, and how climate change will affect human well-being. Psychological dimensions are included in the human aspects of GCC, and they have informed the efforts by especially environmental psychologists to understand and address climate change as well as the role of human behaviors (Clayton et al., 2015; Gardner & Stern, 2002; Koger & Winter, 2010; Swim et al., 2011). Fortunately, people can change behavior. Given the link between climate change and human behavior, any solution will require that people behave differently. Since solutions may be political, technological, community-based, or individual, every solution to climate change will require changes in behavior (Schultz & Kaiser, 2012). Relying mainly on technical efficiency gains resulting from energy-efficient appliances, building insulation, and renewable fuels for transportations, will thus not be sufficient because of the continuously increasing consumption (Midden, Kaiser, & McCalley, 2007). Since all physical and technical innovations have to be accepted and properly used by individuals, changes in relevant human behavior will still be needed to reduce its negative environmental impacts on climate change.

Thus, psychology in general, and environmental psychology in particular, can contribute to an increased understanding of such pro-environmental behavior (PEB) that is related to limited climate change, and to how individual behavior can be changed, as well as turning that understanding into effective interventions (Stern, 2011; Swim et al., 2011; Sörqvist, 2016).

Behavior and environmental consequences

Domains of environmentally significant behavior

One can distinguish at least four major types of environmentally significant behavior (ESB) that differ both in the way they affect the environment and in the way causal factors that shape them are combined (Gardner & Stern, 2002; Stern, 2000; Stern, 2005). First, committed activism is the active involvement in organizations and political demonstrations supporting pro-environmental public policies. A second type is non-activist support of environmentally relevant public policies, in giving financial contributions to organizations or support for policies that affect the environment positively. These two types of behavior affect the environment

only indirectly by influencing public policies. The effects may be considerable, because public policies can change the behaviors of many people and organizations at the same time. A third important type of behavior includes individuals' influence on the environment by affecting the actions of organizations to which they belong. In this way, for example, bankers may use or ignore environmental criteria in their decisions. Because organizational actions are the largest direct sources of many environmental problems, these behaviors can have a great environmental impact (Koger & Winter, 2010).

The fourth type of ESB is the personal, that is, the private sphere, where individuals' purchase, use, and disposal of personal and household products, have an environmental impact. This is the type of environmentally relevant behavior that has been the target of research among psychologists and consumer researchers, and it is what usually comes to mind when one thinks of individuals' environmentally significant behavior (Stern, 2005).

Among these behaviors, it is useful to make a distinction between efficiency actions and curtailment actions due to different psychological properties. Efficiency-increasing actions, such as the purchase of major personal goods, for example, buying a new car or a new home-heating system, are behaviors that have a significant environmental impact. These behaviors tend to be actions that people perform infrequently or only once, and that do not require continuous attention or effort. However, efficiency behaviors may be more subject to losses caused by the rebound effect, that is, the tendency to overspend energy as a psychological compensation for making a climate-virtuous choice (Gifford, 2011, 2014a; Otto, Kaiser, & Arnold, 2014).

On the other hand, curtailment actions usually involve small, simple behaviors that must be repeated frequently for long periods, such as turning off lights when leaving a room, taking a shower, and purchasing organically grown foods. These curtailment behaviors have a smaller environmental impact than efficiency behaviors, but are important due to their accumulated effect when many people do the same things (Gardner & Stern, 2002, 2008). Another important distinction to make is that between environmentally significant behavior (ESB), including all actions with environmental consequences, and pro-environmental behavior (PEB), which refers to actions with beneficial environmental effects (Gardner & Stern, 2002). Since defining what types of behaviors are pro-environmental is quite difficult and since such behavior has to be seen in relation to the impact on the environment of other possible behaviors, there is no definite way of determining what is pro-environmental (Schultz & Kaiser, 2012). Nevertheless, the terms "pro-

environmental behavior” (PEB) and “pro-environmental behavioral intentions” (PEBI) are used throughout the following parts of this thesis.

Environment-related curtailment behaviors

In Europe, a quarter (24.4%) of the household final consumption expenditure is allocated to housing (Eurostat, 2016), and electricity consumption in private households in Sweden accounts for 20% of the total annual electricity consumption (Energimyndigheten [the Swedish Energy Agency], 2015). Research on public attitudes and opinions on climate change and energy conservation indicates that most people believe that reduced energy use is part of the solution to mitigate climate change and that personal actions can contribute to it (Gardner & Stern, 2008). Since households are major contributors to the emission of greenhouse gases, residential energy conservation is a topic of interest in the efforts to mitigate climate change (EEA, 2012; Eurostat, 2016; Gardner & Stern, 2008). There is a great reservoir of potential for reducing carbon emissions and mitigating climate change that can be realized quickly and directly (Gardner & Stern, 2008). It is, however, reasonable to ask why these potential savings remain largely unfulfilled and what can be done to achieve them. One explanation may be that many householders are motivated but lack the necessary knowledge about what actions will produce the desired benefits. Despite a considerable improvement of the technical energy efficiency of appliances over the past decades, a reduction of the total energy use has not been sufficient because of the continuously increasing demand for domestic electricity. However, analyses have shown that there is potential for substantial electricity savings in the residential sector by means of measures targeting behavior change (De Almeida, Fonseca, Schломann, & Feilberg, 2011). It has been pointed out that the reduction of energy use through conservation and efficiency has immediate and cost-effective effects (Alcott & Mullainathan, 2010).

Another curtailment behavior that has potentially negative impacts on the environment is the production and consumption of food. As agriculture contributes to 13% of all greenhouse emissions in Sweden and the overall food consumption is responsible for about 25% of the climate impact of an average Swedish consumer (Naturvårdsverket [the Swedish Environmental Protection Agency, EPA], 2014), food consumption-oriented policy-making and interventions for change of consumer behavior have become an environmental concern.

Among the domains of environment-related behaviors, such as energy conservation, transportation, food, waste disposal, and material purchases

with a great influence on several social domains (Stern, 2000; Gifford, 2014b), this thesis will focus on curtailment behaviors within the private sphere by investigating household energy conservation and food consumption.

Pro-environmental behavior – theoretical models

At least two major theoretical approaches have guided work by environmental psychologists in their interest in pro-environmental behavior. One of those approaches includes theories from a social-environmental perspective, relating to elements such as goals, norms, intentions, values, and attitudes, in an attempt to predict behavior, and the other includes behavior analysis using behavior modification techniques to promote PEB (Gifford, 2014a; Newsome & Alavosius, 2011).

Established theoretical models within the field

The social-environmental perspective

Theoretical models based on a social-environmental perspective, and which have been at the center of many published empirical works, are the “theory of planned behavior” (*TPB*) developed by Ajzen (1991, 2005), and the “value-belief-norm theory of environmentalism” (*VBN theory*) developed by Stern (2000) and Stern, Dietz, Abel, Guagnano, and Kalof (1999). Further established theoretical models are the “norm activation model” (*NAM*) focusing on the moral and normative dimensions of human behavior (Schwartz, 1977; Steg & De Groot, 2010), and “Schwartz’s Value Theory” (1992, 1994), modified to fit environmental issues (Stern et al., 1993).

Since attitudes are only moderately related to behavior (Kaiser & Schultz, 2009), a large amount of research has focused on understanding why, and under what conditions, the attitude-behavior link can be strengthened. The two dominant theories, *TPB* and *VBN*, see environmental behavior as caused by attitudes, beliefs, and norms. The *VBN* theory stresses the role of personal norms and moral obligation stemming from underlying values, whereas *TPB* highlights intentions and their impact. In their review, Bamberg and Möser (2007) showed that self-reported intentions are strong predictors of PEB, but that attitudes, behavioral control, problem awareness, and personal moral norms also predict behavior and intentions. In general, the findings show that the relationships between the studied determinants and the sustainable behavior are more complicated than first assumed. Thus, one important challenge is to learn more about how these determinants interact as well as moderating and mediating one another (Gifford, 2014a).

Behavioral perspective

The other way of promoting environmentally desirable behavior by means of the two major theoretical approaches, is to alter the consequences of behavior according to applied behavioral analysis. This approach, based on the principles of operant conditioning with origins in the work of Skinner (1953, 1971), has been widely used in efforts to promote PEB. As proposed by Skinner (1953), people are motivated to do things for the promise of what follows. In other words, we do what we do in order to obtain positive consequences or escape, or avoid, negative consequences. Furthermore, we repeat behaviors that lead to positive consequences and avoid behaviors that result in negative consequences. This idea is the theoretical basis for interventions aiming to improve PEB by offering rewards and penalties. The behavioral analytic approach emphasizes observable actions and contextual variables that can be manipulated to promote behavior changes (Geller, 2002). Behavior analysis focuses on three aspects of behavior: the *activator*, that is, an event preceding the behavior (antecedent factors), the *behavior*, as an observable response, and the *consequence*, which is an extrinsic stimulus that occurs in response to a behavior. The consequences are the events that motivate behavior, and from the perspective of an operant conditioning framework, these consequences are seen as contingencies. The most motivating consequences occur soon and are quick, certain, and sizable. In promoting PEB the efficacy of behavioral analysis has been well documented (Lehman & Geller, 2004; Schultz & Kaiser, 2012; Vining & Ebreo, 2002).

Non-established theoretical models with potential within this field

The social-environmental hypothetical model of PEB and PEBI

Each of the established theories mentioned above can only partly explain a prediction of pro-environmental behavior, and as they include relatively few constructs they allow for convenient testing. On the other hand, the price of simplicity is incompleteness and one must consider the impact of the excluded factors, which usually contribute to the unexplained variance in predicting pro-environmental behavior (Gifford, 2014a). Because of this, the determinants of pro-environmental behavior in this thesis are combined with factors outside the established theories.

Although self-reported attitudes, values, and intentions are only moderately related to an actual change of behavior (Bamberg, 2003; Kaiser & Schultz, 2009) – the well-documented attitude-behavior gap, there were two

reasons to study such factors in this thesis by using self-report. First, one aim of the thesis was to reduce energy consumption in households by carrying out an intervention where observable energy use was measured. As interventions to change energy-related behaviors, combined with self-reported measurement of underlying determinants of energy use, have hardly been examined, such combinations are recommended by a number of researchers (Abrahamse et al., 2005; Lehman & Geller, 2004; Newsome & Alavosius, 2011). Evaluations of an intervention's effectiveness should measure changes in behavioral determinants (demographic variables, attitudes, values, and other psychological factors) as well as changes in energy-related behaviors. In other words, the effectiveness of interventions and possible determinants of behavior should be examined in combination in order to increase the understanding of the success or failure of intervention programs (Newsome & Alavosius, 2011). Second, there was a need for a broad survey providing reference values in the population for the measured psychological factors that later could be compared with the corresponding values for participants in the planned intervention. In this way, it would become clear if people who were successful in reducing their energy consumption would show particularly high values regarding certain psychological factors.

In the following section, the psychological factors investigated as determinants of pro-environmental behavior (PEB) and pro-environmental behavioral intentions (PEBI), in Study 1 of this thesis, are presented, followed by the hypothetical model of PEB and PEBI.

Psychological factors investigated as determinants of PEB and PEBI

Values are general preferences for end states or ways of acting. They are cognitive representations of abstract goals (e.g., a world of equality) or abstract means of behaving (e.g., being unselfish) and serve as guiding principles important to a person's choices of actions (Rokeach, 1973; Schwartz, 1992). It has been empirically validated that values can be used as predictors for variables such as attitudes and behavioral intentions (Gärling et al., 2003; Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999; Thøgersen & Ölander, 2002).

The different value types can be described in two dimensions on four value orientations: self-transcendence versus self-enhancement, openness to change versus conservatism. Self-transcendence combines the value types of universalism and benevolence, whereas self-enhancement combines the value types of power and achievement. Universalism is a wider form of altruism with the motivational goal of the welfare of *all* people, encompassing

humankind, and manifested in values such as social justice, equality, and peace on earth. In contrast, benevolence is defined as altruism towards ingroups, characterized by values such as loyalty, forgivingness, and responsibility. The motivational goal of benevolence is the welfare of close others (Schwartz, 1992, 1994). While previous studies found universalism positively related to pro-environmental attitudes and behaviors, only inconsistent relations were found between benevolence and pro-environmental attitudes and behaviors (Grunert & Juhl, 1995; Schultz & Zelezny, 1999; Thøgersen & Ölander, 2002).

Self-enhancement is defined as an egoistic value orientation, including the value types power and achievement. The motivational goal of power is control or dominance over people and resources. Examples of power include authority, social power, and wealth, and these are opposite to the goals of universalism in Schwartz's (1992) value structure (Hansla et al., 2008a). In contrast, the motivational goal of achievement includes values such as success, capability, and ambition, which are opposite to benevolence in the self-enhancement-to-self-transcendence continuum (Schwartz, 1992; Hansla et al., 2008a). As power is the opposite of universalism in the value-orientation model developed by Schwartz (1992), it represents the highest degree of self-enhancement.

Studies have shown that persons who hold more altruistic, prosocial, and biospheric values, report favoring environmental preservation, whereas those who see the environment as a source of resources to be consumed tend to hold self-enhancement values (Bardi & Schwartz, 2003; Gärling et al., 2003; Honkanen & Verplanken, 2004; Kaiser & Byrka, 2011; Nilsson, von Borgstede, & Biel, 2004; Nordlund & Garvill, 2002; Stern, 2000). De Groot and Steg (2010) also found that these egoistic values result in less environmental concern. However, the relations between values and pro-environmental behavior are weak (Vining & Ebreo, 2002), and need moderating and mediating variables, such as personal norms and beliefs, to satisfactorily predict behavior from values (Nordlund & Garvill, 2003). In general, relations between values and environmental attitudes are more complicated than these findings imply (Gifford, 2014a).

Environmental concern (EC): traditionally, attitudes have cognitive, affective, and conative (behavioral intentions and actions regarding the object) dimensions, but environmental attitudes may be described as having preservation and utilization dimensions. Environmental concern can be defined as a general attitude towards the environment, reflecting a personal evaluation of environmental issues (Franson & Gärling, 1999). Environmental

attitudes can determine behavior in a direction that either strengthens or weakens its environmental quality. Based on the definition of environmental attitudes towards environmental problems and environmental protection, one can distinguish environmental concern evaluations from awareness-of-consequences beliefs.

Schultz (2000, 2001) pointed out that environmental concern is rooted in a person's value system, which means that people are concerned about environmental problems when these problems threaten things they value. Schultz (2001) found strong evidence for the distinction between concern for oneself, concern for others, and concern for the biosphere. Egocentric concerns focus on the individual. People with egoistic environmental attitudes are concerned about the environment, but their concern is at a personal level. Thus, the environment should be protected because, for example, *I don't want to breathe polluted air, or I don't want to drink dirty water.* Altruistic attitudes describe an overall concern about environmental problems because the problems affect other people. Biosphere concerns are based on all living species, including nonhuman animals, plants, oceans, forests, and so forth. Each of the three types of attitudes implies concern for the environment, but each is based on different underlying values (Schultz, 2000; Schultz et al., 2005).

Studies of the relationships between EC evaluations and the values adopted from Schwartz have shown significant positive relationships between self-transcendence and biospheric environmental concern, as well as between self-transcendence and altruistic concerns. Self-enhancement was found to be positively related to egoistic concerns but negatively related to altruistic and biospheric concerns (Hansla et al., 2008a; Nordlund & Garvill, 2002; Schultz et al., 2005; Steg et al., 2005; Stern et al., 1995). Furthermore, biospheric environmental concern correlated positively with self-reported PEB (Schultz, 2001; Schultz et al., 2005). Several studies have also shown that a strong environmental concern increases the likelihood of PEB (Bamberg, 2003).

Awareness-of-consequences beliefs (AC): In the value-belief-norm theory (Stern, 2000; Stern et al., 1999; Stern et al., 1995), AC beliefs are central constructs referring to beliefs about adverse consequences of environmental problems, meaning consequences that may never actually occur. In the VBN theory, beliefs mediate between values and norms to influence behavior. That means, for example, that if people value other species very highly, that is, show awareness of consequences for the biosphere, they will be concerned about environmental circumstances that may threaten those highly valued

species. Similarly, people with high altruistic values who care about other people, that is, show awareness of consequences for other humans, will be concerned about environmental circumstances that may threaten the well-being of other people, just as people with egoistic values will be concerned about conditions that may threaten themselves, that is, show awareness of consequences for oneself.

Beliefs about awareness of consequences for valued objects (AC) are shown to activate pro-environmental personal norms and are therefore related to altruistic or self-transcendence value orientation. Self-enhancement has been found to be less strongly related to the AC beliefs (Nordlund & Garvill, 2002, 2003; Schultz et al., 2005; Schultz & Zelezny, 1999; Steg et al., 2005; Steg & Nordlund, 2013; Stern & Dietz, 1994; Stern, Dietz, Kalof, & Guagnano, 1995).

Taking awareness-of-consequences beliefs (AC) together with environmental-concern evaluations (EC) to the construct environmental attitudes, these have frequently been studied as predictors of PEB. Despite long-standing criticisms of this attitude construct, studies have consistently shown that attitudes about environmental issues are positively correlated with PEB (mediated by intentions) (Bamberg & Möser, 2007; Hines, Hungerford, & Tomera, 1986/1987; Gifford & Sussman, 2012).

In sum, positive correlations between the above described values, the environmental attitudes, and PEB, are well documented within previous research. Nevertheless, we found reasons to include these factors both in the survey of Study 1, and in the self-reported measurement of underlying determinants of energy use in combination with the intervention measuring observable energy use. This was done in order to increase the understanding of the effectiveness of the planned intervention, as mentioned earlier, together with the intention to confirm if people who were successful in reducing their energy consumption would show particularly high values regarding these factors.

Moral judgment competence

Much of the research about concern for the environment has a foundation in moral/ethical considerations. Different lines of research have focused on the role of moral obligations to act in favor of the common good. It has been shown that PEB is indirectly influenced by values, via behavior-specific beliefs, attitudes, and norms (Gärling et al., 2003; Nilsson et al., 2004; Nordlund & Garvill, 2002, 2003; Poortinga, Steg, & Vlek, 2004; Steg et al., 2005;

Stern, 2000). In this respect, personal norms play an important role because they refer to feelings of moral obligation to behave pro-environmentally (Gärling et al., 2003; Nordlund & Garvill, 2002, 2003; Stern, 2000; Thøgersen, 2006). There is also evidence linking variations in environmentally responsible behavior to the strength of individuals' norms for such behavior and especially when it comes to the strength of *internalized* (i.e., personal or moral) norms (Harland, Staats, & Wilke, 1999; Stern et al., 1999). Several studies provide evidence that personal norms contribute to an explanation of PEB in energy conservation (van der Werff & Steg, 2015), recycling (Matthes, Selge, & Klöckner, 2012), travel mode choice (Abrahamse, Steg, Gifford, & Vlek, 2009; Hunecke, Blöbaum, Matthies, & Höger, 2001), and pro-environmental buying (Thøgersen, 1999). In contrast, evidence about the influence of norms is strangely mixed, and a meta-analysis by Abrahamse and Steg (2013) examining a variety of social influence, found that norms had only a small effect on behavior, which is supported by Gifford (2014a), who stresses that the norm-behavior link is not as obvious as it appears.

Because of this weak relation between personal norms and behavior, there may be a need for using methods where not only beliefs, attitudes, and norms are measured, but also a competence corresponding to moral behavior. Such a method worth testing is the Moral Judgment Test (MJT), proposed by Lind (1978, 1982, 1985a, 1985c, 2002). This dual-aspect theory of moral behavior is based on Kohlberg's definition of moral judgment competence (1984). It is an extended method for measuring moral judgment competence, designed to assess both affective and cognitive mechanisms of a person's judgment behavior as distinct aspects of the same pattern of behavior (Lind, 2008). This means that moral competence is synonymous with both moral internal principles and moral behavior. According to the dual-aspect theory of moral behavior, the moral behavior of a person is defined by the individual's dedication to basic moral principles (affective aspect) and by his/her ability to reason and act according to those principles (cognitive aspect) (Lind, 1985a, 1985c, 2002).

A study by Karpiak and Baril (2008) stated that principled moral reasoning, the most advanced level of moral development, correlates positively with ecocentrism, that is, belief in the intrinsic importance of nature. This link found between high moral judgment competence and pro-environmental belief, indicates that moral judgment competence may turn out to be a stronger predictor of PEB and PEBI than the influence of those norms reported by Abrahamse and Steg (2013) in their meta-analysis.

Locus of control

The psychological construct “locus of control” (LOC) developed by Rotter (1966) is based on his social learning theory (1954) in seeking to explain the degree to which people believe that they can bring about positive events and avoid negative events. Rotter (1966) defined locus of control as a generalized expectancy of perceived internal or external control. The perception of internal or external control refers to the degree to which an individual perceives events as being contingent upon his/her own behavior or characteristics, which are assumed to be relatively stable across varying conditions. Individuals placing locus of control to a higher degree within themselves, believe that they can influence outcomes because of their own abilities, skills, or characteristics. These individuals are regarded as having an internal orientation (internals). Individuals who place locus of control to a higher degree outside themselves perceive that external forces such as luck, chance, and fate determine outcomes and events. They may also perceive the actions and behaviors of other powerful persons as determining coming events and believe that events are unpredictable because of the complexity of reality. These individuals are regarded as having an external orientation (externals). Individuals can thus be classified along a range of very internal to very external.

Locus of control has been found to consistently correlate with environmentally responsible behavior and behavioral intention (Bamberg & Möser, 2007; Fielding & Head, 2012; Hines, Hungerfors, & Tomera, 1986/87; Hwang, Kim, & Jeng, 2000; Ojedukon, 2011; Stern, 1992). Individuals with an internal locus of control (that is, individuals who perceive that their own behavior makes a difference) more often behaved in an environmentally responsible manner than did individuals with an external locus of control (that is, individuals who perceive that changes are due to random events or the behavior of other more influential individuals). This was also found for domestic electricity savings among Danish consumers (Thøgersen & Grønhøj, (2010). However, several studies have used different environmentally-specific measures of locus of control as a related construct to LOC (e.g., Cleveland, Kalamas, & Laroche, 2005; Hwang, Kim, & Jeng, 2000; Fielding & Head, 2012) and found results mainly consistent with studies that used general, dispositional, non-environmentally-specific measures of locus of control to predict environmental behavior. However, in the comprehensive meta-analysis of Hines, Hungerfors, and Tomera (1986/87), as well as in the replication study of Bamberg and Möser (2007), it is not clear to the reader what instruments measuring locus of control were used in the studies

included in the reviews. Locus of control also seems to have a moderating effect on the relation between one's values and pro-environmental behavior (Engqvist Jonsson & Nilsson, 2014). It is apparent that people need to believe that they have some control over events if values are to have an effect on environmentally friendly behavior.

Sense of coherence

The concept of sense of coherence (SOC) introduced by Antonovsky (1979, 1988) in his salutogenic theory, is supposed to influence the capacity of people to stay healthy under stressful conditions. Antonovsky has identified three core components of SOC called comprehensibility, manageability, and meaningfulness. Persons having a strong SOC were high on these components in contrast to those having a weak SOC. Gilbar (1998) has pointed out a positive relation between a strong SOC and low experienced stress as well as the ability to cope with stress. SOC has been defined as a global orientation "that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence. That means: (1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement" (Antonovsky, 1988, p. 19).

Furthermore, a strong SOC correlates positively with good quality of life (Julkunen & Ahlström, 2006), and with health behaviors such as non-smoking (Igna, Julkunen, & Ahlström, 2008). Since health behavior, that is, the ability to make healthy choices, can be seen as a potentially important mediating factor in the SOC-health relationship, it seems reasonable to assume a similar relationship between SOC and environmentally friendly behavior choices. The components of SOC, that is, comprehensibility, manageability, and meaningfulness, would in fact in all probability also promote the individual's choice of environmentally friendly behavior if he/she were to experience the choice as easy to understand, possible to cope with, and meaningful.

A hypothetical model of predictors of PEB and PEBI

The most common social-environmental theoretical models, used within the research field of predicting PEB and PEBI, include relatively few constructs. For that reason, none of those theories was considered applicable to all of the factors included in this thesis. A theoretical model explaining the hypothetical relations between values, attitudes, moral judgment competence,

locus of control, sense of coherence, and PEB and PEBI, was therefore constructed and is presented in Figure 1. The model is investigated in Study 1 and hypothesizes that values first affect awareness of consequences and environmental concern as intermediate or transmitting variables. Further, we find it reasonable to assume that awareness of consequences together with environmental concern affect moral judgment competence, which in turn, in a causal chain, affects PEB and PEBI. It also hypothesizes a causal relationship of locus of control and sense of coherence with PEB and PEBI.

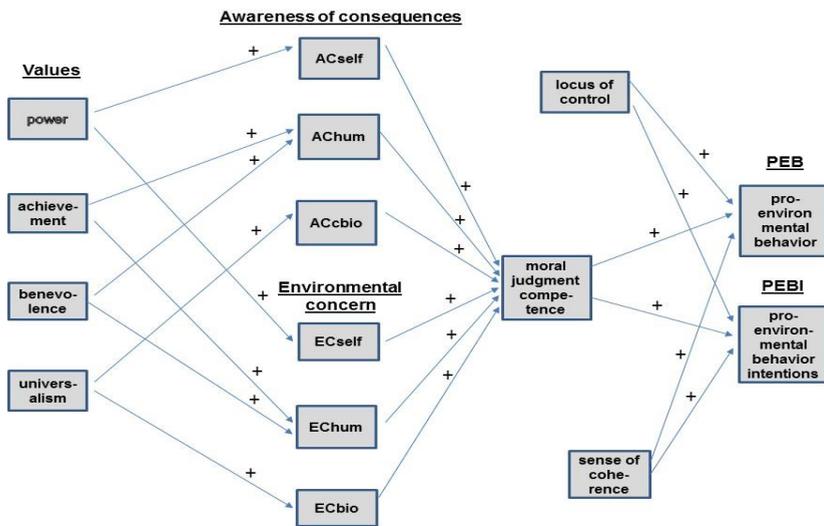


Figure 1. A hypothetical model of predictors of PEP and PEBI.

Behavioral perspective – a model of conscious behavior choice

As an extension of earlier conceptual and empirical research within behavioral analysis, the “Relational Frame Theory” (RFT) offers new perspectives on learning that occurs in the absence of direct experiences (Dymond & Roche, 2013; Hayes, Barnes-Holmes, & Roche, 2001; Törneke, 2010). Besides the commonly used motivational strategies within behavioral analysis, such as feedback and rewards, there was a need in this thesis to reinforce the achieved and rather small changes of residential energy behavior in a more intensive way. That is why the specific feedback strategy, based on

relational framing in presenting the energy consequences as much greater and clearer, was chosen in the energy-conservation intervention in Study 2, and evaluated by interviewing the intervention participants in Study 3.

Human language presents the opportunity to relate different stimuli to each other, and to derive associations verbally. These derived relations between stimuli will also affect the meaning we give to the stimuli and how they will affect us. Relating stimuli in this way is taking verbal behavior (Skinner, 1957) a step forward in defining derived relational responding. The core concept, namely, arbitrarily applicable relational responding, as described by Hayes et al. (2001), is based on Skinner's concept of operant conditioning (a learned response class). Moreover, the basic analytic units of human verbal behavior, namely, relational frames, may be combined into units that are more complex (Hayes et al. (2001). An example of this is when energy reductions achieved by participants in an intervention are met by feedback messages related to the size of reduction if all people in the country would reduce their energy in the same way. Verbal behavior may also have the function of rules or instructions aimed at future behavior and consequences that the individual has not experienced earlier (Hayes et al., 2001; Törneke, 2010), for example, feedback messages that relate energy reductions achieved today to limited climate changes in the future of our children and grandchildren.

An application of RFT was carried out in Study 2 of this thesis, where a feedback based on RFT, named "complex feedback", relates specific behaviors by specific participants at specific moments and in this way has a reinforcing and motivating effect on the capacity to change behavior towards energy reduction. Feedback was given with different contents in three different ways: (1) monetary framing, (2) environmental framing (CO₂), and (3) energy framing (kWh). The change of energy use compared to baseline was put in relation to financial short-term and long-term consequences for the participant, to energy production from a local, national, and international perspective, and to the environmental and climate consequences of changes in CO₂ emissions. For example, if a participant in the experimental group reduced the energy use by 1 kWh compared to baseline, feedback was given in three ways introduced with different symbols : (1) monetary framing with the message "You have used 1 kWh less energy compared to the same time last year. This means that you pay X1 Swedish crowns less for your energy this month, 12xX crowns less after a year if you keep your reduction and 20x12xX crowns less for your energy after twenty years with the same low energy use." In this way, a very small behavior change is reinforced by

relating this change to more complex economic consequences, which will further motivate change. The second way of giving feedback was: (2) environmental framing in terms of greenhouse gas emissions (CO₂) with the message “If all people in your town would reduce their energy use as much as you have now, 1 kWh, it would mean 95.4 tons less CO₂ emissions. This would correspond to the same reduction of CO₂ as if 43 people left the car at home and traveled by public transport to work (40 km) during one year.” This verbal behavior is setting the small-achieved change in relation to greater environmental consequences in order to reinforce and motivate to further behavior changes. The third way of giving feedback was: (3) energy framing (kWh) with the message “If everyone in Sweden reduced their energy consumption as much as you, 1 kWh, it would correspond to the energy that a medium-sized wind power plant in Sweden produces in two years.” The achieved and rather small change of energy behavior is intended to be reinforced by this relational framing in presenting the energy consequences as potentially much greater. A more international perspective on relational framing can be taken with the following feedback message: “If everybody in the EU made an energy reduction equivalent to yours, 1 kWh, it would mean the same amount of energy that the largest Swedish hydropower plant Harsprånget produces during three months.”

From the perspective of applied behavior analysis, a successful intervention will have to establish new contingencies by altering the consequences for targeted behaviors (Cone & Hayes, 1980; Newsome & Alavosius, 2011). Based on behavior analytic principles, the sustainable behavior of an individual involves a choice between response options that have differing short- versus long-term consequences. Knowledge about future aversive consequences (e.g., predictions about negative environmental outcomes because of global warming) does not necessarily lead to PEB, especially if an individual has no past reinforcing experience of that behavior, if the behavior is effortful, and/or if it competes with established behavior. In addition, promoting PEB is associated with a unique challenge, in that individuals are asked to change current convenient behaviors (mostly unsustainable) whose most harmful consequences are likely to occur in the temporally distant and uncertain future, something which makes the change unlikely (Hirsh, Costello, & Fuqua, 2015). This delay, between an individual’s current unsustainable behavior and any future environmental critical consequences, is a major barrier to change when considering the immediate positive consequences of the current unsustainable behavior (habits, convenience, and social norms). RFT challenges traditional behavioral

interventions, mainly in terms of direct-acting contingencies, in the sense that relational responding within RFT is a way of describing how language functions in our everyday behavior and affects how we relate to events and contingencies. Language colors our perception of experiences and is part of our relation to the environment. How we describe circumstances and frame relations thus strongly influences how we respond to certain PEB contingencies (Newsome & Alavosius, 2015).

This theoretical model of behavior analysis, described and applied in Study 2 of this thesis and with reference to RFT, relies on decisions governed by reflective, controlled, and conscious processes. The feedback given reinforces behavior changes preceded by deliberate mental effort in order to make decisions about important choices in life. Conscious decision-making refers to cognitive and emotional processes of forming preferences, selecting and executing an action from alternatives, and evaluating and predicting rewarding or aversive outcomes. However, not all decisions are governed by conscious processes.

Behavioral perspective – a model of unconscious behavior choice

Many of the choices that consumers make have important and long-lasting consequences for energy consumption and for the greenhouse gas emissions. This is true for the purchases of cars, houses, household appliances, clothing, and food. Modifying choice situations to make climate-friendly consumption easier originates in applied behavioral analysis. The behavioral analytic approach emphasizes observable actions and contextual variables that can be manipulated to promote behavior changes (Geller, 2002; Lehman & Geller, 2004; Schultz & Kaiser, 2012) and is based on the principles of operant conditioning with origins in the work of Skinner (1953, 1971). However, in recent years the intentions to promote daily pro-environmental curtailment behaviors have focused on certain behavior-focused initiatives usually referred to as nudges. To some extent, models from environmental psychology and behavioral economics have also contributed to shape the concept of nudging with the explicit goal to promote pro-environmental behavior changes (Stoknes, 2014).

Nudging means carefully guiding people's behavior in desirable directions, and arranging the choice situation in a way that makes the desirable behavior the easiest or most attractive option. Nudges may be appropriate when choices have delayed effects, when they are complex or infrequent and learning is therefore not possible, when feedback is not

available, or when the relation between choice and outcome is ambiguous, as suggested by Thaler and Sunstein (2008).

In contrast to the theoretical model of behavior analysis, RFT, described and applied in Study 2 of this thesis and which relies on decisions governed by reflective and conscious processes, an application of nudging is based on automatic, intuitive, and unconscious processes. This automatic way of making decisions may be described as cognitive and/or affective task-relevant processes that take place outside conscious awareness and guide large parts of our daily behaviors, that is, those things which we do routinely, almost automatically, for example, taking a walk, driving the car, and consuming our daily food. This model of behavior analysis, relying on decisions governed by intuitive and unconscious processes, was applied in Study 4 of this thesis, where the consumption of climate-friendly food is promoted by using nudging. It was an important challenge of this thesis to investigate the change of behavioral choices from the perspective of both conscious and unconscious decision-making processes.

By influencing the context in which a choice has to be made, it may be possible to bypass the cognitive system of conscious processes, and thus alter an individual's behavior in the desired way, as suggested by Thaler and Sunstein (2008) and Sunstein (2015). When relying on the cognitive system of unconscious processes, behavior change does not always mean that we need to change our mindset.

Within the research field of promoting daily pro-environmental curtailment behaviors, such as food consumption, specific applications of nudges have been defined, frequently called tools (Sunstein, 2015). Tools that count as nudging and have been applied in several consumer domains to influence consumption include 1) simplifying and framing of information, 2) changing layouts and features of different environments, 3) changing to the default policy, and 4) drawing attention to social norms in order to change behavior (Naturvårdsverket [The Swedish Environmental Protection Agency, EPA], 2014; Sunstein, 2015).

Based on the insight that the amount, accessibility, and complexity of information provided affect the decisions people make, nudging builds on presenting more simple and straightforward information in order to promote a desirable behavior. Simplification in combination with framing, and a conscious phrasing of the information, may also encourage decision-making by activating people's values and attitudes (Lehner, Mont, & Heiskanen, 2016). Simplified information tailored to specific choice situations increases the likelihood of influencing individual consumers, in making the information

more salient. A study showed that grocery shoppers base their choices in supermarkets on a small number of factors, where the salience of the factors in question is an important aspect. Most often these factors are price (for 46% of respondents) and health (36%), but they can be modified depending on the choice context (Kalnikaitė, Bird, & Rogers, 2013).

The physical environment also affects individuals' consumer choices. Changed accessibility, presentation, and visibility of food have a significant impact on the type and amount of food consumed (Lehner et al., 2016). One way to nudge people into buying certain products is to place these products on shelves at eye level. Also, products that are situated closest to the cashier are the ones that are often sold (Goldberg & Gunasti, 2007).

Another nudging tool, namely, changes to the default policy, is based on the fact that people prefer not to act unless they have to and instead procrastinate. For that reason they are easily influenced by defaults, standard choices, which determine the result in case people take no action. For example, a single-sided print option is a default which contributes to much higher volumes of paper than if the default option had been double-sided copies. Egebark and Ekström (2016) demonstrated in a Swedish study that 30% of paper consumption is determined by the default and that by switching the default options paper consumption could be reduced by 15%.

Finally, human behaviors are strongly influenced by social norms, which, according to Cialdini, Reno, and Kallgren (1990), affect the individual in two ways, namely, as injunctive norms and as descriptive norms. The injunctive norms affect the individual to act based on moral guidelines, that is, what ought to be done in certain ways. The descriptive norms, on the other hand, point to how most people behave (the "normal" way), thus giving the individual a benchmark for how to best act in a particular situation. The norm must be salient, that is, visible to the individual in order to exert influence on behavior (Cialdini & Goldstein, 2004). Thus, people seem to be greatly influenced by their social environment, for example, receiving information about others' behavior, when it comes to the type and amount of food they consume. In a study by Schwartz (2007), the social norm was made visible by a verbal prompt in order to affect fruit consumption in two schools. In one school where employees in the school cafeteria asked pupils "Would you like fruit or juice to lunch?", they found that 70% of the children consumed a fruit at lunch, compared to less than 40% in the control school where no such verbal prompt was given.

Nudging as a concept has been the focus of increasing attention over the past decade, not only among academics, but also among policy makers and in

civil society. Nudging approaches have been successfully applied in different areas and to different types of behavior, for example, with respect to the reduction of energy consumption (Allcott & Mullainathan, 2010), the limitation of paper consumption (Egebark & Ekström, 2016), and the reduction of food waste from restaurants (Kallbekken & Saelen, 2013). Lehner et al. (2016) concluded in their review that nudges hold a certain potential for reducing environmental impacts in the three environmentally critical domains of sustainable consumption, namely, energy, food, and transport.

However, some researchers have voiced critique against the lack of a clear theoretical delineation of the nudging concept. The question of what counts as a nudge, and where the boundaries between behavioral economics and conventional informative instruments lie, has also been raised by way of critique (Ölander & Thøgersen, 2014). Thaler and Sunstein used a very broad definition: "A nudge, as we will understand the term, is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (2008, p. 6). In the literature, many different ideas are generally used. These ideas have in common that choices are to a large extent dependent on the context and that many decisions are taken with little or no conscious processing preceding them. Parallel to an increased application of nudging, there is a growing need to critically review the theoretical value of the concept of nudging. Many researchers argue that nudging is not a theory per se, but an empirical application of pioneering work in behavioral decision theory to, for example, environmental problems, which gives rise to a need for elaborating a coherent "nudging theory" (Ölander & Thøgersen, 2014).

Interventions to promote pro-environmental behavior

The intervention strategies that will be described in this section were applied successfully to promote household energy conservation (Abrahamse et al., 2005; Steg & Vlek, 2009). A variety of antecedent strategies influence one or more determinants prior to the performance of behavior.

Interventions based on behavior analysis always target specific behaviors in order to produce constructive change. In other words, the behavior-based approach focuses on observing what people do, analyzes why they do it, and then applies a research-supported intervention strategy to improve people's observable behavior. The aim of an intervention based on applied behavior analysis, is to change external conditions in order to make pro-environmental behavior more likely (Gifford, 2014; Lehman & Geller, 2004). Behaviors are directed by the antecedent stimuli that precede them and indicate the

availability of a positive or negative consequence. Further appearance of the behavior is determined by the subsequent consequences. Most behavioral interventions targeting pro-environmental behavior include antecedent and/or consequence strategies for behavior change (Lehman & Geller, 2004).

Information

Communication and dissemination of information in mass media campaigns, and targeting participants of interventions on how to save residential energy, have been common policy approaches for a long time. However, they are usually ineffective. Research on information effects on residential energy consumption (Abrahamse et al., 2005) and travel mode choice (Möser & Bamberg, 2008) has generally found that information can increase knowledge but has minimal effects on behavior. Specific and correct knowledge about environmental problems may predict pro-environmental behavior to some extent (Fielding & Head, 2012), as well as tailored information, which is designed to reach a specific person or group on the basis of characteristics unique to those individuals (Abrahamse, Steg, Vlek, & Rothengatter, 2007). With the purpose to promote PEB, both general and tailored information was applied as antecedent strategies in Study 2.

However, information and knowledge may also constitute a psychological barrier. Gifford (2011) refers to limited cognition about the problem due to our ancient brain that is not developed to deal with diffuse threats whose consequences lie far in the future. Because we are bad at sacrificing short-term enjoyment for long-term benefits, we deny responsibility for what is happening. Greenhouse gases are not visible to the naked eye, since they are colorless and odorless, which makes it difficult to take the information about them seriously and know how to act (Gifford, 2008; Lorenzini, Nicholson-Cole, & Whitmarsh, 2007).

This lack of knowledge about the cause and extent of climate change becomes a source of uncertainty, something which, as experimental research on resource dilemmas has demonstrated, may lead to a reduction of pro-environmental behavior (Kortenkamp & Moore, 2006; Stoknes, 2014).

Even if knowledge and education alone often do not lead to more pro-environmental behavior, these factors can serve as priming agents. Humans are famously less rational than once believed, which is as true for thinking about climate change as it is in other domains (Kahneman, 2011). For this reason, simplification and framing of information in order to promote ecological food consumption was applied as an antecedent strategy in Study

4, relying on decisions governed by less rational, intuitive, and unconscious processes.

Commitment

A commitment is an oral or written pledge or promise to change behavior. Once people have made a commitment as an antecedent strategy, they are more likely to perform the target behavior due to the activation of personal and social norms, especially when the commitment is active, public, and perceived as voluntary (Abrahamse et al., 2005; Cialdini, 2003; Lehman & Geller, 2004). Social norms are rules and standards for human behavior that are shared by members of a group. These norms are what is commonly done or (dis)approved of and they refer to what other people think or do (Keizer & Schultz, 2013). In that sense, social norms can be potential driving forces for the progress of behavior change, but they can also contribute to regress (Thøgersen, 2008). The tendency to compare one's actions with those of others is true for most people (Festinger, 1954). From these observations of others, people derive which subjective and descriptive norms can be considered the "correct" behavior. In Study 2, the written consent to participate can be regarded as a commitment given by the households in order to reduce energy. Social norms were also applied as an antecedent strategy in Study 4 in order to promote a sustainable food consumption.

Goal setting

Setting one or more goals involves giving households, for instance, the goal to save 5% or 15% energy as a reference point. A goal can be set by the experimenters, or by the households themselves. It is assumed that individual behavior is goal-directed and that the anticipation of reaching an attractive goal motivates the desired behavior. Goal setting is most effective when the goals are high but realistic at the same time. This strategy is mostly used in combination with other intervention strategies (Abrahamse et al., 2005) and it is one of the antecedent strategies included in Study 2. After one has set a very high goal to save energy, for example, 40%, it may be difficult to reach this goal. People generally do not wish to see that they have failed and may perceive cognitive dissonance (Festinger, 1954) from still using a lot of energy, that is, behaving in a way that is not sustainable. In order to reduce cognitive dissonance, it is often easier to change one's mind ("energy use is not causing much CO₂ emissions") than to change one's behavior.

Modeling

Modeling strategies demonstrate a desired behavior to intervention participants who are influenced through observational learning, an insight based on Bandura (1977). The demonstrated examples used as antecedent stimuli are assumed to be followed when they are perceived as understandable, relevant, meaningful, and rewarding (Abrahamse et al., 2005; Sussman, Greeno, Gifford, & Scannel, 2013). Modeling can involve in vivo demonstrations, videotapes, or demonstrations via television, but it was not used in Study 2 due to technical limitations in the web-based system.

Changing external conditions

The physical environment affects behavior, which is also true for individuals' consumer choices. Changed accessibility, presentation, and visibility of food are antecedent nudging strategies with a significant impact on the type and amount of food consumed (Lehner et al., 2016). This antecedent strategy was not applied in Study 4, however, because of difficulties to apply a repositioning of the organic products without disturbing the daily business routine of the grocery store too much.

Changes to the default policy

As people have a tendency to procrastinate and prefer not to act unless they are forced to, they are easily influenced by defaults, that is, standard choices, which determine the result in case people take no action. If only ecological vegetables were offered in a grocery store and consumers had to ask for the non-ecological products if they preferred to buy such vegetables, this would be an antecedent nudging strategy. However, this strategy was not applied in Study 4, because it might have caused a negative effect on the sales and profits of the store, and appropriate agreements in advance with the storeowners were not made.

Feedback

Consequence strategies are assumed to be primary determinants of behavior (Lehman & Geller, 2004; Skinner, 1953) and mainly consist of feedback and rewards. Feedback involves providing information to people about their environment-relevant behaviors, and it is often applied to residential energy conservation. Such information makes the consequences of

behavior more salient and it may influence behavior because it can relate specific outcomes (e.g., energy savings) to specific behaviors.

Feedback is often given continuously by means of a monitor displaying electricity use per hour, as a real-time feedback equivalent to the feedback given by the display in Study 2, but in some studies the feedback is given daily, weekly, or monthly. Darby (2006a) and Grønhøj and Thøgersen (2011) have found positive effects of continuous feedback on the reduction of energy use. The most successful feedback approaches have resulted in household electricity savings of up to 20%, while the more common outcomes are savings from 5% to 12% (Darby, 2006a; Fischer, 2008). More frequently given feedback (daily or every hour) is more effective, according to Abrahamse et al. (2005) and Fischer (2008), as well as feedback given directly after an action and feedback given over a longer time. Karlin, Zinger, and Ford, however, describe in a meta-analysis from 2015 that feedback is more effective for shorter (i.e., less than 3 months) or quite long (i.e., longer than 1 year) feedback interventions.

Continuously given feedback by means of a monitor displaying electricity use per hour, was given to both the experimental and the control group in Study 2, but must be seen in contrast to the other consequence strategy, namely, the “complex feedback” based on the Relational Frame Theory and given only to the experimental group in Study 2.

It is not clear whether it makes a difference to give feedback with a different content, for example, in terms of monetary rather than environmental costs (Abrahamse et al., 2005). A literature review by Fischer from 2008, and another by Abrahamse et al. (2007), identify a combination of features for feedback to be successful as a tool for saving energy, for example, that feedback is based on actual consumption, involves interaction and choice for households, is presented in a clear and appealing way, and uses computerized and interactive tools.

Rewards

Monetary rewards have been shown to have a positive effect on energy savings and may serve as an extrinsic motivator to this behavior. However, results of several studies suggest that the effect of rewards is rather short-lived, as the desired behaviors usually dropped back to baseline levels when the reward was removed (Abrahamse et al., 2005). This was the reason for not applying the consequence strategy reward in the interventions in this thesis.

Which behaviors to target and how?

Despite a vast number of studies investigating the predicting effects of values, attitudes, and other psychological factors on pro-environmental behavior in general and energy conservation in particular, there are serious limitations to this approach. As mentioned above, one well-documented limitation of this social-environmental perspective is that self-reported attitudes, values, and intentions are only moderately related to actual change of behavior (Bamberg, 2003; Kaiser & Schultz, 2009). Because of this attitude-behavior gap, the approach of attitudinal research should target actual behavior change directly (Lehman & Geller, 2004; Newsome & Alavosius, 2011).

Nevertheless, a survey based on self-report was chosen to be carried out in the first study in this thesis, for two reasons. First, the planned intervention targeting observable energy savings was to be combined with self-reported measurement of underlying determinants of energy use behaviors, in order to increase the understanding of the success or failure of intervention programs (Newsome & Alavosius, 2011). Second, there was a need for a broad survey providing reference values in the population for the measured psychological factors that later could be compared with the corresponding values for participants in the planned intervention. In this way, it would become clear if people who were successful in reducing their energy consumption would show particularly high values regarding certain psychological factors. The daily behaviors that were targeted in Study 1 were eight specific types of PEB and PEBI in the field of lighting, transport, showering, food consumption, washing of dishes, and clothing, selected because of their great environmental impact.

There is some evidence pointing to the fact that the same determinants apply to all PEB (Kaiser & Gutscher, 2003). However, considerable evidence also points to different groups of PEB having different determinants (Abrahamse & Steg, 2009; Stern, 2000).

In order to design effective interventions, one should make careful decisions considering the behavior in question (Gatersleben, 2013; Steg & Vlek, 2009). Targeted behaviors should have demonstrated large and negative environmental impacts, and a certain level of specificity, and they should be amenable to change (Schultz & Kaiser, 2012). The most effective interventions are tailored to the individual/household and to the specific behavior.

These interventions also take into account the specific barriers related to the behavior, and use mixed strategies (Abrahamse et al., 2007). A combination of strategies for behavior change will be more successful, as there

is mostly more than one barrier to any pro-environmental behavior (Gardner & Stern, 2002; Lehman & Geller, 2004; Osbaldiston & Schott, 2012; Schultz, 2014; Steg & Vlek, 2009). Fischer (2008), however, reveals mixed findings, and Ehrhardt-Martinez, Donnelly, and Laitner (2010) mean that there is no current consensus regarding the impact of combined interventions. Whether interactions between the different strategies are to be found, is still a question to be answered.

A final consideration in selecting a target behavior is to choose actions where change is possible. It has been shown that targeting individuals that are not already doing what seems possible within a certain behavioral domain, for instance, high consumers of residential energy, has a greater potential for change than involving individuals that already engage in the targeted behavior (Schultz & Kaiser, 2012).

The behavior chosen to be investigated in Study 2 was energy use in private households, mainly because of the possibility to measure CO₂ consumption in real time. Energy consumption in households has a large and negative environmental impact and may be amenable to change by tailoring the influence on the individual. The six specific categories of energy behaviors with great potential for energy savings to be studied were: use of refrigerator and freezer, lighting, use of entertainment technology, cooking, washing of dishes and clothes, drying of clothes, and showering. A breakdown of electricity into specific rooms and activities was, however, not technically possible. The underlying psychological determinants of behavior change from Study 1 were simultaneously examined.

In order to increase the understanding of how to design successful interventions for behavior change, the experiences of the participants were investigated in Study 3 by conducting semi-structured interviews. The participants were asked about their expectations of the intervention program and their experiences of the period with information about the environment and climate. Further topics were the visual feedback of consumption through the graph, the complex feedback, experiences of the transition from an old habit to the adoption of a new behavior, and experiences of the content and instructions of the program.

Another behavior with great environmental impacts, and with consequences for climate change, is food consumption. In order to study ecological consumption of fruits and vegetables, in Study 4, by influencing consumers in their consumer decisions in the grocery store, we used the behavior-focused initiatives commonly called nudges. It was an interesting challenge to apply a model of behavior analysis based on automatic, intuitive,

and unconscious processes using nudging. This was in contrast to the more traditional theoretical model of behavior analysis described and applied in Study 2 of this thesis, relying on decisions governed by reflective and conscious processes. In Study 4, the intervention had its focus on the behavior, without taking any account of consumer values and attitudes, as no data from the consumers was collected. To make nudging successful, a possibility would be to apply it in environments with high levels of control over the behavior of consumers and with little or no interference by other actors, for example, in school canteens. Because so many competing factors affect the individual through marketing in the retail store, nudging is not always very impactful. However, it is important to challenge the environment where most daily choices of food products are made, namely, in the food stores, in order to achieve more sustainable food consumption.

Relatively little is known about the long-term effects of interventions and their cost effectiveness. Due to limitations in time or resources, or to other constraints, many studies have not monitored the effects of the interventions over longer periods. It is, however, crucial to establish whether behavior changes are maintained once an intervention has been discontinued (Abrahamse et al., 2005; Lehman & Geller, 2004; Staats et al., 2004). The maintenance of a new established behavior was investigated in Study 2.

Intervention research is often action-based and seems to lack a coherent theory underlying the promotion of PEB. In order to enhance our understanding of informational strategies and behavior change, it is important to clarify the underlying theoretical assumptions about how interventions work, in what contexts they work, and for what types of behavior they are suitable. These factors should be systematically recorded as part of an evaluation (Gifford, 2014a).

2. Aim

The overall aims of this thesis were to investigate the effects of interventions on energy conservation and ecological food consumption in promoting pro-environmental behavior, to explore experiences of an energy-saving intervention from the perspective of the participants, and to investigate how values, attitudes, and other psychological factors predict pro-environmental behavior and pro-environmental intentions. The specific aims of the studies included in the thesis were as follows:

The *specific aim of Study 1* was to investigate the predictive power of value orientation, awareness of consequences, environmental concern, moral judgment competence, locus of control, and sense of coherence, on eight pro-environmental behaviors and behavioral intentions.

The *specific aim of Study 2* was to evaluate the intervention effects of “complex feedback” based on Relational Frame Theory on residential energy conservation, and to explore interactions between the feedback effects and the psychological factors from Study 1.

The *specific aim of Study 3* was to explore the experiences of participating in the intervention on energy conservation (Study 2), in order to increase the understanding of how a process of change affects the participants, and gain more knowledge about how to design effective interventions.

The *specific aim of Study 4* was to investigate the effects of behavior-focused initiatives, usually referred to as nudges, in an intervention to promote the consumption of organic fruits and vegetables.

3. Methods

The methods used in this thesis differ between the four studies regarding design, participants, data collection, and analyses. The system of methods used in the four studies is presented in Table 1.

Table 1
Overview of the methods used in the thesis

Study	Design	Participants	Data collection	Analyses
1	Survey	463 residents	Paper questionnaire	Path analysis
2	Randomized experimental field study	25 households	Web-based registration of electricity use	Descriptive analysis
3	Qualitative analyses	8 households	Interviews	Content analysis
4	Experimental field study	Consumers in a grocery store	Digital registration of consumption	Analysis of variance

The different types of design used in this thesis were a survey (Study 1), a randomized quasi-experimental field study (Study 2), a qualitative analysis (Study 3), and a quasi-experimental field study (Study 4).

Participants in Study 1 were recruited from residents living in the Swedish cities Stockholm and Uppsala, obtained from the National Register of Residents in Sweden (SPAR). The only inclusion criterion was an age between 18 and 65 years. To be included in Study 2, the individuals had to have lived for at least one year in apartments that were rented out by a municipal housing company in Sweden. The individuals also needed to have the intention to stay for another six months in their apartments, to be included. The participants in Study 3 consisted of the eight individuals who completed the intervention in Study 2. Since the consumption of fruit and vegetables was digitally recorded in a grocery store in Study 4, the participants in this study were anonymous.

Study 1

Values, attitudes, moral judgment competence, locus of control, and sense of coherence as determinants of pro-environmental behaviors and behavioral intentions

Participants and procedures

A random sample of 2,000 residents from the Swedish cities Stockholm and Uppsala and aged between 18 and 65 years was obtained from the National Register of Residents in Sweden (SPAR). A survey questionnaire was mailed to them and 468 usable questionnaires were completed, representing a response rate of 23.40%. The analysis, including 463 questionnaires (female 56.8%), was preceded by the deletion of five surveys and two variables, due to missing values. After deletion, the missing data was limited to six cases reaching 10 to 30%, no variable exceeding 4% was missing data, and values missing reached an overall of 0.54% of the total values. Cases with missing data were excluded pairwise from the relevant scale data.

Measurements

In addition to items covering sociodemographic data (sex, age, education, marital status, nationality, and type of housing), the main constructs were measured as follows:

Value orientation was measured using a selection of 16 value items from Schwartz's (1992) Value Inventory Scale. The respondents were asked to indicate the degree to which each of the 16 values was a guiding principle in their lives. Each value was rated by the respondents on a scale from 1 ("fully disagree") to 5 ("fully agree"). The values social power, wealth, social recognition, authority, self-respect, ambition, influences, and capability, represented self-enhancement. The values social justice, equality, a world at peace, loyalty, forgiveness, tolerance, the welfare of others, and responsibility, represented self-transcendence (Schwartz, 1992). Higher scores indicate stronger guiding principles in the lives of the respondents. The internal consistency, Cronbach's alpha, was 0.69 for the value type power, 0.75 for the value type achievement, 0.61 for the value type benevolence, and 0.73 for the value type universalism. One item was excluded from the power scale and one item from the universalism scale, in order to improve reliability. With an internal consistency not reaching 0.70, the value type power showed a mean inter-item correlation of 0.31.

Awareness-of-consequences beliefs (AC) were measured according to Stern et al. (1993), and used in a similar way to Gärling et al. (2003), where respondents indicated to what extent they agreed with 9 items measuring egoistic, altruistic, and biospheric AC using three items for each AC subscale rating on a scale from 1 (“fully disagree”) to 5 (“fully agree”). Items were recoded to make higher scores indicate stronger beliefs that environmental degradation adversely affects valued objects and that environmental protection benefits them. After eliminating one question from the awareness of consequences for oneself, the ACself scale, and one item from the awareness of consequences for others, the AChum scale, the reliability was slightly improved to Cronbach’s alpha of 0.51 for oneself, 0.50 for others, and 0.54 for the biosphere. The low reliability of these scales is in accordance with Gärling et al. (2003), with a reported Cronbach’s alpha of 0.45 (ACself), 0.42 (AChum), and 0.54 (ACbio), which is confirmed by Snelgar (2006). For the two-item scales of ACself and AChum and the three-item scale ACbio, showing low reliability with an internal consistency not reaching 0.70, the mean inter-item correlation was 0.21 for ACself, 0.11 for AChum, and 0.29 for ACbio.

Environmental-concern evaluations (EC), as suggested by Schultz (2001), were used with 12 items to measure environmental concern with the question: “I am concerned about environmental problems because of the consequences for:” (abbreviated version of Schultz, 2001, p. 338). Participants were asked to indicate the degree to which they were concerned about harmful effects of environmental problems for the following items: egoistic items (ECself): my future, my lifestyle, my health and me; altruistic items (EChum): all people, children, people in Sweden, and my children; and biospheric items (ECbio): plants, marine life, birds, and other animals. Respondents were asked to rate their concern on a scale from 1 (“fully disagree”) to 5 (“fully agree”), with higher scores indicating stronger environmental concern. Cronbach’s alpha reached 0.90 for environmental concern for oneself (ECself), 0.86 for others (EChum), and 0.91 for the biosphere (ECbio). The reliabilities of the three subscales in this study are well in line with Cronbach’s alpha reported as good to high by Schultz (2000, 2001) and Schultz et al. (2005).

Moral judgment competence was assessed using the MJT, a questionnaire created by Lind and derived from his dual-aspect theory. The participants completed the Swedish version of MJT, validated and certificated by Lind (2010a). The MJT assesses moral judgment competence (MJC) by recording how a subject deals with arguments, especially with arguments that oppose his/her position on a difficult problem (Lind, 2008). The main index for moral competencies, the *C-score*, measures the degree to which a subject’s judgments

about *pro* and *con* arguments is determined by moral concerns or principles rather than by non-moral opinions. It is an experimentally designed functional measure (Lind, 2008). Participants confront two moral dilemma stories. One is about workers dealing with a law violation and the other one is about a doctor having to decide whether he is going to assist a dying patient to take her own life (euthanasia). The respondent must express whether he/she approves or disapproves of a string of arguments in favor of or against the described behavior in each story. After the participant has made a decision about the dilemma described (“Was the behavior of the workers/doctor correct or incorrect?”), the participant is given six arguments in favor of the decision and six against it for each dilemma (Lind, 2009). These arguments are designed to represent each of Kohlberg’s six moral orientations (Kohlberg, 1984). The participants responded to a 9-point Likert-type scale ranging from “-4” (completely disagree) to “+4” (completely agree). An example of an item in favor of the workers’ behavior corresponding to the developmental Stage 1, is “Because they didn’t cause much damage to the company.” Another example of an item against the workers’ behavior corresponding to Stage 4, is “Because we would endanger law and order in society if everyone acted as the two workers did” (Lind, 2009).

The calculation of a C-score ranging from 1 to 100 followed the procedure devised by Lind (2010b). It indicates the percentage of an individual’s total response variation due to his/her concern for the moral quality of given arguments or behavior. It may be categorized as *low* (1-9), *medium* (10-29), *high* (30-49), and *very high* (more than 50 points) (Cohen, 1988; Lind, 2010b). Cases with one or two missing data (MD) have been replaced by the individual mean (38 cases). Cases with more than two missing data (10 cases) have been eliminated in the analyses by using “Exclude cases pairwise” (Lind, 2008, 2010b). The original German version and all certified translations of the MJT, including the translated and validated Swedish version (Lind, 2010a), are valid measures of moral judgment competence (MJC) and moral attitudes, by virtue of the test design and five empirical criteria derived from the dual-aspect theory of moral behavior. Conventional criteria of test analysis, based on classical test theory and item response theory (“test reliability”, “test consistency”), do not apply to the MJT because this test has been rigorously validated using theory-based criteria (Lind, 2008).

Locus of control was measured using an abbreviated version of the Rotter scale (1966). Andersson (1976) developed this version for use in Sweden, mainly in work settings. The scale consists of eight statements related to the construct of locus on control. For each statement, participants made

agreement-disagreement ratings on a 5-point scale from “agree completely” (1) to “disagree completely” (5). The summed ratings have a minimum score of eight and a maximum of 40, with a low score representing an external locus of control orientation and a high score representing an internal locus of control orientation. The variable locus of control (LOC) was dichotomized around the mean of 27.47 (SD = 4.54), with the cut-off point set at 27.47. Individuals who scored 27.47 points or less were designated as having an external locus of control (ELC, 54.2%), while individuals who scored 27.48 points or more were designated as having an internal locus of control (ILC, 44.1%). The locus of control (LOC) scale was tested for consistency using Cronbach’s alpha. The result shows a coefficient of 0.72, which is well in line with the recommendations of DeVellis (2003).

Sense of coherence (SOC) was measured with a 13-item short version of the original scale. It covers the three components of the SOC concept, that is, comprehensibility, manageability, and meaningfulness (Antonovsky, 1993). Respondents were asked to rate their SOC on a scale from 1 to 7, with a high score representing high SOC. In this sample, the internal consistency of the sum score, assessed with Cronbach’s alpha coefficient, was 0.85.

Outcome variables were eight specific types of PEB and PEBI targeting everyday behaviors with an environmentally great impact. The eight types of PEB and PEBI were: (1) using low-energy lighting in the residence, (2) buying garden-grown vegetables, (3) using public transport, (4) using a well-filled dishwasher and washing machine, (5) avoiding air travel in one’s spare time, (6) showering briefly, (7) recycling the household waste, and (8) airing clothes instead of washing. Both current behavior (PEB) and future intentions (PEBI) were measured, in order to get a sense of the existing practices of the respondents as well as their willingness to engage in environmental actions in the future.

Respondents were asked to rate variable (1), that is, using low-energy lighting in the residence, on a scale from 1 (“everywhere”) to 4 (“nowhere”), while the other seven types of PEB and PEBI were rated on a scale from 1 (“always”) to 4 (“never”). Items were recoded to make higher scores indicate higher levels of environmentally responsible actions, which means a *sustainable lifestyle*.

Cronbach’s alpha for the total scale of PEB and PEBI together, as *sustainable lifestyle*, was 0.75. The scale measuring sustainable lifestyle was divided into two separate sections, *actual lifestyle*, corresponding to PEB, and *intentional lifestyle*, corresponding to PEBI.

Data analysis

Relations of study variables were explored using the Pearson product-moment correlation coefficient. Predictors of PEB and PEBI were analyzed by using path analysis. Due to a slight violation of multivariate normality assumptions, robust maximum likelihood estimation was used. The value scales universalism and benevolence, awareness of consequences for oneself, for others and for the biosphere, and environmental concern for others and for the biosphere were transformed using logarithmic transformation. Possible indirect effects were tested by calculating 99% bias-corrected bootstrapped confidence intervals based on 1,000 bootstrapping resamples, as suggested by Mackinnon, Lockwood, and Williams (2004). A chi-squared test (χ^2), root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker–Lewis index (TLI), were used to evaluate the goodness-of-fit of the model. The $RMSEA < 0.05$, $CFI > 0.95$, $TLI > 0.90$ and a non-significant ($p > 0.05$) χ^2 test indicate an acceptable model (Kline, 2005). After fitting the theoretical model, all possible modifications were made based on modification indexes. Path analysis was carried out using Mplus version 7.2 (Muthén & Muthén, 1998-2010). To exclude the effect of possible confounding variables all data from the path analyses was also analyzed by controlling age, gender, and education.

Study 2

Challenges in evaluating intervention effects of feedback on residential energy conservation in a field setting

Participants and procedures

The participants were individuals in households living in apartments that are rented out by a municipal housing company in Sweden. Recruitments were made by means of a written request to participate sent out to 1,430 households from an address list provided by the housing company. Only households who had lived in their apartments for at least one year and who had the intention to stay for another six months were eligible. Consent to participate was given by 25 households, which were then randomly assigned to an experimental condition consisting of 13 participants and to a control condition consisting of 12 participants. Of the original 25 participants, 8 completed the intervention (experimental and control group) and 7 participants partly followed the intervention by completing a varying number of periods. In order to use also the information provided by these participants,

a third group was created, labelled the outgroup. The attrition rate was 10 participants (40%). No formal analysis of attrition was possible due to limited sample sizes. Each participant represented a multi-person household of electricity users and all registering of electricity use applied to the household as a whole. The individual who was in contact with the researcher and gave consent to take part in the study is referred to as “the participant.”

Intervention

The apartments were technically equipped with electricity meters allowing separate measurement of energy use in every apartment, which enabled monitoring of electricity use in kWh every hour. As baseline measures, data from three months before the intervention period was obtained for each household. The web system made the use of electricity visible in graphs to participants logging in to the web system. The electricity consumption recorded by the graphs was the total amount of electricity use in the entire apartment. A breakdown of electricity use into specific rooms and activities was not technically possible. An overview of the intervention, consisting of eight different periods of varying duration and content for the two groups, is shown in Table 2.

After completing a questionnaire (PRE, see Questionnaire measures below), all participants received written information about the climate, the environment, and lifestyles (period 1). The information contained facts about the impact of human lifestyle on climate change in terms of increased greenhouse gas emissions. The texts also showed possibilities for changing behavior regarding transport, food, and energy consumption in a way that would help to limit climate change. Both groups were encouraged to observe their daily electricity consumption given by the graphs as continuous feedback (period 2). In addition, the experimental group received advice on six categories of energy behaviors with great potential for energy savings (use of refrigerator and freezer, lighting, entertainment technology, cooking and dishes, laundry and drying of clothes, and showering) and was encouraged to keep a diary about how these behaviors were visible on the graph (period 2). For example, taking a shower and preparing breakfast in the morning could be observed as an increase of the energy consumption visible on the graph during the morning hours. These observations and self-reflections were communicated with the project manager via a message function in the program.

During the next period, the experimental group was offered different options of goal setting for energy reduction of two behaviors of free choice

among each of the six categories of energy behaviors previously presented (period 3). For example, “Allow hot food to cool before putting it in the fridge and freezer” and “Always wash with a fully loaded washing machine” constitute two options of goal setting. After a period of focusing on the change of the chosen behaviors (period 4), a new process of goal setting and choice of behaviors followed (period 5). The web system provided individualized complex feedback to the participants in the experimental group each time their energy use deviated from baseline (periods 4 and 5). Feedback was given with different content in three different ways, as described above in the section about behavioral perspective. The combination of strategies directed to the experimental group during the periods 2-5 was expected to be more successful than using just one strategy, as there is mostly more than one barrier to any pro-environmental behavior. In addition, the intention was to study possible interactions between the strategies. No further activities than general information about energy savings were directed to the control group (periods 2-5).

After eight weeks of intervention activities, both groups completed a short survey about the intervention program (period 6), followed by three months of inactivity in order to study if the savings in energy use would be maintained (period 7). The intervention was completed by a second questionnaire (POST, see Questionnaire measures below) (period 8). Further details regarding the intervention are described in the paper.

In addition to items covering sociodemographic data (sex, age, education, marital status, nationality, and type of housing), the same measurements as in Study 1 were used to examine the underlying psychological factors.

Table 2
Overview of intervention design

Period	Duration	Experiment	Control
Period 0	1-2 days	Questionnaire (PRE)	Questionnaire (PRE)
Period 1	5-6 days	Information, climate, lifestyle	Information, climate, lifestyle
Period 2	14 days	Observation of daily use Advice on types of behavior Diary	Observation of daily use Information of energy savings
Period 3	7 days	Goal setting Choice of behavior change	Information of energy savings
Period 4	14 days	Behavior change Complex feedback	Information of energy savings
Period 5	14 days	Goal setting Choice of behavior change Behavior change Complex feedback	Information of energy savings
Period 6	1 day	Survey about the intervention	Survey about the intervention
Period 7	90 days	Maintenance	Maintenance
Period 8	1 day	Questionnaire (POST)	Questionnaire (POST)

Data analysis

The very small number of households participating within each group did not allow for an inferential statistical analysis in order to make meaningful comparisons of intervention effects. Due to these small sample sizes, further analysis of the results was based on individual means and on the observation of individual and group usage patterns.

Study 3

Experiences of reducing household energy consumption – a qualitative analysis of a field study

Participants and procedures

All participants who had completed the intervention carried out in Study 2 were recruited to take part in semi-structured interviews. Eight households – three participants from the experimental group and five participants from the control group – were interviewed.

Interviews

The interviews were thematic and the interviewees were asked to speak freely about a number of topics. One topic was expectations of the intervention program, followed by experiences of the questionnaire and experiences of the period with information about the environment and the climate. Further topics were the visual feedback on consumption through the graph, experiences of the transition from an old habit to the adoption of a new behavior, and experiences of the content and instructions of the program. The opening question was, *Could you please tell me about your experiences of participating in the intervention program?* The answers were followed up with clarifying and exploratory questions, such as *How did you feel about that?* and *How was it for you?* The following questions were specifically addressed to the experimental group: *How did you experience the moment of setting goals for a change of behavior?* and *How did you experience the complex feedback on energy reduction provided within the program?* This last question was sometimes followed by exploratory comments, such as the following: *The feedback given in three different ways, about energy costs and environmental consequences related to CO₂ and kWh, respectively.* The following question was specifically addressed to the control group: *How did you experience your choice of certain energy behaviors for change?*

The interviews lasted between 40 and 60 minutes and were all performed by the same researcher (KW). Five interviews were conducted face-to-face in a municipal library near the apartments of the participants and one in a restaurant. Two interviews were conducted through Skype calls. The interviews were tape-recorded and transcribed verbatim, including notations of non-verbal expressions such as silence and laughter.

Data analysis

The interview transcripts were subject to qualitative content analysis where common themes across different households were identified (Graneheim & Lundman, 2004; Kvale, 1997; Krippendorff, 2004). An inductive, data-driven, bottom-up approach was applied in creating codes, sub-categories, and categories on varying levels of abstraction with the aim of identifying themes.

Study 4

The effect of nudging in promoting the consumption of organic fruits and vegetables

Participants and procedures

The study was conducted in cooperation with a grocery store in a small town in Sweden. The purchase of nine different fruits and vegetables, available as both organically and conventionally produced products, was measured during the opening hours, 8 a.m. to 9 p.m., on eight consecutive Fridays. Organic and conventional products were placed next to each other on the same shelf. Nudging instruments were applied directly to the selected organic products and were visible to the consumers every other week, on four Fridays (the nudge days). No nudging instruments were applied and visible to the consumers on the other four Fridays (the baseline days).

Materials

Signs were made specifically for nine different products, two fruits and seven vegetables. The fruits (lemon and apple) as well as the vegetables (cherry tomato, carrot, pepper, iceberg lettuce, rucola, broccoli, and baby spinach) were selected because they were available both as organically and conventionally produced products. The paper signs were coated in plastic, all of them were size A5 (6 x 8.4 inches), and there was a color photo of the product at the top. Below the photo, all signs had a short text presenting simple and straightforward information in order to promote the desirable behavior of choosing that specific organic product, for example, *Organic carrots are grown in a way that improves the health of the soil*. At the bottom of the signs of lemon, carrot, iceberg lettuce, broccoli, and baby spinach, there was either a descriptive norm referring to the behavior of others, for example, *Increasingly more people have bought organic lemons in recent years*, or an injunctive norm referring to what ought to be bought, for example, *If you choose organic baby spinach, you will spare the environment*. Instead of social norms, the signs for apple, cherry tomato, pepper, and rucola, contained an emotional image of a happy face at the bottom.

The consumption data of the targeted products was selected and delivered from the general digital registration of consumption in the grocery store.

Data analysis

Data was analyzed using three-way analysis of variance to test for the effect of nudging, price differences, and duration of the parts of the intervention on the percentage of organically produced fruits and vegetables sold. A price index was computed, dividing the unit price of the organic product by that of the correspondent non-organic one. Based on this index, two groups were formed: Group 1, similar prices (index <1.5), and Group 2, different prices (index >1.5). Furthermore, in order to evaluate possible effects of the repeated manipulation, the duration of the intervention in time was divided into two parts (Time 1: the first four Fridays, including two nudge days and two baseline days, and Time 2: the last four Fridays, including two nudge days and two baseline days).

4. Ethical considerations

The first two studies were approved by the Regional Ethical Review Board in Umeå, (Study 1, Reg. No. 2010-248-31 Ö, and Study 2, Reg. No. 2011-172-31 Ö).

Participants recruited to these two studies were given written information about the relevant study. They were informed that participation in the study was voluntary and that a withdrawal from the consent to participate was possible at any time without giving a reason. The information given included how to make a request for withdrawal and how to ask general questions about the study. In addition to this, participants were informed about their right to confidentiality, how data was to be stored, and how results would be published. The participants in these studies gave their written informed consent to participate.

The questionnaires in Study 1 were coded and separated from the written consent form. The intervention in Study 2 was conducted by using a specifically created web-based system for data collection and the implementation of the intervention. Participants were assigned a personal ID number and a password for login. Communication between researcher and participants took place within a messaging system included in the web-based system, or via email, to which the participants had given their consent. The transfer and registration of tenants' energy consumption from the municipal housing company to the database system of Mid Sweden University were governed by a special written agreement between the parties.

Participants in Study 3 were recruited from participants who had completed the intervention in Study 2, which was preceded by the ethical approval mentioned above. No additional ethical aspects needed to be considered since all questions included in the interviews involved experiences of the intervention itself, without questions connected to the participants' personal opinions and identity.

Since no participants were actively recruited to Study 4, no personal data was collected, and the procedures did not include any risk of physiological or psychological harm, ethical approval was not required.

5. Results and conclusions

Study 1

Results

The aim was to investigate the predictive power of a number of psychological factors, namely, value orientation, awareness of consequences, environmental concern, moral judgment competence, locus of control, and sense of coherence, on eight pro-environmental behaviors and behavioral intentions. After fitting the modified model, where non-significant paths were removed and additional direct effects and residual covariances were added to the model based on modification indexes, an acceptable fit was achieved.

Significant indirect effects were found when predicting intentional lifestyle with universalism. Specific indirect effects were found via awareness of consequences for the biosphere ($b=0.26$, 99% CI = 0.05-0.48) and via environmental concern for the biosphere ($b=0.33$, 99% CI = 0.11-0.56) (see Figure 2). Further, a direct effect between universalism and intentional lifestyle was statistically significant ($b=1.29$, 99% CI = 0.60-1.98). Universalism also had a significant indirect effect via awareness of consequences for the biosphere when predicting actual lifestyle ($b=0.19$, 99% CI = 0.022-0.36). A direct effect was also statistically significant ($b=0.73$, 99% CI = 0.08-1.38).

Most of these results remained after controlling the age, gender, and education as covariates. The only differences were that direct effects from environmental concern for oneself and universalism on locus of control, and direct effects from awareness of consequences for oneself to actual lifestyle and to intentional lifestyle, were no longer statistically significant.

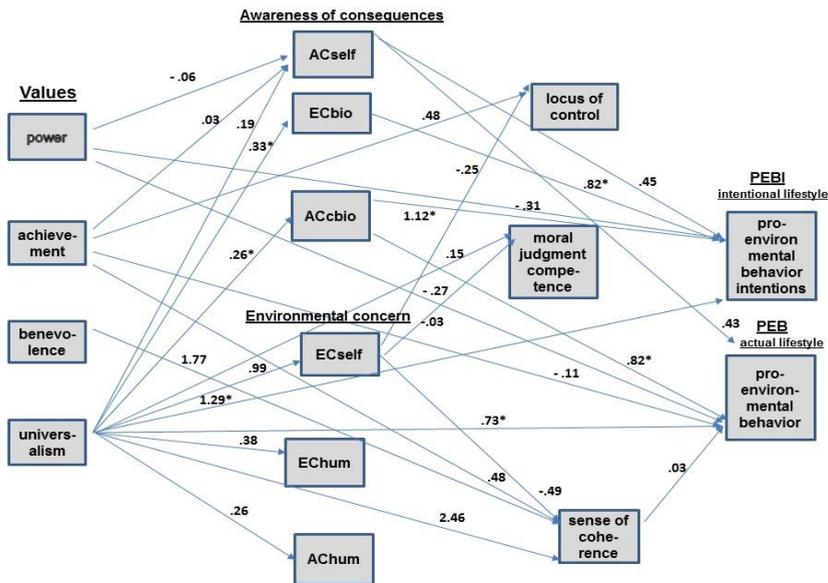


Figure 2. The final path model of predictors of PEP and PEBI

*significant path coefficient

Conclusions

These results indicate that the value type universalism predicts PEB and PEBI with attitudes, awareness of consequences for the biosphere, and environmental concern for the biosphere, as intermediate or transmitting variables. The findings are well in line with previous research. However, the expected predicting effect of values on PEB and PEBI with moral judgment competence as a moderating or mediating variable, was not confirmed. Neither were the environmental attitudes biospheric environmental concern (ECbio) or biospheric awareness of consequences (ACbio) confirmed as predictors of PEB and PEBI. In the same way, path analyses could not confirm the expected effects of moral judgment competence, locus of control, or sense of coherence on PEB and PEBI.

Study 2

Results

The aim was to evaluate the intervention effects of feedback on residential energy conservation. The mean values of energy consumption for the

experimental group showed only a slight tendency to reduced electricity use observed when the complex feedback was provided (see Figure 3). As expected, no energy use reduction during the complex feedback was discernible for the control group. For the outgroup, there was an unexpected reduction of energy use during period 4, although the participants of this group did not take an active part in the intervention after period 3. It was not possible to relate the found values of the psychological factors to any successful behavior change.

During period 7, that is, the last period of the intervention after all active intervention strategies were removed for three months in order to study if reached savings in energy use would be maintained, the levels of energy use almost remained on the level from the previous period, for the experiment group and the outgroup. Thus, almost no decline of intervention-related savings occurred. An interesting and unexpected tendency of lower energy consumption for the control group was, however, observed during period 7.

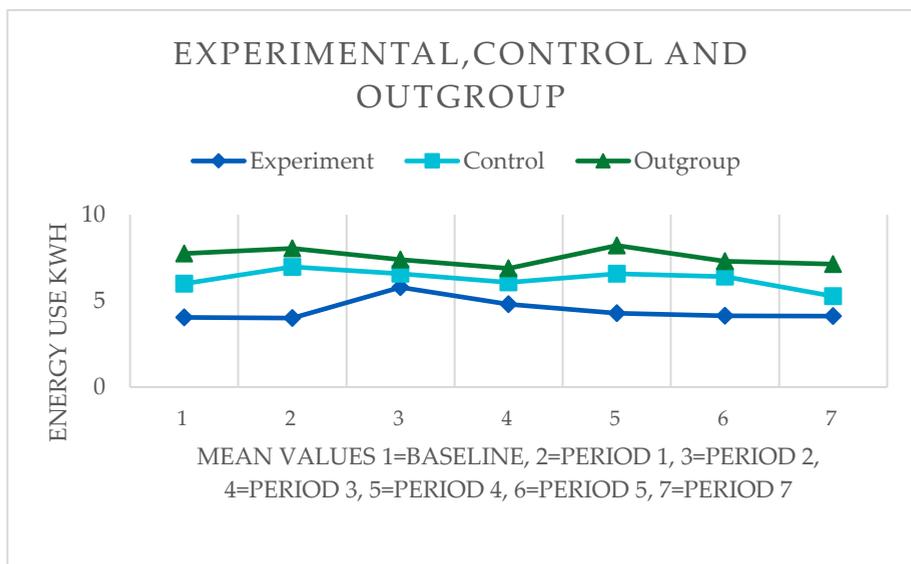


Figure 3. Energy consumption (kWh) as mean values for the experimental, control and outgroup in each period during the intervention.

Period 1: information (exp and con); **Period 2:** observation of daily use, advice on categories of behavior, diary (exp); observation of daily use, information about energy savings (con); **Period 3:** goal setting, choice of behavior to change (exp); information about energy savings (con); **Period 4:** behavior change, complex feedback (exp);

information about energy savings (con); **Period 5**: goal setting, choice of new behavior to change, behavior change, complex feedback (exp); information about energy savings (con); **Period 7**: maintenance (exp and con).

Conclusions

The expected effects of complex feedback on energy reduction were not found. However, the consumption pattern of the experimental group could indicate that the participants had, to a small extent, been affected by the motivation-increasing strategies during periods 4 and 5, after which consumption increased slightly during period 7 when the complex feedback was aborted. The main problem is the very small sample size, which reduced the statistical power so that the study failed to find any statistically significant effects.

Study 3

Results

The aim was to explore the experiences of participating in the intervention carried out in Study 2. The findings indicate that the factors influencing the experience of participating in an intervention in order to change behavior, are complex and constitute an interaction of positive and negative factors. The themes pointed out the importance of the motivation-increasing factors being sufficiently prominent to counter internal and external barriers to behavioral change. Furthermore, the interviewees described difficulties in breaking old habits that were related to comfort and laziness. In addition, they described personal limitations and external obstacles that complicated the ability to change everyday life. They also reported experiences of ambivalence about prioritizing personal interests over the environment. Despite this, the results showed a willingness to change behavior as well as confidence in the ability to do so, and they showed that the program had a motivational impact. The program as a whole met the expectations and was perceived to have had a positive impact on the participants' ability to reduce energy consumption in the home. However, requests for a more challenging intervention program and extended motivating strategies were also expressed.

Conclusions

These results support the importance of specific strategies in developing the design of future interventions for promoting residential energy conservation.

One strategy is to decrease uncertainty about the relationship between a behavior and its effect on energy use by offering deliberated knowledge about the beneficial environmental effects of energy behavior changes, and clear instructions on how to use technical equipment, in order to increase motivation. Another strategy is to reduce ambivalence by making all the applied strategies and instructions very clear, easily accessible, and easily comprehensible. Furthermore, motivation strategies used in interventions should be adapted to the participants' level of energy competence. Finally, one might question the current conventional and individualistic approach to pro-environmental behavior change in asking if this is within the capacity of individuals to bring about alone, or whether more fundamental structural changes in society are needed.

Study 4

Results

The aim was to investigate the effects of behavioral interventions, commonly known as nudges, in promoting the consumption of organic fruits and vegetables. The results revealed that nudging had a greater effect on the percentage of organic products sold when price differences between the organic product and the correspondent non-organic one were lower, but only in the first part of the study.

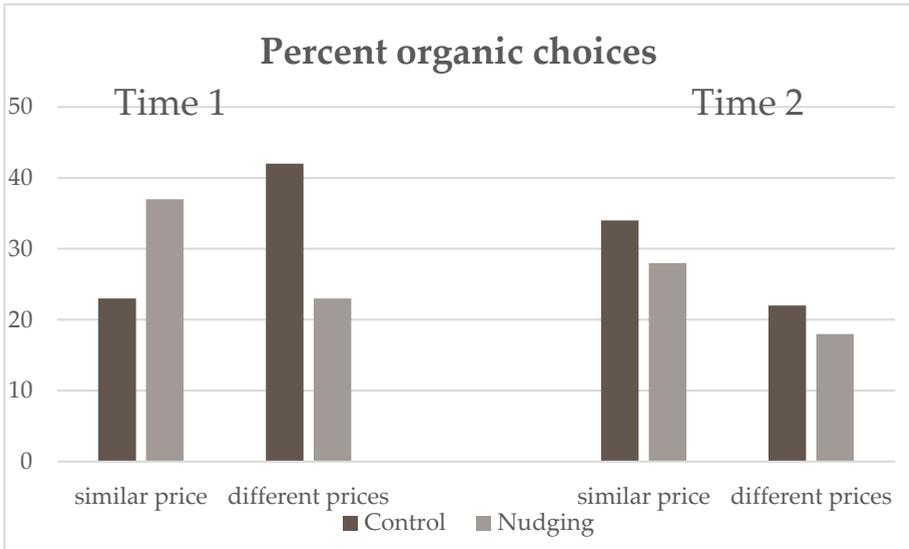


Figure 4. Percentage of organic choices in the Nudging and the Control conditions, as a function of the Price index (similar or different), and Time (first 4 weeks or last 4 weeks).

Conclusions

In the first part of the experiment, nudging had limited potential to increase the consumption of organic products, at least when the price differences were small. That means that, in the first weeks, consumers in nudging situations tended to buy more organic products when these products were only slightly more expensive than conventional products. This effect disappeared in the second part of the experiment. The price is a well-known barrier to the purchase of organic food, and measures need to be taken to compensate for the prevailing differences in price between organic and conventional products. Suggested measures were to apply a combination of all available nudging tools to strengthen the effects of nudging, as well as collecting psychological data from the participants so as to be aware of their attitudes towards choices of organic products. These actions should also be taken in order to compensate for the fact that grocery stores are environments with low levels of control due to many competing marketing factors.

6. Discussion

The results of this thesis will be discussed in the light of the overall aims. These were to investigate the effects of interventions on energy conservation and ecological food consumption in promoting pro-environmental behavior, to explore experiences of an energy-saving intervention from the perspective of the participants, and to investigate how values, attitudes, and other psychological factors predict pro-environmental behavior and pro-environmental intentions. To fulfill these aims, four studies were conducted, each from a different perspective and using a different design. A more specific aim was to investigate the predictive power of value orientation, awareness of consequences, environmental concern, moral judgment competence, locus of control, and sense of coherence, on eight pro-environmental behaviors and behavioral intentions. Further, specific aims were to evaluate the intervention effects of “complex feedback”, based on the Relational Frame Theory, on residential energy conservation, and to explore interactions between the feedback effects and the psychological factors from Study 1, followed by the specific aim to explore the experiences of participating in this intervention. Finally, the specific aim was to investigate effects of behavior-focused initiatives, usually referred to as nudges, in an intervention to promote the consumption of organic fruits and vegetables.

Predicting pro-environmental behavior

As mentioned in the introduction, previous research has shown that the relationships between studied determinants and pro-environmental behavior are more complicated than first assumed (Gifford, 2014a). However, among factors studied, research has pointed out that values are important in predicting specific attitudes and behaviors. Even a causal influence of pro-environmental values has been reliably documented. By activating certain values, it is possible to influence a range of environmental behavior-specific attitudes, beliefs, norms, intentions, and behaviors (Gärling et al., 2003; Rohan, 2000; Stern, 2000; Stern et al., 1995, 1999; Thøgersen & Ölander, 2002, 2006). The results found in Study 1, indicating that the value type universalism has a direct significant influence on actual and intentional lifestyle, are thus in line with earlier research. Further findings in Study 1 pointed out that the value type universalism affects actual lifestyle, with awareness of consequences for the biosphere as a mediating variable, and intentional lifestyle, with awareness of consequences for the biosphere and environmental concern for the biosphere as mediating variables, which is in accordance with earlier

studies (De Groot & Steg, 2007). Study 1 confirms the specific value type universalism as positively related to pro-environmental attitudes and behaviors (Bardi & Schwartz, 2003; Gärling et al., 2003; Honkanen & Verplanken, 2004; Kaiser & Byrka, 2011; Nilsson, von Borgstede, & Biel, 2004). These results are not surprising, as universalism is a wider form of altruism with the motivational goal of the welfare of *all* people, encompassing humankind, and expressed in values such as social justice, equality, and peace on earth. People who strongly endorse values of universalism will be more prone to behave in a pro-environmental way regarding both actual lifestyle and intentional lifestyle. In the same way, the mediating relation between universalism and awareness of consequences for the biosphere (ACbio) on actual and intentional lifestyle, may be easily explained by the fact that if people value other species very highly, as is the case of individuals with strong ACbio, they will be concerned about environmental circumstances that may threaten those highly valued species. In addition, it may be reasonable to believe that the evaluation of environmental concern for the biosphere (ECbio), with a strong concern for plants, marine life, birds, and other animals, will strengthen the intentional pro-environmental behavior of people holding values of universalism.

Study 1 did not, however, confirm any of the other included psychological factors as direct or indirect determinants of pro-environmental behavior, as hypothesized in the model. It may be argued that the low correspondence between the other investigated psychological factors and behavior may be partly explained by the use of self-report. It is noted in earlier meta-analyses (Hines et al., 1986/87; Bamberg & Möser, 2007) that correlations were substantially higher when actual behaviors were assessed instead of self-report. Future studies in this area should therefore prefer measuring actual behavior. From a behavioral theory perspective, one would argue that the actual consequences of such real-life behavior would, in the final analysis, be the main motivational factors (Cone & Hayes, 1980; Schultz & Kaiser, 2012).

When interpreting the results, one should pay attention to the fact that found determinants of one single behavior may not be applied to other behaviors as dependent variables. The results, pointing at the variables with missing effects, indicate that a separate SEM analysis for every type of both actual and intentional lifestyle might have been more successful in confirming these independent variables as determinants of PEB and PEBI. This is in accordance with Vining and Ebreo (2002), who conclude that no single factor describes different PEB in a similar way, and with Thøgersen (2006), who claims that some determinants, specifically the normative/moral influence,

vary between behaviors. Regarding the specificity of the pro-environmental behavior in relation to its antecedents, future research should focus not only on the predictive power of values, attitudes, and other personality and moral factors, but also on the question of when and how they are predictive of behavior.

One should note that, both in the present study and in several of the previous studies with similar aims, constructing reliable measures of the theoretical constructs could be challenging. One possible reason is that participants fail to distinguish conceptually between the different terms used in defining the scales. This, in turn, points to the need for researchers to develop more specific instruments, which cover the complex and multidimensional constructs to be studied. The measurements used for moral judgment competence, locus of control, and sense of coherence, are not specifically targeting environmental issues, something which may be a weakness contributing to their missing predicting effects as determinants. On a more general level, one could of course argue that the approach used in this study to understand factors promoting responsible environmental behavior, is rather restricted, since we here only focus on the predictive power of individuals' cognitions, such as values and attitudes.

However, the generally low, and missing, correspondence between psychological factors and PEB and PEBI found in this and other studies, highlights the need for future research to develop more comprehensive and specific instruments and validate these instruments across a variety of specific PEB and PEBI.

Promoting pro-environmental behavior

In general, strategies included in interventions to promote more sustainable behavior have been implemented with varying degrees of success. The provision of every single strategy, antecedent and/or consequence strategy for behavior change, does not necessarily result in behavior change (Abrahamse & Matthies, 2013). Instead, a combination of strategies for behavior change will be more successful, as there is mostly more than one barrier to any pro-environmental behavior (Osbaldiston & Schott, 2012; Schultz, 2014).

In this thesis, Study 2 and 4 applied measurements of actual behavior changes implemented in real life instead of using self-report, something which provided a higher external validity. Furthermore, in Study 2 the examination of the effectiveness of the intervention on behavioral change was combined with the investigation of possible determinants of behavior, in

order to make it clear if people who were successful in reducing their energy consumption would show particularly high values regarding certain psychological factors. Long-term effects of interventions were also investigated in Study 2 during period 8, where the energy use was observed for another three months, without any intervention activities, in order to see whether the achieved energy savings were maintained.

The intervention conducted in the second study considered all the mentioned aspects of measuring actual behavior in combination with investigating the underlying psychological factors, as well as the maintenance of energy savings, over a longer period. However, the small number of households participating in each group did not permit an inferential statistical analysis in order to make meaningful comparisons of intervention effects, or relate the found values of the psychological factors to any successful behavior change.

A finding that may be worth discussing, however, is the fact that the expected increase in energy consumption during the last three months, after all active strategies were removed, did not occur for the experimental group and the outgroup. This observation indicates a tendency to maintain the energy reduction achieved over a longer period of time for these two groups. An even more interesting observation is a tendency in the control group to use even less energy during the same final period of three months. There may be reasons to assume that these observations during the last period of maintenance could be seen as delayed effects of the complex feedback for the experimental group, and an effect of the intervention itself for the control group. This is consistent with Frazer and Leslie (2014), who found maintenance effects (the effects could not be statistically validated, however, due to a very small sample size) of the energy use during no feedback periods.

The difficulties in recruiting a sufficiently large number of participants clearly demonstrate the complications associated with long-term interventions in field settings (Frazer & Leslie, 2014; Steg & Vlek, 2009). An intervention lasting for five months may challenge the participants' motivation and endurance, which may have contributed to the attrition rate of 40%, followed by another 28% of the participants who did not complete the intervention. The missing effects in this study may, in part, be due to the fact that no hot water could be registered within the scope of the intervention. Only registration of household electric appliances was available, which means that each behavior change probably had a small impact on the total electricity consumption. This is not well in line with Steg and Vlek (2009), who stress that it is important to identify target behaviors that have a relatively large

energy-saving potential. Furthermore, it is likely that this small sample consisted of highly motivated participants already very engaged in energy savings and with low levels of energy use, which would be a barrier to further reductions of the energy consumption due to floor effects.

The strategies to promote pro-environmental behavior included in the intervention discussed above, assume that the behavior relies on decisions governed by reflective, controlled, and conscious processes. Existing conventional strategies for changing behavior are mostly based on some degree of information, which is, together with conscious cognitive processes, assumed to lead to rational choices. For that reason, the intention to promote people's rational choices is often combined with providing information and incentives. However, most of the time our everyday behaviors occur without thinking, that is, we act before we think, and we do not always make conscious reasoned choices.

To investigate the promotion of such everyday pro-environmental behavior that relies on automatic and unconscious processes, another strategy was applied, namely, the modification of choice situations through behavior-focused initiatives such as nudges. This approach to decision-making, applied in Study 4 on sustainable consumption behavior, is based on the notion that our behavior is governed not only by reflective and conscious processes but also by automatic and unconscious processes. To nudge means carefully guiding people's behavior in a desirable direction, and arrange the choice situation in a way that makes the desirable behavior the easiest or most attractive option. By changes of the context in which a choice has to be made, it may be possible to bypass the cognitive and rational system, and increase the possibility to achieve the desired behavior (Thaler & Sunstein, 2008; Sunstein, 2015).

In Study 4, the findings indicated that nudging had limited potential to contribute to the consumption of organically produced fruits and vegetables. The intervention showed that people, in the first weeks, tended to increase their purchase of organic products in nudging situations when these products were only slightly more expensive than conventional products. However, the opposite occurred when the price of organic products was considerably higher than that of the conventional products. In this situation, an increase in sales of conventional products could be recorded. This is consistent with the results in studies by Kalnikaitė, Bird, and Rogers (2013), who found that consumers in grocery stores base their choice of products on very few factors, among which price was the dominating one. Aschemann and Witzel (2017) also concluded that price is the major barrier to the purchase of organic food.

In this fourth study, the nudging tools referred to as framing of information and drawing attention to social norms were applied. However, with an application of alternative nudging tools, for example, changes in the physical environment and changes to the default policy, we might have reached more clear effects of nudging on consumer behavior, as found by Goldberg and Gunasti (2007) and Van Gestel, Kroese, and De Ridder (2018). On the other hand, it would probably have turned out to be difficult to apply a repositioning of the organic products without disturbing the daily business routine of the grocery store too much. The same goes for an application of organic fruits and vegetables as the standard choice, as this might have a negative effect on the sales and profits of the store.

Nudging experiments in real life have so far shown limited success, although they provide high external validity. This may be due to the opposing power of marketing in the environment of grocery stores, where many competing factors affect the individual. Although environments with higher levels of control over the behavior of consumers, and with little or no interference by other actors, would probably allow for more successful nudging, it remains an important challenge to promote a more sustainable food consumption in the environment where most daily choices of food products are made, namely, in the food stores.

In contrast to Study 2, where actual energy-saving behaviors are investigated together with underlying psychological factors, the focus in Study 4 was limited to the food-consumption behavior. The reason for not identifying the consumers in the fourth study was primarily not to disturb the daily business routine of the grocery store too much. However, future studies promoting sustainable food consumption will certainly contribute to a better understanding of individual consumer choices if the values of the participants are identified. Where individuals carry a positive attitude to or a desire for a particular behavior but fail to behave in accordance with their attitudes or desires, nudges appear to be more effective than in situations where the individual is consciously opposed to a certain behavior (Kalnikaitė et al., 2013).

To sum up, neither the intervention from Study 2 nor the intervention from Study 4 could demonstrate clear behavior changes regarding energy savings or the consumption of organic products. The two interventions carried out, both with the aim to promote pro-environmental behavior, were applied with two completely different types of design and were based on two different dimensions of cognitive decision-making. The long-lasting intervention in Study 2 was based on applied behavior analysis and conscious cognitive processes in making rational choices. This intervention comprised

combinations of different strategies to increase motivation but was faced with weaknesses like a small sample size and small energy effects due to the missing registration of hot water use. The intervention in Study 4 was also based on applied behavior analysis but relied on the notion that automatic and unconscious processes govern our behavior. In this intervention, no participants were identified and every separate moment of decision-making by the consumer was very short. The weaknesses of this study were linked to price differences that were difficult to level out and to the application of only two nudging tools. In order to reach an increased understanding of the behaviors investigated in these two studies, one could argue for further studies of both types of design and both dimensions of cognitive decision-making. These studies may also seek to answer the questions if and how cognitive and/or emotional mechanisms are influencing the behavior in Study 2 and Study 4, respectively, if the desired changes of behavior may influence attitudes, and if there are reasons for assuming interactions between strategies and tools.

How to design future intervention programs

How to target a behavior with great environmental impact, how to select a key group for that behavior, and how to plan the usage of available resources – those are aspects that have been extensively described in previous research (Gifford, 2014a; Steg & Vlek, 2009). However, the psychological motives for change, from the perspective of the participants, have hardly been examined and little is reported about the process through which behavioral change may be experienced and achieved. In Study 3, a number of experiences are highlighted that will contribute to an increased understanding of how to design effective interventions. One of the experiences was a general struggle to overcome internal and external barriers. The participants expressed uncertainty about the functions of the display measuring energy use, and they also talked about the resistance from other family members to the change of energy use in the household. This draws attention to the importance of social interactions between the members of the household. The existence of consumption feedback technology has shown an impact on household practices and domestic social life, as described by Hargreaves, Nye, and Burgess (2010), Schwartz, Stevens, Ramirez, and Wulf (2013), and Schwartz et al. (2015). The aspect of uncertainty about the relation between a specific behavior and its effect on energy use, discussed by Nilsson, Jakobsson Bergstad, Thuvander, and Andersson (2014) and Ojala (2008), was also found in Study 3. The findings in the third study suggest decreasing uncertainty by

offering deliberated knowledge about the beneficial effects of energy-behavior changes and clear instructions on how to use technical equipment in order to increase motivation.

Participants in Study 3 further experienced a resistance against adopting new habits, something which they attributed to convenience and laziness. As far as I know, this way of characterizing oneself as lazy is not discussed within intervention science. Being lazy might also be a comfortable explanation for not taking any measures to reduce one's energy consumption, and thus a way to avoid feelings of discomfort.

The process of leaving comfortable everyday behaviors behind and trying to adopt new and unfamiliar ways of acting may cause contradictory feelings and ambivalence. Theories of ambivalence have been applied to various environmental problems (Castro, Garrido, Reis, & Menezes, 2009; Ojala, 2008) but are quite unknown in the field of energy conservation. The found ambivalence in Study 3 was experienced as divided feelings regarding the choice between a subjective experience in the short term, and a good environmental impact in the long term. As Castro et al. (2009) found that negative beliefs are stronger predictors of the attitudes towards recycling among participants scoring high on ambivalence, it is reasonable to assume that these effects of experienced ambivalence regarding recycling can be applied to energy conservation. In developing the design of future interventions for promoting energy conservation, it therefore seems to be of great value for the level of ambivalence to be kept low. To succeed with this, all applied strategies and instructions must be very clear, easily accessible, and easily comprehensible.

Among the positive experiences were the feelings of ability and motivation expressed by the participants in Study 3 as the effect of successful reductions of energy use. Increased learning about a sustainable lifestyle, the environment, energy costs, and energy savings, as an effect of positive expectations, was reported by most of the participants, which is in accordance with Hargreaves et al. (2010), Nilsson et al. (2014), and Schwartz et al. (2015). Many interviewees referred to altruistic considerations, saying that this new knowledge of sustainability will benefit society and have the best effects for everyone. An altruistic concern for keeping energy consumption low was also found by Nilsson et al. (2014), where many interviewees referred to the collective need of energy, instead of egoistic financial considerations. Particular attention should be paid to the motivational aspects of the processes of change based on the approach of applied behavioral analysis (Skinner, 1953) and particularly to the extended feedback presented as

“complex feedback” in Study 2, the Relational Frame Theory (RTF) (Dymond & Roche, 2013; Hayes, Barnes-Holmes, & Roche, 2001; Törneke, 2010). In general, motivation was promoted by all applied motivational strategies during the intervention; however, as the experimental group in particular mentioned goal setting and complex feedback as motivating experiences, it may be argued that these strategies in fact had motivation-increasing effects. Most respondents expressed the need for more motivational strategies promoting behavior change.

Another dimension of experiences, expressed by the interviewees, was feelings of success and satisfaction after having achieved energy-saving changes. This may be comparable to the descriptions of “being proud” reported by Schwartz et al. (2015) in the study where people had accepted smart energy monitors as a part of their daily life. Both Schwartz et al. (2015) and Hargreaves et al. (2010) discuss that the development of a competence may be a precondition for reflections on energy actions gradually leading to a more comprehensive and continuous change of lifestyle. This aspect of competence should be considered when planning interventions for change of behavior.

7. Methodological considerations

Measurement issues

Awareness-of-consequences beliefs (AC) were measured with the two-item scales of ACself and AChum and the three-item scale of ACbio, showing low reliability, which may be regarded as a limitation. However, the low reliability of these scales was in accordance with Gärling et al. (2003) and Snelgar (2006). All used questionnaires have been previously validated in Swedish, except the Moral Judgment Test (MJT) measuring moral judgment competence (Lind, 2008). We carried out a validation study of a Swedish version translated from English according to the validation procedure and criteria, as described in Lind (2008), and using the procedure of “translation/back-translation.” We tested the new Swedish version of MJT on 183 students at Mid Sweden University and in schools in the immediate area. The results pointed out that the Swedish version of MJT met the criteria for validity and was certified by Lind (2010) as fully valid.

Data from all variables in Study 1 was collected using self-report questionnaires. Such self-reports have the advantage of being easy to administer but are also subject to response bias, such as social desirability and self-serving biases. Participants may interpret the questions differently and have difficulties to assess the psychological variables, as well as the actual and intentional behaviors, objectively. The survey in Study 1 was extensive, with seven subscales, which could have caused fatigue effects with a negative influence on the results.

The objective measurement of actual energy-saving behaviors in Study 2, and of the consumption of organic products in Study 4, can be regarded as reliable in reflecting these actual behaviors. Nevertheless, a change that could be brought to the design of future studies would be to target behaviors that are particularly significant in terms of environmental impact (Gatersleben, 2013). However, the environmental impact of energy consumption depends on measures of direct or indirect energy use and how this energy is produced (Abrahamse et al., 2007). Behavior may also be beneficial for the environment at one level but harmful at another. For example, buying organic food may reduce the use of harmful pesticides but this food may be transported longer distances by plane. Consequently, to provide a better understanding of psychological factors and behaviors in reducing the environmental impact of lifestyles, it is important to consider these potentially conflicting issues and to take advice from environmental scientists (Gatersleben, 2013). Because of a

lack of internal validity and rigorous control of confounding variables, field research limits inferences about cause and effect. Nevertheless, there is a need for assessment of real behaviors to explore the ecological validity in the real world with social relevance, as stated by Frazer and Leslie (2014).

Representativeness of the samples

The representativeness of a sample is of major importance when it comes to the generalization of results. Participants in Study 1 were recruited from a random sample of residents in the Swedish cities Stockholm and Uppsala. The addresses of the sample were obtained from the National Register of Residents in Sweden (SPAR). The findings from this sample are transferrable to all groups in society, which was an important factor for our intention to use the same survey in Study 2. In the intervention for residential energy reduction, Study 2, the aim was to find out if participants with successful behavior changes would differ in the same psychological factors measured compared to the findings in Study 1, which were representative of the general population. In Study 2, participants were recruited from an address list provided by the housing company. Individuals who had lived in these households for a shorter time than one year, and who had the intention to move within the coming six months, were excluded. The recruited participants were randomized into an experimental group and a control group in order to generalize the findings, which was, however, not possible because of the lack of results due to the small sample size. The participants in Study 4 were unknown consumers who purchased fruit and vegetables in a grocery store during eight Fridays. Thus, the food consumption data in Study 4 is collected from a sample with sufficient representativeness of the general population to allow generalization of the findings.

Statistical issues

The data from Study 1 was first analyzed using hierarchical regression analyses. Since very few effects were found, it was tempting to assume that the findings would benefit from the more complex statistical procedures building on Structural Equation Modeling. However, the results of the conducted SEM analysis could not reveal any more effects of the independent variables on actual and intentional lifestyle.

Methodological issues of qualitative data analysis

One investigator only (KW) conducted the interviews and performed the data analysis. This could be a strength, as there was less risk of the topics discussed and the follow-up questions being different from one interview to the next. It could also be a methodological weakness, as different investigators would have contributed to an elucidation of a greater variety of experiences of participating in the intervention. However, several investigators involved in the qualitative data analysis would have required quality assurance measures, such as assuring high inter-rater reliability.

8. Conclusions and future directions

In summary, one can say that the results of the four studies in this thesis confirm that human behavior is complex and that in order to increase the understanding of how we can promote behavior changes, considerable efforts are still needed. There are several adjustments to be made to improve on the identified methodological weaknesses as well as developing the design of the actual interventions.

Although the value type universalism was found to be a good predictor of both actual and intentional behavior, with the awareness of consequences for all other species and the environmental concern for the biosphere as mediating variables, no other psychological factor tested could predict any of the measured behaviors or behavioral intentions. As the predicting effect of the value type universalism is well known from earlier research, our findings could not contribute to an increased understanding of such pro-environmental behavior change in order to mitigate climate change. A change could be brought to this first study by carrying out separate analyses for every type of behavior. In the present study, each determinant was analyzed in relation to all eight actual behaviors taken together, followed by the analysis of each determinant in relation to all eight behavioral intentions. Making separate analyses for every single type of behavior may be more successful in confirming the psychological factors as determinants of PEB and PEBI, as some determinants vary between behaviors. Moreover, by measuring moral judgment competence, locus of control, and sense of coherence, one should endeavor to modify these instruments so that the questions cover more environmentally specific issues.

The first study also served the purpose of presenting how individuals in the population score on the psychological factors investigated. This would, in turn, or so we hoped, make it possible to find out whether the participants giving their consent to participate in the energy-saving intervention in the second study would substantially differ from the general population regarding the psychological factors. In addition, we hoped to find out if individuals who were very successful in reducing energy use would score in a specific way on some of the measured factors. This possibility was not given, however, as the small number of households participating in each group in Study 2 did not permit an inferential statistical analysis in order to make meaningful comparisons of intervention effects or relate the found values of the psychological factors to any successful behavior change. The overriding challenge in fulfilling the aims of an energy-conservation intervention is to

recruit a sufficient number of participants that allow for inferential statistical analysis in order to evaluate the intended results. Creating personal contacts with prospective participants in the residential area where the intervention is to be conducted, combined with financial or practical rewards for participation, would probably contribute to a sufficient sample size. Furthermore, in order to make participation more attractive and the effects of the intervention more salient, one could shorten the time of the intervention, use an easy application on cell phones, increase the motivation strategies, and include measurement of hot water use. These modifications of the second study would, in case of a replication, most likely increase the opportunities to achieve the expected effects of energy savings and confirm the complex feedback as a motivating strategy for behavior change.

The findings in the third study, as expressed by the participants, suggest a need for more deliberate knowledge about the beneficial environmental effects of energy-behavior changes and for clear instructions on how to use the technical equipment in order to increase motivation. Further, the participants called for applied strategies and for very clear, easily accessible, and easily comprehensible instructions, also in order for the participants to get the opportunity to develop a competence in energy actions and their environmental consequences. These suggested improvements are worth considering when it comes to the design of future intervention programs, for example, the use of new software programs and applications via the cell phone, that may be successful in promoting pro-environmental behavior.

As for the intervention in the fourth study, the findings indicate that in order to make nudges more successful in promoting sustainable food consumption in future studies, one has to deal with the price as the major barrier to the purchase of organic food, together with the application of alternative nudging tools. Although several uncontrollable factors characterize the environment in grocery stores and interfere with consumer behavioral choices, further efforts should be made in cooperation with the owners of grocery stores in manipulating prices, changing the consumer context and product environment, and measuring the values and attitudes of the consumer. There is a need in future studies to overcome the obstacles in the field and influence the consumer where the daily choices of food products are made.

However, regarding the different types of interventions used in the second and the fourth study, it seems clear that future intervention studies will need to extend the research on both types of design and with both types of cognitive decision-making. Sometimes we behave based on applied behavior analysis

and conscious cognitive processes in making rational choices. In other situations, we behave based on the notion that our behavior is governed by automatic and unconscious processes. Further research will thus probably benefit from investigating both ways of behavior in order to extend our understanding of how to promote pro-environmental behavior.

Concluding remarks

The four studies in this thesis should be seen as an attempt to move the positions a little bit forward to an increased understanding of human behavior and the complex conditions for changing our behavior. These studies do not claim to have made new discoveries in the field of promoting environmentally friendly behavior. Rather, they have confirmed some previously known determinants of such behavior, such as the value orientation universalism. In addition to values and attitudes, well documented in the field, some completely new factors were tested, such as moral judgment competence, locus of control, and sense of coherence. These new factors had no predicting power on pro-environmental behavior but they could possibly show the expected effects in future studies, after methodological considerations.

When looking at the two field experiments to promote behavior change towards pro-environmental behavior, very limited effects were found, which is mainly due to difficulties in recruiting participants, in the energy-conservation intervention, and to price differences, in the food-consumption intervention. After attempts to eliminate these barriers, such interventions might give some new insights into how to promote pro-environmental behavior.

As mentioned in the introduction, human behavior is complex and promoting behavior change requires a solid understanding of how people behave in different situations and contexts (Gifford & Nilsson, 2014). The overall findings of the studies in this thesis confirm the complexity both of behavior and of behavior change. Due to the human-caused global warming, which has increasing scientific support, the human-induced emissions of greenhouse gases have to be reduced (IPCC, 2014). The need for changes of individual human behavior towards more pro-environmental actions is increasingly urgent in order to diminish climate changes and promote environmental sustainability. I hope that this thesis will help to highlight the need for change towards pro-environmental behaviors and provide inspiration for further studies in this area of research.

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