GREEN CONSUMER BEHAVIOR:
CONSUMERS’ KNOWLEDGE
AND WILLINGNESS TO ACT
PRO-ENVIRONMENTALLY

A dissertation submitted to

ETH ZURICH

for the degree of

Doctor of Sciences

presented by

CHRISTINA TOBLER

lic. phil., University of Zurich

born June 10th, 1978

accepted on the recommendation of

Prof. Dr. Michael Siegrist, examiner
Prof. Dr. Heinz Gutscher, co-examiner
Dr. Vivianne H. M. Visschers, co-examiner

2011
This thesis formed part of the project Climate Policy Making for Enhanced Technological and Institutional Innovations (ClimPol), which is funded by the Competence Center Environment and Sustainability of the ETH Domain (CCES).
Summary

With their behaviors and decisions, consumers have a substantial impact on the environment. Choices regarding food or modes of transportation, for instance, influence greenhouse gas emissions and contribute to climate change. As voters, people can further support or dismiss environmental policies. Since it is very difficult for consumers to recognize the environmental consequences of their actions, public knowledge about the issue may be limited. Even if consumers are aware of their environmental impacts, they may be unwilling to change their behaviors because of the costs or inconveniences involved. The present thesis aimed to examine people’s knowledge about the environmental consequences of consumer behavior, as well as their willingness to reduce these environmental impacts. Both aspects were investigated for the domain of climate change and food consumption.

Several studies were conducted to examine consumers’ environmental knowledge and their willingness to act pro-environmentally. Chapter 1 presents the main research questions of this thesis and provides a literature overview of past research. The first part of this work examines consumers’ environmental knowledge. Chapter 2 develops an extensive knowledge scale to measure people’s understanding of climate change. It demonstrates that people’s knowledge related to CO₂ seems to have increased somewhat compared to previous studies. But the public still holds several misconceptions regarding climate issues. Additionally, it was found that knowledge about climate change and its causes influenced climate-related attitudes, namely concern, skepticism, and feelings of powerlessness. Chapter 3 analyzes consumers’ environmental assessment of food products and compares it with life cycle assessment (LCA) results, which represent the overall environmental impact of a product. In contrast to the LCA, consumers appear to mainly consider transportation distance rather than transportation mode. Consumers further seem to overestimate the environmental impact of packaging and conservation.

The second part of the thesis focuses on consumers’ willingness to act pro-environmentally. Chapter 4 examines consumers’ willingness to show climate-friendly behaviors and support climate mitigation measures. It demonstrates that a distinction in terms of a behavior’s directness as well as a differentiation according to perceived costs seems to be appro-
appropriate to classify climate-friendly actions. Perceived climate benefit and perceived costs and inconveniences had the strongest influence on people’s willingness to act or support climate mitigation policy measures. Chapter 5 addresses consumers’ willingness to adopt ecological food consumption behaviors. Consumers rated purchasing organic food and reducing meat consumption as least environmentally beneficial and appeared to be most unwilling to adopt these behaviors. Respondents’ willingness to eat seasonal fruits and vegetables was influenced by taste and environmental motives, whereas preparedness to reduce meat consumption was influenced by health and ethical motives.

The last chapter summarizes and discusses the main findings of the presented studies and addresses possible limitations. The thesis concludes with implications for communication strategies to promote pro-environmental actions.
Zusammenfassung

Mit ihrem Verhalten und ihren Entscheidungen haben Konsumenten und Konsumentinnen einen grossen Einfluss auf die Umwelt. Die Wahl bestimmter Lebensmittel oder Transportarten wirkt sich beispielsweise auf die Treibhausgasemissionen aus und trägt so zum Klimawandel bei. Zusätzlich können Wähler und Wählerinnen umweltpolitische Massnahmen annehmen oder ablehnen. Für Konsumenten und Konsumentinnen ist es jedoch sehr schwierig, die Umweltkonsequenzen ihres Verhaltens zu erkennen; dies könnte das allgemeine Umweltwissen einschränken. Auch wenn die Konsumenten und Konsumentinnen sich der Umweltfolgen bewusst sind, sind sie möglicherweise aufgrund von Kosten oder Unannehmlichkeiten nicht bereit, ihr Verhalten zu ändern. Die vorliegende Arbeit untersucht daher, was die Bevölkerung über die Umweltkonsequenzen von Konsumverhalten weiß und beleuchtet die Bereitschaft, diese Umweltfolgen zu reduzieren. Beide Aspekte werden in den Bereichen Klimawandel und Nahrungsmittelkonsum untersucht.


Contents

Summary 3

Zusammenfassung 5

1 General introduction 11
   1.1 Introduction .................................................. 13
   1.2 Climate change ............................................... 14
   1.3 Environmental impact of food consumption ................. 16
   1.4 The influence of knowledge on pro-environmental behavior .... 17
   1.5 Consumers’ willingness to act pro-environmentally .......... 23
   1.6 Overview of the thesis ....................................... 30
   References ...................................................... 35

2 Consumers’ knowledge about climate change 41
   Abstract .......................................................... 42
   2.1 Introduction .................................................. 43
   2.2 Methods ....................................................... 47
   2.3 Results ......................................................... 51
   2.4 Discussion .................................................... 63
   References ...................................................... 69
   Appendix .......................................................... 73

3 Consumers’ environmental food assessments 75
   Abstract .......................................................... 76
   3.1 Introduction .................................................. 77
   3.2 Methods ....................................................... 79
   3.3 Results ......................................................... 83
   3.4 Discussion .................................................... 90
   References ...................................................... 96
4 Addressing climate change  
   Abstract .................................................. 102  
   4.1 Introduction ......................................... 103  
   4.2 Methods .............................................. 110  
   4.3 Results ............................................... 115  
   4.4 Discussion ........................................... 123  
   References .............................................. 130  

5 Eating green  
   Abstract .................................................. 136  
   5.1 Introduction ......................................... 137  
   5.2 Methods .............................................. 140  
   5.3 Results ............................................... 144  
   5.4 Discussion ........................................... 150  
   References .............................................. 156  

6 General discussion  
   6.1 Introduction ......................................... 163  
   6.2 Central findings .................................... 164  
   6.3 Evaluation & suggestions for future research ....... 169  
   6.4 Conclusions & implications ......................... 171  
   References .............................................. 175  

Acknowledgements ........................................ 179
# List of Tables

1.1 Overview of the thesis .......................................................... 34

2.1 Physical knowledge about CO$_2$ and the greenhouse effect .............. 53
2.2 Knowledge concerning climate change and causes .......................... 55
2.3 Knowledge concerning expected consequences of climate change .......... 57
2.4 Action–related knowledge ......................................................... 59
2.5 Descriptive statistics and Pearson correlations for the four knowledge scales and education ......................................................... 60
2.6 Regression analyses for concern about climate change, skepticism, and feeling of powerlessness ...................................................... 62
2.7 Items, descriptive statistics, internal consistencies, and factor loadings of the attitudinal scales ......................................................... 73

3.1 Perceived environmental harmfulness for each criterion provided ........ 86

4.1 Items measuring the willingness to act ........................................ 117
4.2 Items measuring the acceptability of climate policy measures .............. 118
4.3 Descriptive statistics and Pearson correlations for the willingness to act and the acceptability of climate policy measures ...................... 119
4.4 Multiple regression analyses predicting the willingness for climate-friendly actions ................................................................. 121

5.1 Descriptive statistics for perceived environmental benefit of food consumption patterns, including independent $t$-tests for gender ..................... 145
5.2 Frequencies of respondents in the stages of willingness to show environmentally friendly food consumption patterns ............................ 146
5.3 Multinomial regression for willingness to eat seasonal fruits and vegetables 147
5.4 Multinomial regression for willingness to reduce meat consumption .... 149
List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Early models of pro-environmental behavior</td>
<td>18</td>
</tr>
<tr>
<td>1.2</td>
<td>Model of ecological behavior (Fietkau and Kessel, 1981)</td>
<td>24</td>
</tr>
<tr>
<td>1.3</td>
<td>Value-belief-norm (VBN) theory</td>
<td>25</td>
</tr>
<tr>
<td>3.1</td>
<td>Example slide of the choice task</td>
<td>81</td>
</tr>
<tr>
<td>3.2</td>
<td>LCA results versus consumers’ environmental assessments of product characteristics</td>
<td>85</td>
</tr>
<tr>
<td>3.3</td>
<td>LCA results versus consumers’ perceived environmental harm of each vegetable</td>
<td>88</td>
</tr>
</tbody>
</table>
Chapter 1

General introduction
1.1 Introduction

In 1971, Theodor Seuss Geisel (under the pen name Dr. Seuss) broached the issue of the environmental impacts of mass consumption in his children’s book *The Lorax*. The book described how a ”Once-ler” discovers bright-colored trees, which he chops down to produce a consumer product out of their tuft (a ”Fine-Something-That-All-People-Need”). The Lorax, a creature who speaks for the trees, continually pleads his urgent message to the greedy Once-ler to consider the environment. Despite his repetitive pleading, his warnings are ignored. The business continues to grow into an immense industry that keeps cutting down the trees, and contaminating the air and water by emitting smog and effluents. In the end, all the animals of the land, sea, and air have departed because their living environments are polluted and they can find no more food; the last tree has fallen, and the entire ecosystem is destroyed. The conclusion reads, ”Unless someone like you cares a whole awful lot, nothing is going to get better. It’s not.”

Today, 40 years after *The Lorax* was published for the first time, the issue has lost none of its topicality. Today we are faced with an array of environmental problems, which together indicate a change in the ecosystem caused by human activities and challenge our present lifestyles (Bamberg & Möser, 2007). Among others, these environmental challenges include climate change, ozone depletion, large-scale exploitation of natural resources, and increasing contamination of air, water, and soil. Both directly and indirectly, consumer activities cause substantial environmental impact (see Ölander & Thøgersen, 1995). For instance, fuel and energy consumption contribute to climate change, and agricultural production of food can lead to eutrophication (i.e., excessive nutrients from sewage or fertilizers result in increased growth of the plants in a lake, pond, or stream, which in turn causes the extinction of other organisms). Overall, the domains of housing, transport, and food are responsible for about 70% of the environmental impacts (Jungbluth, Nathani, Stucki, & Leuenberger, 2011; Tukker & Jansen, 2006). Since consumer actions strongly affect the environment, it seems worthwhile to examine people’s ability and willingness to address this issue. Therefore, the present thesis investigates consumers’ environmental knowledge as well as their willingness to act pro-environmentally.

For several reasons, it is very difficult for consumers to actually recognize environmental impacts (Kollmuss & Agyeman, 2002). First, many ecological problems are non-immediate. Due to a time-lag that frequently lies between human action and the environmental consequences, people often perceive changes only when the impact has already
caused damage. Furthermore, most environmental impacts, such as the ozone hole or the accumulation of GHG, cannot be personally observed by individuals. Second, environmental degradation often occurs very slowly and gradually, and this is extremely difficult for most individuals to discern. Third, most environmental problems are exceptionally complex. Laypeople are frequently unable to comprehend such multifaceted systems and therefore tend to simplify them, which might in turn lead to an underestimation of the problem.

For the above-mentioned reasons, environmental problems caused by human actions are frequently not discernible to consumers. In the first part, the present thesis therefore examines consumers’ knowledge about environmental issues and their causes. However, environmental knowledge alone may not suffice to motivate consumers to act pro-environmentally. As is concluded in *The Lorax*, unless consumers care, change is very unlikely to occur. Nevertheless, caring about the environment might not be the only predictor of ecological consumer behavior. The second part of the thesis therefore investigates factors that might encourage consumers to act pro-environmentally. In this context, pro-environmental behavior can be defined as behavior that attempts to minimize the environmental impact of one’s action, or as behavior that is environmentally beneficial (Kollmuss & Agyeman, 2002; Steg & Vlek, 2009).

Taking a practical stance, Steg and Vlek (2009) recommend focusing on behaviors that have a significant effect on the environmental quality. Following this reasoning, this thesis examines consumers’ knowledge and propensity to act in the domains of climate change and food consumption. Both domains are highly environmentally relevant, which will be described in detail in the next two sections. This will be followed by a summary of the findings regarding the influence of environmental knowledge on pro-environmental behavior. The subsequent section outlines the past research concerning consumers’ willingness to be actively involved in pro-environmental behaviors. The introduction ends with an overview of the thesis.

1.2 Climate change

Climate change refers to changes, which occur over an extended period – typically lasting decades or longer – in the statistical properties (mean and/or variability) of the climatic system (IPCC, 2007). Indisputable, climate change can be observed as increases in the
global average air and ocean temperatures, widespread melting of snow and ice, and a rising in the global average sea level. Anthropogenic global greenhouse gas (GHG) emissions increased by 70% between 1970 and 2004. Current atmospheric concentrations of the two GHGs, carbon dioxide (CO$_2$) and methane, far exceed what has been considered the natural range for the last 650,000 years. The pronounced increase in global atmospheric concentrations of GHG is a result of human activity. Global increases in CO$_2$ concentrations, for instance, are mainly caused by fossil fuel use, whereas the increase in methane appears to be mainly due to agriculture and fossil fuel use. Thus, most of the observed increase in global average temperatures is caused by human activity.

The consequences of climate change might, for instance, include an increase in extreme weather events, such as heat waves, floods, and drought (IPCC, 2007). Some regions, such as mountainous areas, are particularly prone to the consequences of climate change. Specifically, Switzerland, especially the alpine regions, is affected above average by climate change (North et al., 2007). Several indicators substantiate the fact that the climate has indeed warmed in Switzerland (North et al., 2007; OcCC, 2008). For instance, since 1900, the mean annual temperature increased by 1.5$^\circ$C in Switzerland, whereas that mean increase was 0.9$^\circ$C for the northern hemisphere. In the last decades, the number of days with temperatures above 30$^\circ$C has distinctly increased, whereas the number of days with temperatures below 0$^\circ$C has markedly decreased. There is also a considerable decline of alpine glaciers, which occurs continuously and with increasing acceleration. It has been estimated that in the year 2100 (compared to 1990), an increase in mean summer temperature of 3.5–7$^\circ$C is likely to occur (OcCC, 2008).

Such climatic changes in Switzerland will affect both the flora and fauna (e.g., migration of plants and animals), and tourism (e.g., lack of snow) (OcCC, 2008). They will also influence infrastructure (e.g., lower water levels in rivers might impede electricity production of water-cooled power plants) and human health (e.g., mortality associated with heat waves and extreme weather events).

Overall, these indicators provide evidence that addressing the issue of climate change is critically important. Nevertheless, the Swiss total GHG emissions have fallen only slightly since 1990 (Federal Office for the Environment (FOEN), 2010). In Switzerland, private and public demand represents the most important sector with regard to climate change. It generates 62% of total emissions (90 Mt CO$_2$ equivalents), of which 26% are directly emitted by households and 74% are related to the manufacturing of goods (Jungbluth et al., 2011). The largest percentage of greenhouse gas emissions by private and public
demand are caused by housing and energy, followed by nutrition, and transportation (Jungbluth et al., 2011).

As the private sector represents such an influential emitter of GHG, individuals could substantially contribute to the mitigation of climate change by altering their consumer behaviors. Overall, people could reduce their CO$_2$ emissions by up to three tons per year per capita by changing their lifestyles and behaviors (e.g., living in houses with low energy demand, or reducing car use) (Känzig & Jolliet, 2006). Furthermore, citizen acceptance of climate policy measures is vital in the implementation of such regulations. Therefore, psychology could contribute to the domain of climate change by examining what people believe and know about the issue, and by identifying the barriers that prevent consumers from addressing climate change (Spence, Pidgeon, & Uzzell, 2009).

1.3 Environmental impact of food consumption

As discussed previously, nutrition has an influence on climate change. Agriculture is the main contributor of methane and nitrous oxide, and fossil fuels are used in transportation, processing, retailing, storage, and the preparation of food products (Carlsson-Kanyama & González, 2009). In addition, food consumption is also associated with additional environmental burdens, which include other emissions (such as phosphate, pesticides and heavy metals) and the exploitation of natural resources, such as land and water (Jungbluth et al., 2011). For instance, agricultural practices, such as the application of pesticides and fertilizers, have caused soil erosion and dangerous phosphate concentrations in drinking water (Tanner, Kaiser, & Kast, 2004).

Overall, food consumption is responsible for 20–30% of the total environmental impact in the Western World (Tukker & Jansen, 2006), and about 30–40% of the environmental impact in Switzerland (Jungbluth et al., 2011). Jungbluth and colleagues (2011) therefore concluded that, within the different consumption categories, nutrition is the most important priority area for sustainable consumption and production.

In contrast to the consumption of other goods, food is a basic need and cannot be renounced or substituted. However, depending on the ingredients, greenhouse gas emissions from different meals of similar caloric content and nutritional value can vary by a factor of nine (Carlsson-Kanyama, 1998). Plant-based foods, for instance, produce the lowest GHG emissions (except if transported by airplane); whereas animal products represent
substantially higher GHG emissions (Carlsson-Kanyama & González, 2009). Similarly, the energy requirement for fresh ingredients from animal and vegetable (with the same origin) can differ by a factor of about 10, with meat consuming the largest amount of energy (Dutilh & Kramer, 2000). Thus, reducing meat consumption would reduce the environmental strain on resources, such as energy, water, soil, and biodiversity (de Boer, Hoogland, & Boersema, 2007).

In many countries, heated greenhouses are used to increase quality and yield. However, this procedure can substantially increase the overall energy requirements for production (up to 40 MJ per kilogram of produce) (Dutilh & Kramer, 2000). In addition, importing products from other regions can further raise the energy requirement by a factor of 10, depending on the means of transportation. Rail and boats use the smallest fraction of energy, whereas planes have the largest energy requirement. Finally, preservation techniques, such as heat treatment (e.g., pasteurization), freezing, and drying, necessitate additional energy in the production process.

In sum, to reduce the environmental impact of food consumption, it appears most essential to avoid products imported by air, to reduce meat consumption, and to favor organic products (Jungbluth, Tietje, & Scholz, 2000). Furthermore, food products grown using greenhouse production techniques should be avoided. Packaging, on the other hand, appears to be of minor importance. Thus, through their dietary practices, consumers can substantially reduce their personal environmental impacts. For this reason, there is a special focus on food consumption in one part of the thesis.

1.4 The influence of knowledge on pro-environmental behavior

The previous sections indicate that consumer behaviors are associated with a number of environmental impacts. However, it was also pointed out that it is difficult for individual consumers to discern the environmental consequences of their behaviors (see first section). Therefore, knowledge might represent an important factor concerning pro-environmental behavior. If individuals, for example, are oblivious of the environmental degradation caused by a certain action, they are not likely to have a negative attitude toward this activity (Fransson & Gärling, 1999). Early models of pro-environmental models assumed that environmental knowledge linearly influenced environmental concern and
attitudes and that, in turn, leads to pro-environmental action (Kollmuss & Agyeman, 2002; see Figure 1.1). Following this supposition, it would suffice to provide the public with information about environmental problems in order to motivate the people to adopt pro-environmental behaviors. Accordingly, people who attempt to promote pro-environmental behavior (e.g., politicians and/or environmental activists) often believe that behavior changes are merely a function of knowledge (Kaiser & Fuhrer, 2003).

Figure 1.1. Early models of pro-environmental behavior (Kollmuss & Agyeman, 2002)

In fact, lack of knowledge or information was found to be an important barrier to acting pro-environmentally (Huddart Kennedy, Beckley, McFarlane, & Nadeau, 2009). A meta-analysis of past studies additionally indicated that individuals with greater knowledge concerning environmental issues and how to address them were more willing to engage in pro-environmental behavior than those lacking this knowledge (Hines, Hungerford, & Tomera, 1986/87). However, this relationship was moderate at best. Accordingly, Kollmuss and Agyeman (2002) concluded that only a small fraction of pro-environmental behavior may be directly associated with environmental knowledge and awareness. Similarly, information campaigns appear only to have a moderate effect on increasing the target behaviors (Hines et al., 1986/87).

Thus, it appears that the influence of knowledge on pro-environmental behavior is less straightforward than the earlier models assumed. In line with this assumption, another meta-analysis reported that knowledge was an important but indirect determinant for pro-environmental behavior (Bamberg & Möser, 2007). Knowledge regarding environmental issues was related to an internal attribution of responsibility, social norms, and feelings of guilt. In addition, it influenced perceived behavioral control (i.e., people’s estimation of their ability to perform pro-environmental behaviors) and environmental attitudes. These factors, in turn, influenced (directly and indirectly) the intention to act, which ultimately increased pro-environmental behavior.
1.4.1 Different forms of environmental knowledge

Past studies often examined environmental knowledge as one construct. However, environmental knowledge can be differentiated into various types. *Declarative* or *factual* environmental knowledge describes knowledge about an environmental system, such as definitions, causes, and consequences of environmental problems (Kaiser & Fuhrer, 2003; Tanner & Kast, 2003). Ideally, knowing about environmental issues should reduce people’s uncertainties and encourage them to act (Kaiser & Fuhrer, 2003). However, the relationship between declarative knowledge and ecological behavior has been found to be moderate (Hines et al., 1986/87).

*Procedural* or *action-related* knowledge refers to information about behavioral options and possible action (see Kaiser & Fuhrer, 2003; Tanner & Kast, 2003). Some research indicated that action-related knowledge was more predictive for ecological consumer behavior than factual knowledge (e.g., Tanner & Kast, 2003). However, the empirical findings are mixed, and Kaiser and Fuhrer (2003) concluded that both forms of knowledge have a comparable effect on ecological behavior.

Another suggested form of knowledge is *effectiveness* knowledge, which describes knowledge about the relative effectiveness of different behaviors to achieve a certain outcome (Kaiser & Fuhrer, 2003). However, the environmental benefits of ecological behaviors are not necessarily obvious for consumers and effectiveness knowledge is commonly lacking. Kaiser and Fuhrer (2003) assume that to require effectiveness knowledge, declarative and procedural knowledge are also vital. They emphasize that knowledge is only successful in changing pro-environmental behavior if different forms of knowledge converge toward one ecological goal.

Overall, an individual needs to know about environmental problems and potential actions in order to behave pro-environmentally (Kaiser & Fuhrer, 2003). However, environmental knowledge does not necessarily lead to the corresponding action because other factors, such as incentives, perceived consequences, or attitudes, might mediate the impact of knowledge on ecological behavior. Thus, knowledge about environmental issues appears to be a necessary, yet insufficient prerequisite for pro-environmental behavior (Bamberg & Möser, 2007; Kaiser & Fuhrer, 2003). It consequently seems worthwhile to examine the environmental knowledge among consumers. Therefore, the following two sections summarize past findings about public knowledge regarding climate change and ecological food consumption.
1.4.2 Knowledge about climate change

Since climate change occurs over longer periods of time, it is difficult to experience and largely invisible for individuals. The fact that climate is a statistical and therefore technical concept (Swim et al., 2009) additionally complicates the issue for laypeople. Similarly, the causes of climate change are difficult to experience since the connection between today’s action and its effects on the climate cannot be perceived (Moser, 2007). Therefore, climate change is a subject where laypeople have to rely on scientists and/or reports in the mass media to acquire knowledge about the issue (Swim et al., 2009).

Overall, public understanding of the causes and effects of climate change throughout the different regions of the world is limited (Swim et al., 2009). Past studies examining the public’s climate-related knowledge demonstrated that laypersons have an incomplete understanding of climate and appear to confuse it with weather (Bostrom, Morgan, Fischhoff, & Read, 1994; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994; Reynolds, Bostrom, Read, & Morgan, 2010). Furthermore, people often confused stratospheric ozone depletion with climate change and they also seemed to have difficulties in differentiating between climate-related causes and actions and other more general ecological behaviors (Bostrom et al., 1994; Poortinga, Pidgeon, & Lorenzoni, 2006; Read et al., 1994; Reynolds et al., 2010).

Such misunderstandings regarding climate change and its causes were found in a large body of research. These misunderstandings appear to be global in nature (e.g., Bord, Fisher, & O’Connor, 1998; Dunlap, 1998; Leiserowitz, 2007b) and persistent over time (Reynolds et al., 2010). Similar misconceptions were also found in Switzerland. In one study, for instance, 35% of Swiss respondents believed that the greenhouse effect is caused by a hole in the Earth’s atmosphere (Diekmann & Meyer, 2008). Furthermore, not even half of the respondents knew that CO$_2$ was the main contributor to the greenhouse effect (Diekmann & Meyer, 2008; Jaeger, Dürrenberger, Kastenholz, & Truffer, 1993).

Past research suggests that knowledge regarding the causes of climate change is an important determinant of behavioral intentions and support for climate protection policy measures (Bord, O’Connor, & Fisher, 2000; O’Connor, Bord, & Fisher, 1999; O’Connor, Bord, Yarnal, & Wiefek, 2002). In interviews, laypeople also mentioned a lack of basic knowledge (e.g., about causes, impacts, and solutions) as a significant barrier to personal engagement (Lorenzoni, Nicholson-Cole, & Whittmarsh, 2007). Other researchers, however, have argued that lack of knowledge is probably not the main barrier to action; and
increasing public awareness might not result in actual behavioral change as various cognitive and structural barriers are involved (Bulkeley, 2000; Dunlap, 1998). Thus, simply educating the public about climate change most certainly will not suffice to motivate people to address the subject of climate change. However, to understand the necessity of climate policy measures or climate-friendly behavior, it is important to have a certain understanding of the issue. Lack of knowledge might contribute to a feeling of uncertainty, which ultimately may result in skepticism about the reality of climate change, the human influence, and the need for action (Lorenzoni et al., 2007). Thus, overall lack of knowledge might ultimately influence people’s attitudes toward climate change as well as people’s willingness to both act and support mitigation policies.

In sum, public understanding of climate change has been examined in a number of studies. However, to this point, there has been no standardized, uniform measurement to assess people’s understanding of climate change. Therefore, direct comparisons between countries, samples, and time-frames are difficult. Furthermore, it is unknown whether the dissimilar types of knowledge (see Section 1.4.1) have a different influence on climate-related attitudes (such as concern, skepticism, or feeling of powerlessness).

1.4.3 Knowledge about ecological food consumption

As discussed in Section 1.3, to reduce the environmental impact of food consumption, consumers should avoid products imported by air, reduce meat consumption, prefer organic products, and avoid products grown with heated greenhouse production techniques (Jungbluth et al., 2000). Although the environmental relevance of packaging seems to be limited, in an Australian study, the largest fraction of consumers believed that if food manufacturers used less packaging, this would be helpful for the environment (Lea & Worsley, 2008). The majority also thought that it was environmentally beneficial if consumers composted household food scraps and bought local food, followed by farmers caring more for the environment (e.g., using fewer pesticides), and supermarkets charging customers for plastic carry bags. The smallest number of participants believed that buying organic products and consuming less meat was helpful for the environment. Thus, it seems evident that consumers lack knowledge about which consumption behaviors are the most environmentally beneficial.

Since the environmental impact of a food product is not immediately apparent and has to be deduced through a rather complex procedure, assessing the environmental friendli-
ness of a food product is challenging for most consumers. (Tanner & Jungbluth, 2003). Furthermore, food products often demonstrate conflicting environmental features. A vegetable, for instance, may be regional but stem from greenhouse production, whereas a field-grown alternative might be imported from overseas. Only a few studies have examined how consumers judge the environmental friendliness of food products. Tanner (2006) compared consumers’ environmental assessments with the results of life-cycle assessments (LCA)\(^1\) and found an average error rate of about 51%. Furthermore, consumers’ environmental judgments were error-prone and highly context-dependent (Tanner, 2006, 2008; Tanner & Jungbluth, 2003).

Even the environmental assessment of a single product characteristic, such as packaging, seems to be difficult for the average consumer. They appear to mainly take material and returnability into account (Van Dam, 1996). In contrast to LCA results, consumers perceive glass to be the most environmentally friendly packaging material, followed by paper. Plastic packaging, however, is perceived to be most environmentally harmful. If the packaging could be returned (i.e., deposit-based return system), this increased consumers’ perception of environmental friendliness. Overall, consumers’ environmental assessment seems to be heavily influenced by their perception of post-consumption waste, whereas the environmental impacts of production tend to be ignored. However, so far, very little is known about which factors consumers pay attention to when assessing the overall environmental friendliness of food products.

In sum, consumers seem to have an incomplete understanding of the environmental impacts caused by their activities, both in the domains of climate change and nutrition. As environmental knowledge appears to be a necessary prerequisite for ecological behavior, a close examination of people’s misconceptions seems worthwhile. However, as discussed previously, knowledge alone might not be sufficient motivation for people to engage in pro-environmental behavior. Therefore, the second part of the thesis examines the determinants influencing consumers’ willingness to act pro-environmentally.

\(^1\)A life-cycle assessment (LCA) is a holistic method that assesses the overall environmental impact of a product across its life cycle; from raw material extraction, through production, use, and disposal (Baumann & Tillmann, 2004).
1.5 Consumers’ willingness to act pro-environmentally

In this section, two selected models are presented: the model of ecological behavior (Fietkau & Kessel, 1981) and the value-belief-norm (VBN) theory (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Both models were developed specifically to explain consumers’ willingness to act pro-environmentally. In the second part of this section, empirical findings about the determinants of pro-environmental behavior will be summarized. The following subsections then outline research findings on consumers’ willingness to address climate change and to adopt ecological food consumption behaviors.

1.5.1 Model of ecological behavior

As discussed in Section 1.4, knowledge alone does not seem to suffice in encouraging consumers to behave pro-environmentally. Therefore, Fietkau and Kessel (1981) suggested a model of ecological behavior, which included additional factors influencing pro-environmental behavior (see Figure 1.2). In line with the early models of pro-environmental behavior (see Figure 1.1), the model postulates that environmental knowledge has an effect on environmental attitudes and values, which in turn influence pro-environmental behavior. Moreover, ecological behavior is additionally influenced by the possibility to act; thus external, infrastructural, and economic factors may enable or hinder people to/from acting ecologically (see Kollmuss & Agyeman, 2002). For instance, if there is no public transportation available, it is difficult for individuals to reduce their car use. Pro-environmental behavior is further influenced by incentives for pro-environmental behavior (e.g., social desirability, quality of life, monetary savings) and the perceived consequences (i.e., perceived feedback about ecological behavior). Thus, overall, the model of ecological behavior postulates that individuals decide whether or not to act pro-environmentally in a relatively rational manner.

1.5.2 Value-belief-norm theory

In contrast to the previous model, the value-belief-norm (VBN) theory focuses more on the individual’s perception of moral obligations. It postulates a causal chain that moves from relatively stable elements of an individual’s personality and belief structure (i.e., values) to beliefs about the human-environment-relations (worldview that human actions
have substantial negative effects on a fragile biosphere) (see Figure 1.3; Stern, 2000; Stern et al., 1999). The causal chain moves forward to the awareness of the consequences, to the feeling of responsibility for action, and to a sense of moral obligation to act. Ultimately, this sense of moral obligation influences the individual’s predisposition to act in support for the environmental movement.

Stern and colleagues (2000; 1999) further suggested distinguishing different types of environmentally significant behavior. They differentiated between environmental activism (e.g., active involvement in environmental organizations), consumer behavior (i.e., private-sphere behaviors), environmental citizenship, and policy support or acceptance.

Reviewing past findings, Stern and Vlek (2009) concluded that the models focusing on moral obligations to act pro-environmentally (such as the VBN theory) seem to be successful in explaining low-cost environmental behavior. Nevertheless, they appear far less explanatory for behaviors associated with higher costs or constraints. This is supported by the low-cost hypothesis assuming that lower costs ease the transformation of attitudes into the corresponding behavior (Diekmann & Preisendorfer, 2003). However, if behaviors involve higher costs or more inconveniences, environmental attitudes do not seem to suffice to overcome these barriers. For such costlier behaviors, the theory of planned behavior (TPB) (Ajzen, 1991), which assumes that individuals make reasoned choices,
appears to be more accurate (Steg & Vlek, 2009). This might be because the model considers a wider range of factors, including non-environmental motivations and perceived behavioral control.

Overall, many studies have suggested different models, and Kollmuss and Agyeman (2002) concluded that the influencing factors of pro-environmental behavior might be too complex to visualize in a model.

1.5.3 Empirical findings about consumers’ willingness to act pro-environmentally

There is a large body of research examining the determinants of consumers’ willingness to act pro-environmentally (e.g., Arbuthnot, 1977; Carrus, Passafaro, & Bonnes, 2008; Gilg, Barr, & Ford, 2005; Whitmarsh & O’Neill, 2010). Two meta-analyses, which examined past studies in the realm of ecological behavior (including different pro-environmental actions) offered a synthesis of the major categories of variables examined by past research. They both found that the strongest determinant of pro-environmental behavior was people’s intention to act (Bamberg & Möser, 2007; Hines et al., 1986/87). Ecological behavior was also positively influenced by environmental attitudes and by the belief that one’s actions were likely to have an impact (locus of control or perceived behavioral control). A feeling of personal responsibility toward the environment (or a moral norm)
additionally increased ecological behavior. Knowledge only had a moderate effect on pro-environmental behavior (see Section 1.4). Furthermore, pro-environmental behaviors seem to be more likely if people are younger and have both a higher education level and income (Hines et al., 1986/87). Nevertheless, the relationships between the demographic variables and the pro-environmental behaviors were weak.

However, pro-environmental behavior encompasses a wide variety of behaviors, which might not be influenced by the same factors. By distinguishing between the different types of ecological behavior, one past study was able to more closely examine the determinants of pro-environmental behavior (Lee & Holden, 1999). Environmental attitude was a significant predictor of all types of action, namely on people’s willingness to show consumer behaviors with high (e.g., attend demonstrations) and low costs (e.g., recycling), their willingness to pay (e.g., for clean sewage), and their regulatory support (e.g., ban on pesticides). Worry about the environment (i.e., distress and empathy) increased all types of pro-environmental action except regulatory support. Perceived consumer effectiveness only increased consumers’ willingness to adopt high-cost behaviors.

Similarly, another study found that pro-environmental self-identity was a significant predictor for some pro-environmental behaviors (i.e., waste reduction, eco-shopping and eating, and conservation of water and domestic energy). Other ecological actions, such as one-off domestic energy conservation actions, eco-driving, political actions, and reducing car use and flights, were not influenced by pro-environmental self-identity (Whitmarsh & O’Neill, 2010). These results support the suggestion of the VBN theory to distinguish between different types of action (Stern, 2000; Stern et al., 1999). They are also in line with Balderjahn (1988) who concluded that specific behavioral patterns have their own cluster of predictors. Thus, the factors influencing pro-environmental action seem to be highly dependent on the respective behavior.

### 1.5.4 Willingness to address climate change

Past research demonstrated widespread awareness of and concern about climate change in industrialized countries (Leiserowitz, 2007b; Lorenzoni & Pidgeon, 2006; Poortinga et al., 2006). Similarly, 82% of the Swiss public rated the greenhouse effect and global warming as highly dangerous (Diekmann & Meyer, 2008). However, when compared with other problems (e.g., personal or social issues), climate change was considered a less important issue (Lorenzoni & Pidgeon, 2006). People’s level of concern might ultimately affect their
motivation to act (Swim et al., 2009). In fact, past research indicates that concern about climate change increases consumers’ willingness to change their behaviors (e.g., Semenza et al., 2008).

Nevertheless, although widely discussed, climate change and the human contribution to it is not universally accepted as a reality (e.g., Reynolds et al., 2010). Accordingly, uncertainty and skepticism seem to represent important barriers to address climate change (Lorenzoni et al., 2007). In fact, Leiserowitz (2006, 2007a) identified a group of "naysayers" who felt skeptical or cynical about the reality of climate change. They, for instance, believed that climate change is natural, and that there is hype about this subject. People belonging to the naysayers group were substantially less willing to support climate change policies (Leiserowitz, 2006). Several studies also found that a conservative political ideology had a negative effect on people’s concern for climate change (e.g., Dunlap & McCright, 2008; Zia & Todd, 2010). Furthermore, support for climate policies was found to be influenced by affect, values, and political ideology (Leiserowitz, 2006; O’Connor et al., 2002). Next to knowledge about the causes of climate change (see Section 1.4.2), people’s willingness to both act and support government initiatives was further influenced by an ecological worldview and the perception of climate change as a societal threat (Bord et al., 2000).

However, consumers can address climate change in various ways (e.g., drive less, use less heat in winter, or support policies). As is the case with general ecological behavior, different types of climate-friendly actions might be determined by different factors. In fact, Ngo and colleagues (2009) found that different determinants variously influenced indoor GHG reduction behaviors (e.g., turning off lights or keeping moderate room temperatures) and automobile GHG emissions. Whereas psychological variables (i.e., environmental attitudes and worry about environmental problems) were influential factors for indoor GHG behaviors, they did not have an effect on automobile GHG emissions. Similarly, the determinants of voting intentions appear to differ from those of voluntary actions (O’Connor et al., 1999; O’Connor et al., 2002). Females, for instance, were more willing to act in a climate friendly manner (e.g., choose a car with good mileage) than men, but they were less willing to support policy measures (e.g., tax on gasoline) (O’Connor et al., 1999). In contrast, people with higher education were more willing to vote for government policies to address climate change, but less willing to show voluntary actions. However, both means of addressing climate change were influenced by risk perception of climate change (O’Connor et al., 1999; O’Connor et al., 2002).
Overall, these results indicate that there are various types of climate-friendly actions, which might be influenced by dissimilar factors. However, no previous study has attempted to systematically classify climate-friendly actions. It therefore seems worthwhile to more closely examine consumers’ willingness to address climate change.

1.5.5 Willingness for ecological food consumption

Green food products are locally produced rather than imported; and organic, seasonal, and fresh – rather than frozen or canned, and unwrapped (Tanner et al., 2004; Tanner & Kast, 2003). However, past research on consumers’ ecological food consumption has focused on the consumption of organically produced food (e.g., Grunert & Juhl, 1995; Magnusson, Arvola, Koivistio Hursti, Aberg, & Sjödén, 2003; Squires, Juric, & Cornwell, 2001; Tregear, Dent, & McGregor, 1994; Wandel & Bugge, 1997). Very few studies have examined consumers’ willingness to eat ecologically by taking additional factors of ecological consumption into account.

Tanner and colleagues (2004; 2003) measured green food purchases by considering a wide range of environmentally relevant product characteristics, such as production, packaging, conservation, and provenance. They demonstrated that consumers’ attitude toward environmental protection, fair trade, and local production had a positive influence on green food purchases (Tanner & Kast, 2003). Ecological food purchases were further increased if consumers had action-related knowledge. If consumers perceived time barriers or frequently shopped in supermarkets, they were less likely to buy green food products. Among the contextual conditions, ecological consumption was influenced by store and household characteristics (e.g., supermarket vs. non-supermarket, or household size), but not by socioeconomic features (e.g., education or household income) (Tanner et al., 2004).

Among the different ecological food consumption behaviors, composting and buying locally produced food were most commonly performed by consumers (Lea & Worsley, 2008). Fewer consumers reported using their own carry bags when shopping (instead of shopping bags), to avoid buying products in non-environmentally friendly packages. Eating less meat and purchasing organic products were the behaviors least frequently adopted by consumers.

In contrast to the above-mentioned studies, a large body of research isolatedly examined the consumption of organic food. Few studies also examined consumers’ willingness to
CONSUMERS' WILLINGNESS TO ACT PRO-ENVIRONMENTALLY

eat local food, or to reduce or forego meat. A summary of the findings is presented in the following.

Organic food

In line with findings about general pro-environmental behavior (see Section 1.5.3), past studies indicate that consumers’ willingness to buy organic food increased if they were confident in their ability to buy sustainable food (perceived behavioral control), if they believed that their personal effort was effective (perceived consumer effectiveness), and if they thought that persons important to them expected them to buy organic food (social or subjective norms) (Robinson & Smith, 2002; Vermeir & Verbeke, 2008). Another important factor was consumers’ personal norm of buying organic food (Thøgersen & Ölander, 2006). Women generally seem to have a more positive attitude toward organic food and are more willing to buy organically produced groceries (Lockie, Lyons, Lawrence, & Grice, 2004; Magnusson, Arvola, Hursti, Aberg, & Sjödén, 2001; Wandel & Bugge, 1997).

Consumers appear to buy organic food if they care about the naturalness of their food (Lockie et al., 2004), and if they are concerned about the environment, their health, and that of their family (Grunert & Juhl, 1995; Magnusson, Arvola, Hursti, Aberg, & Sjödén, 2003; Squires et al., 2001; Tregear et al., 1994; Wandel & Bugge, 1997). Compared to conventional products, organic food was perceived as healthier and more expensive (Magnusson et al., 2001). Consequently, the perception of organic food being expensive was most commonly mentioned as a reason for not buying organic food (Tregear et al., 1994).

Locally produced food

There are few studies examining consumers’ willingness to buy local food. A qualitative study found that consumers perceived local food as of higher quality (Chambers, Lobb, Butler, Harvey, & Traill, 2007). People believed local food products to be superior in taste because of seasonality, and that they were fresher due to the shorter haulage. However, they also believed local food to be more expensive than national or imported food and wanted to have the choice and availability of imported food all-year-round.
30 CHAPTER 1. GENERAL INTRODUCTION

Meat consumption

Individuals who either chose a vegetarian diet or partially avoid meat commonly mention ethical principles about the killing or raising of animals, dislike of meat, disgust, and influences of others as reasons for their consumption behavior (Santos & Booth, 1996). Similarly, another study found that being low on meat consumption was influenced by consumers’ pickiness about meat, an animal friendly attitude, food involvement, and the motivational focus (promotion or prevention orientation) (de Boer et al., 2007). Past research further indicates that meat consumption is influenced by the perceived difficulties of vegetarian diets, the number of vegetarian friends, and beliefs about meat (such as unhealthiness, or the conviction that meat is a necessary dietary component) (Lea & Worsley, 2001). Furthermore, women and older people generally appear to be more likely to be low on meat, whereas people who frequently eat in the company of others tend to consume more meat (de Boer et al., 2007).

Altogether, past studies have found that pro-environmental behavior was influenced by psychological factors, such as intention to act, environmental attitudes, locus of control, or moral norms. However, following the model of ecological behavior (Fietkau & Kessel, 1981), it also seems important to consider how consumers perceive the incentives and consequences of ecological behaviors. As this aspect has often been neglected in past research, the present thesis takes into account how the perceived costs and benefits influence consumers’ willingness to adopt pro-environmental behaviors.

1.6 Overview of the thesis

The present thesis aimed to examine consumers’ knowledge about the environmental consequences associated with consumer behavior, as well as consumers’ willingness to reduce these environmental impacts. Both aspects were investigated for the domain of climate change, since it is strongly affected by consumer behavior (see Section 1.2), and food consumption, since it is highly environmentally relevant (see Section 1.3).

The thesis is divided into six chapters (see Table 1.1). The first chapter consists of the general introduction, followed by four sections describing different studies about consumers’ knowledge and willingness to act pro-environmentally. The following chapters are described in more detail below.
Chapter 2: Consumers’ knowledge about climate change

Chapter 2 investigates consumers’ knowledge about climate change. The outline in Section 1.4.2 demonstrated various misconceptions held by the public; for instance, confusion about climate change and ozone depletion. It also indicated that knowledge about climate change might influence people’s attitudes toward the issue; and, ultimately, their willingness to both act and support climate mitigation policies. Nevertheless, there has been no standardized method to measure climate-related knowledge. For this purpose, an extensive knowledge scale was developed to measure consumers’ understanding of climate change.

The climate-related knowledge scale considered both factual and action-related knowledge (see Section 1.4.1) and included a broad range of knowledge, namely physical knowledge about CO₂ and the greenhouse effect, knowledge about climate change and its causes, knowledge about the expected consequences of climate change, and action-related knowledge. The questionnaire contained items of different degrees of difficulty, ranging from knowledge that is covered by newspapers to experts’ level of knowledge. Climate-related knowledge was then related to attitudes toward climate change, namely concern, skepticism, and feelings of powerlessness.

The results indicate that although people’s knowledge related to CO₂ seems to have increased compared to previous studies, the general public still holds several significant misconceptions regarding climate issues. Of all the knowledge subscales, knowledge about climate change and its causes was most strongly related to the attitudes toward climate change.

Chapter 3: Organic tomatoes versus canned beans: How do consumers assess the environmental friendliness of vegetables?

The following chapter investigates consumers’ knowledge about the environmental impacts associated with food consumption. As discussed in Section 1.4.3, estimating the ecological quality of food products is rather challenging for consumers, particularly if the products show conflicting features. In contrast to knowledge about climate change, little is known about how consumers judge the ecological quality of food products. Consequently, the study in Chapter 3 examined consumers’ environmental assessment of food products.
The study used a choice task and a questionnaire to observe how consumers judge the environmental friendliness of several vegetables. The consumers’ assessment was compared with life cycle assessment (LCA) results, which represent the overall environmental impact of a product throughout its lifespan.

In contrast to the LCA, consumers mainly considered transportation distance rather than transportation mode and perceived organic production as very relevant for the environmental friendliness. Consumers further assessed the environmental impact of packaging and conservation as more important than the LCA results demonstrate. Findings also suggested the current product information for vegetables is insufficient for judging their environmental friendliness. The implications for information campaigns and ecological food labeling are additionally discussed.

Chapter 4: Addressing climate change: Determinants of consumers’ willingness to act and to support policy measures

The second part of the thesis focuses on consumers’ willingness to act pro-environmentally. When it comes to addressing climate change, both climate-friendly behaviors and policy support encompass a broad range of options. These vary in manifold ways, for instance in terms of costs or perceived climate benefit. Different types of climate-friendly action might be influenced by different factors (see Section 1.5.4). Therefore, Chapter 4 examines consumers’ willingness to show climate-friendly behaviors and support climate mitigation measures.

The aims of this study were two-fold: the first goal was to find a meaningful way to classify different ways of addressing climate change, namely consumers’ willingness to behave in a climate-friendly way and to support policy measures. The second aim was to examine which determinants influence the willingness to engage in these behaviors. Therefore, a large-scale mail survey was conducted, presenting an extensive list of possible actions and mitigation measures.

A principal component analysis yielded three factors of voluntary actions: climate-friendly low-cost behaviors (e.g., recycling), indirect behaviors (e.g., offsetting CO₂ emissions), and mobility behaviors (e.g., reduction of car use). Mitigation measures could be divided into supportive measures (e.g., subsidies) and CO₂ restrictions (e.g., taxes on heating oil). With the exception of mobility, perceived climate benefit had the strongest influence on
people’s willingness to act or support climate mitigation policy measures. For mobility, however, perceived costs turned out to be the most influential factor.

Chapter 5: Eating green: Consumers’ willingness to adopt ecological food consumption behaviors

The fifth chapter addresses consumers’ willingness to adopt ecological food consumption behaviors. As discussed in Section 1.5.5, past research on environmental food consumption has focused on organic food, neglecting other ecologically relevant factors, such as avoiding products that are imported by plane. Through a large-scale survey, the last study investigated consumers’ beliefs about ecological food consumption and their willingness to adopt such behaviors. Additionally, it examined in more detail how different motives and food-related attitudes influenced consumers’ willingness to reduce meat consumption and to buy seasonal fruits and vegetables.

It was found that consumers believed avoiding excessive packaging had the strongest impact on the environment, whereas they rated purchasing organic food and reducing meat consumption as least environmentally beneficial. Similarly, respondents appeared to be most unwilling to reduce meat consumption and purchase organic food. Taste and environmental motives influenced consumers’ willingness to eat seasonal fruits and vegetables, whereas preparedness to reduce meat consumption was influenced by health and ethical motives. Women and respondents who preferred natural foods were more willing to adopt ecological food consumption practices.

Chapter 6: General discussion and conclusions

In the last chapter of this thesis, the main findings of the four studies are summarized and discussed. This chapter also addresses possible limitations of the studies and suggestions for future research. The thesis concludes with recommendations for communication strategies. An overview of the following chapters is presented in the following.
### Table 1.1: Overview of the thesis: chapters, aims or research questions, and applied methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Chapters, aims or research questions</th>
<th>Applied methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wulf</td>
<td>Developing a comprehensive knowledge scale covering a broad range of climate-related knowledge</td>
<td>Mail survey</td>
</tr>
<tr>
<td></td>
<td>What does the Swiss public know about climate change?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How do different knowledge domains relate to concern about climate change, skepticism, and feelings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>What does the Swiss public know about climate change?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Development of a comprehensive knowledge scale covering a broad range of climate-related knowledge</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mail survey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computer-based choice-task questionnaire, choice-task</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
References


Kaiser, F. G., & Fuhrer, U. (2003). Ecological behavior’s dependency on different forms...


Chapter 2

Consumers’ knowledge about climate change

Manuscript submitted for publication as:
Abstract

Several studies have unveiled various misconceptions about climate change that the public holds, for instance, confusion about climate change and ozone depletion. However, so far, there has been no uniform and standardized way to measure climate-related knowledge, which complicates comparisons between different countries or samples. To develop an extensive knowledge scale, we therefore examined the Swiss public’s understanding of climate change in a mail survey and related this scale to attitudes toward climate change. We thereby aimed to consider a broad range of climate-related knowledge, namely physical knowledge about CO$_2$ and the greenhouse effect, knowledge about climate change and its causes, knowledge about the expected consequences of climate change, and action-related knowledge. The questionnaire included items of different degrees of difficulty, ranging from knowledge that is covered by newspapers to experts’ knowledge. Our findings indicate that people still hold several misconceptions, although people’s knowledge related to CO$_2$ seems to have increased compared to previous studies. Of all knowledge sub-scales, knowledge about climate change and causes was most strongly related to attitudes toward climate change.
2.1 Introduction

Past research indicates that accurate knowledge about the causes of climate change is an important determinant of both behavioral intentions and support for climate protection policy measures (Bord, O’Connor, & Fisher, 2000; O’Connor, Bord, & Fisher, 1999). Lack of basic knowledge (e.g., about causes, impacts, and solutions) was also mentioned by laypeople as an important barrier to personal engagement (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). The authors suggested that lack of knowledge might contribute to a feeling of uncertainty about climate change, which ultimately might result in skepticism about the reality of climate change, the human influence, and the need for action. Thus, lack of knowledge might influence people’s attitudes toward climate change as well as people’s willingness to act and to support mitigation policies. It therefore seems important to investigate what the public currently knows about climate change. Although a large body of research has examined people’s understanding of climate change, there has been no standardized way of measuring knowledge, which makes it difficult to compare the results of different studies. Thus, we developed a comprehensive knowledge scale covering a broad range of knowledge about climate change and conducted a large-scale survey in the Swiss population. We also aimed to examine how this knowledge relates to attitudes, such as climate-related concern or skepticism.

2.1.1 Previous studies on laypeople’s knowledge about climate change

When asked about the public’s understanding of climate change, people seem to believe that the scientific background is generally poorly understood (Henderson-Sellers, 1990). In fact, previous studies examining the public’s climate-related knowledge showed that laypersons have a limited understanding of climate and seem to have difficulties distinguishing it from weather (Boström, Morgan, Fischhoff, & Read, 1994; Read, Boström, Morgan, Fischhoff, & Smuts, 1994; Reynolds, Boström, Read, & Morgan, 2010). Several other misconceptions about climate change also seem to be rather consistent. People, for instance, often confuse the problems of stratospheric ozone depletion with climate change and seem to have difficulties in differentiating between causes and actions specific to climate and other more general good environmental behaviors (Boström et al., 1994; Poortinga, Pidgeon, & Lorenzoni, 2006; Read et al., 1994; Reynolds et al., 2010).
Even highly educated adults showed widespread misunderstanding of the fundamental stock and flow relationships of CO₂ emissions and net removal (Moxnes & Saysel, 2009; Sterman, 2008; Sterman & Booth Sweeney, 2007).

The erroneous understanding of climate change and causes appears to be of a global nature (e.g., Bord, Fisher, & O’Connor, 1998; Dunlap, 1998; Leiserowitz, 2007) and persistent over time (Reynolds et al., 2010). Accordingly, such misconceptions have also been found in Switzerland. In a Swiss survey, 35% of the respondents believed that the greenhouse effect is caused by a hole in the Earth’s atmosphere (Diekmann & Meyer, 2008). And although a large majority of the respondents (89%) were aware that combustion of oil, coal, and gas contributes to the greenhouse effect, only 42% knew that CO₂ is the main contributor to the greenhouse effect. In an earlier study, even fewer could identify CO₂ as the main greenhouse gas, namely 28% of the respondents (Jaeger, Dürrenberger, Kastenholz, & Truffer, 1993). This indicates that the public awareness of CO₂ as a contributor to the greenhouse effect has generally risen in Switzerland in recent years. One reason for this increase might be that the issue has been progressively covered in the mass media. The influence of media on public knowledge will be discussed in section 2.1.2.

The public misconceptions found in past research can be assigned to different knowledge domains, such as knowledge about the process of climate change, about its causes, or about its consequences. People’s climate-related knowledge seems to vary across these different knowledge domains. Sundblad et al. (2009) found that experts, journalists, politicians, and laypersons all showed the highest level of knowledge about the causes of climate change, followed by the climate’s state and the consequences of climate change. The levels of confidence in one’s knowledge also varied between the different domains: laypersons felt most confident about their knowledge of consequences, followed by the causes and the climate’s state. Generally, people with higher levels of climate-related knowledge tend to be more confident about their knowledge and seem to consider themselves more informed (O’Connor, Bord, & Fisher, 1998; Sundblad, Biel, & Gärling, 2009). This relationship, however, was usually very weak. People’s confidence in their climate-related knowledge might therefore not be a valid indicator of their actual knowledge and thus no substitute for an objective assessment of climate-related knowledge.

However, past research’s focus on knowledge about climate change has also been subject to criticism. For instance, researchers have argued that people might have a more holistic understanding of climate change and that focusing on public knowledge about the science of climate change might therefore lead to misconceptions of public understanding (Bulke-
ley, 2000). Other researchers have argued that lack of knowledge is probably not the main barrier to action and that, therefore, increasing public awareness might not translate into actual behavioral change as various cognitive and structural barriers are involved (Bulkeley, 2000; Dunlap, 1998). Similarly, past research suggested that a socio-cultural model is more predictive of climatic change commitment than a model focusing on knowledge (Jaeger et al., 1993). We therefore do not claim that knowledge about climate change is a panacea for people to change their behaviors or to support climate protection measures. Simply informing people about climate change most certainly will not suffice to engage the public in the subject of climate change. However, to understand the necessity of climate policy measures or climate-friendly behavior, it is important to have a certain understanding of climate change. If someone, for instance, is unaware of the fact that CO$_2$ is the main cause of climate change, he or she would probably be very unwilling to accept CO$_2$ taxes or to reduce car use. We therefore believe that climate-related knowledge represents an important, yet not sufficient, prerequisite for people’s willingness to accept climate protection measures or to change their behaviors.

2.1.2 The influence of media coverage on public knowledge about climate change

Media coverage forms a dominant source of climate science news for consumers (Antilla, 2005) and may therefore affect consumers’ knowledge and attitudes. Past research examining the influence of media on climate-related knowledge among consumers, however, is mixed. One study indicated that the use of media is positively related to awareness of climate change causes, effects, and solutions (Stamm, Clark, & Eblacas, 2000). Another study, however, found that newspaper use had a negative influence on knowledge about climate change, whereas the number of information sources increased consumers’ climate-related knowledge (Kahlor & Rosenthal, 2009).

In the case of climate change, the media often present dissent where the science largely agrees, which finally leads to biased coverage of human contributions to climate change (Antilla, 2005; Boykoff & Boykoff, 2004). A study detected lack of knowledge among journalists, which might be one reason for this bias (Wilson, 2000). Furthermore, presenting opposing sides in order to provide balance and objectivity is a journalistic tradition (Corbett & Durfee, 2004). As a result, many articles frame climate change in terms of debate, controversy, or uncertainty (Antilla, 2005; Zehr, 2000). The controversy framing might
reduce consumers’ perception of the certainty of scientific findings (Corbett & Durfee, 2004). As discussed, the feeling of uncertainty about climate change could increase skepticism about the reality of climate change, which ultimately might decrease consumers’ willingness to address the issue (Lorenzoni et al., 2007).

2.1.3 Rationale for this study

Although the public understanding of climate change has been examined in several studies, so far there has been no standardized, uniform measure to assess people’s understanding of climate change. Such a comprehensive, quantitatively tested climate-related knowledge scale would allow for comparisons between countries, various samples, and time frames. More importantly, an extensive knowledge scale covering different knowledge domains would enable researchers to examine whether different types of knowledge are important for different types of psychological constructs (such as attitudes, intentions, or support for climate protection measures).

Fietkau and Kessel (1981) suggested in their model of ecological behavior that environmental knowledge has no direct effect on pro-environmental behavior. They assumed that knowledge rather influences people’s environmental attitudes, which then, among other variables, has an impact on ecological behavior (see Kollmuss & Agyeman, 2002). Thus, we believe that climate-related knowledge plays a role in consumers’ attitude formation. We therefore aimed to examine the influence of knowledge on consumers’ attitudes toward climate change, which we will describe in the following.

First, we studied the effect of knowledge on concern about climate change. The relationship between knowledge and concern seems plausible, as people need to be informed about an issue like climate change to worry about it. Investigating the determinants of concern about climate change also seems worthwhile, as this factor has been identified as an important predictor of consumers’ willingness to change climate-related behavior (e.g., Semenza et al., 2008). Second, we examined how knowledge about climate change influenced consumers’ skepticism about this issue. Human contribution to climate change is widely discussed and not universally accepted as a fact (e.g., Reynolds et al., 2010). It is possible that knowing the scientific findings about climate change might reduce consumers’ feeling of skepticism toward this topic. As skepticism might be an influential barrier to addressing climate change (Lorenzoni et al., 2007), it seems important to include this construct in our study. Third, we investigated the relationship between knowledge and
feeling of powerlessness. As discussed, consumers need to have a basic understanding of the causes of climate change to know how to address the issue. Therefore, knowledge might influence consumers’ feeling that they can contribute to climate change mitigation. Furthermore, meta-analyses of past research have shown that the feeling of behavioral control has a positive influence on pro-environmental behavior (Bamberg & Möser, 2007; Hines, Hungerford, & Tomera, 1986/87).

In sum, we aimed to develop a comprehensive knowledge scale, consisting of several subscales. Our aims were three-fold: First, we aimed to develop a comprehensive knowledge scale, which could be used in further research. The scale should cover a broad range of climate-related knowledge domains (such as causes or consequences of climate change) and include different levels of difficulty. Second, we intended to describe the level of climate-related knowledge among Swiss people with this instrument. Our third aim was to examine how these different knowledge domains relate to different climate-related attitudinal variables (namely concern about climate change, skepticism, and feeling of powerlessness).

2.2 Methods

2.2.1 Sample

The data were collected in a mail survey between February and May 2010. We randomly selected households from the telephone book in the German-speaking part of Switzerland and addressed the household member who was 18 years or older and whose birthday was next. Non-responders received two reminders, the second one containing another copy of the questionnaire. Overall, 916 persons sent back filled-out questionnaires, which corresponds to a response rate of 39%.

Sixty percent (n = 546) of our sample was male, 39% (n = 354) female, and 2% (n = 16) did not disclose their sex. The mean age of our respondents was 55 years (SD = 16), which is somewhat older than the Swiss adult population (M = 49 years) (BFS, 2009). The self-reported education level ranged from primary school (5%, n = 41), lower secondary school (8%, n = 75), upper secondary vocational school or business school (41%, n = 374), and upper secondary school (17%, n = 157) to college or university (27%, n = 251). Two percent (n = 18) did not indicate their highest level of education. Compared with Swiss
2.2.2 Questionnaire

In the beginning of the questionnaire, we defined "climate change" as more recent changes of the climate (in the past 250 years) and excluded climate fluctuations of the entire geological history, such as glacial periods and interglacials. Overall, the questionnaire consisted of 16 pages, covering constructs such as knowledge, concern about climate change, skepticism, or feeling of powerlessness. Only the constructs used in this study are reported here.

To develop the knowledge items, we first consulted the existing literature to detect public knowledge and misconceptions (e.g., Bord et al., 1998; Bostrom et al., 1994; Dunlap, 1998; Leiserowitz, 2007; Read et al., 1994; Reynolds et al., 2010). To get an impression of the current state of knowledge among Swiss consumers, we additionally conducted semi-structured face-to-face interviews with a convenience sample of 8 laypersons. The interviews covered consumers’ perceptions of causes and impacts of climate change, as well as possible mitigation measures. Based on the misconceptions and notions found in the literature and interviews (e.g., confusion of climate change with the ozone hole or about the harmfulness of CO₂), we developed 41 knowledge items covering a broad range of climate-related knowledge.

The items consisted of 19 correct and 22 wrong statements. We were careful that the positive or negative wording gave no indication of the correctness of the statements. There was no pattern in the order of correct and wrong statements. Respondents could indicate for each statement whether they believed it to be true, wrong, or whether they did not know. We included the latter response option to avoid participants guessing. Furthermore, we believed it to be less discouraging if respondents could indicate they did not know the answer.

Knowledge can be distinguished in declarative (factual) and procedural knowledge (skills that transform declarative knowledge into action) (Frick, Kaiser, & Wilson, 2004). Thus, we distinguished between factual knowledge, referring to knowledge about definitions, causes, and consequences of climate change, and action-related knowledge, covering information connected to possible actions (Tanner & Kast, 2003). Similarly to past studies (Read et al., 1994; Reynolds et al., 2010; Sundblad et al., 2009), we divided factual knowl-
edge into different knowledge domains and constructed a similar number of items for each
domain: (1) physical knowledge about CO\textsubscript{2} and the greenhouse effect (consisting of 9
items), (2) knowledge about climate change and causes (11 items), and (3) knowledge
about the expected consequences of climate change (11 items). Action-related knowledge
was assessed in 10 items.

For all knowledge scales, we included items of different degrees of difficulty, ranging from
basic understanding of climate change that is discussed in the media to expert knowledge.
We took care that there were correct and incorrect statements throughout the different
levels of difficulty. The items were grouped according to their subject; they were, however,
not ordered according to their difficulty level. Although we strived for scientific correct-
ness, we tried to avoid scientific terms, such as ”concentration,” ”radiative forcing,” or
”global warming potential.” The items thus represent a compromise between scientifically
true, yet generally understandable, statements. The knowledge items were pretested with
a convenience sample of 15 people to identify items with low, medium, and high difficulty.

We used the Fourth Assessment Report of the Intergovernmental Panel on Climate Change
(IPCC, 2007) as a basis for our knowledge scale. Additionally, we sent the knowledge items
to 8 climate scientists at the authors’ university. We asked the scientists to preview the
items to ensure they were unambiguously correct or wrong. These scientists included 4
Ph.D. students of atmospheric and climate science and 3 Ph.D. students with other ex-
pertise (environmental engineering, environmental policy and economics, and agricultural
sciences). Our expert sample further included a professor of atmospheric and climate
science, who was also an IPCC author.

The questionnaire also included items that measured different attitudes related to climate
change, such as concern or skepticism. These items were presented as statements (e.g.,
"I worry about the climate’s state” or ”Climate change is a racket”; see the Appendix),
which respondents could rate on a 6-point Likert scale, ranging from ”strongly disagree”
to ”fully agree.” Finally, the respondents indicated their sex, age, level of education, and
political affiliation.

2.2.3 Data analysis

Like the Rasch scale, the Mokken scale analysis is a probabilistic version of the Guttman
scaling. In contrast to the Rasch scale, however, the Mokken scale analysis is a nonpara-
metric procedure (Van Schuur, 2003). This scale analyzes each participant’s response
CHAPTER 2. CONSUMERS’ KNOWLEDGE ABOUT CLIMATE CHANGE

A respondent’s probability of solving an item depends on two factors: (1) on his or her latent trait (such as knowledge) and (2) on the item’s characteristic (such as level of difficulty) (Molenaar & Sijtsma, 2000). Accordingly, the Mokken scale analysis not only ranks respondents according to their probability of a positive response (i.e., their latent trait, such as ability or knowledge) but also orders items regarding their probability of being answered positively. One of the important assumptions is the one of double monotonicity. First, the item response function should be monotonically nondecreasing, meaning that the items order all respondents similarly (Mokken & Lewis, 1982). Thus, the expected order of the respondents on the latent trait (i.e., knowledge) is the same for each selection of items (Molenaar & Sijtsma, 2000). Second, the item ordering (according to their difficulty) should be the same for each person. If, for instance, person A had a higher probability of solving item x compared to item y, then person B should also show a higher solving probability for item x than for item y. As the Mokken scaling analysis scales both items and respondents, it is subject to stricter conditions than Cronbach’s alpha reliability analysis. Thus, the Mokken scaling analysis appeared to be well-suited for testing our factual knowledge scale. We therefore analyzed the factual knowledge items with a Mokken scale analysis using the MSP5 program (version 5.0, Iec ProGAMMA, Groningen, the Netherlands).

Similarly to a principal component analysis, the Mokken analysis can suggest subscales, by grouping subsets of items based on statistical criteria. The Loevinger scalability coefficient thereby is an important indicator; the coefficient indicates the degree to which respondents can be accurately ordered by the suggested set of items (Molenaar and Sijtsma 2000). The larger $H$, the higher the confidence in this ordering; a perfect scale would result in $H = 1$. A set of items with $H = .3 - .4$ is considered a weak scale. A scale with $H = .4 - .5$ would show medium scalability, whereas $H = .5 - 1$ would indicate a strong scale. Additionally, the scalability coefficients for all individual items should be $H_i > .3$.

For all knowledge items consisting of incorrect statements, responses were reversed so that the results indicate whether the answer was correct, wrong, or whether the respondent did not know the answer. The respondents’ answers were also recoded as dichotomous variables (1 = ”correct”, 0 = ”wrong” and ”don’t know”), so that we could distinguish...
people who knew the correct answers from people who did not. All resulting scales were then tested for their reliability.

We calculated the proportion of correct items for each respondent and each type of knowledge. We then examined the correlations between the different knowledge scales and tested how people’s education was related to these types of knowledge. In the second step, we ran three regression analyses to predict concern about climate change, skepticism, and feeling of powerlessness. As predictors for the regression models, we used socio-demographic variables, political affiliation, and the different types of climate-related knowledge.

2.3 Results

The Mokken analysis yielded three subscales for factual climate–related knowledge, which were in line with our projected knowledge domains: (1) physical knowledge about CO₂ and the greenhouse effect, (2) knowledge about climate change and causes, and (3) knowledge about the expected consequences of climate change. The items measuring action–related knowledge, however, did not result in a Mokken scale. We therefore used principal component analysis to build this scale.

In the following, we report per knowledge domain the response distributions for all knowledge items to examine our sample’s knowledge, followed by a description of the resulting scales and their quality. We then report how the knowledge scales correlate among each other as well as the correlations between the knowledge scales and education. Finally, we present the results of the regression analyses predicting concern, skepticism, and feeling of powerlessness using demographic variables, political affiliation, and the knowledge scores as predictors.

2.3.1 Physical knowledge about CO₂ and the greenhouse effect

Table 2.1 displays the response distribution and Mokken scale analysis of the knowledge domain physical knowledge about CO₂ and the greenhouse effect. The table shows that the respondents seemed to be well informed about how CO₂ is produced (item 1, see Table 2.1). A vast majority also knew about the definition of the greenhouse effect.

\[^1\text{We also conducted analyses using the three answer categories (coded as "correct" = 2, "don't know" = 1, and "wrong" = 0). They resulted in inferior scales, suggesting dichotomous scaling is more adequate.}\]
(item 2) and was aware that CO₂ is a greenhouse gas (item 3). Only a minority showed knowledge about other greenhouse gases, such as water vapor (item 9) or the climatic effect of methane (item 8). The well–documented misconception involving the ozone hole as the main cause of the greenhouse effect was also prevalent among our participants (item 7).

The Mokken scale analysis of physical knowledge yielded a scale consisting of six items with the Loevinger scalability coefficient $H = .39$ (see Table 2.1). Thus, the knowledge subscale is of weak (almost moderate) scalability with an acceptable reliability of $\rho = .65$, probably due to the broad range of the items’ topics. With $H_i > .33$, the scalability coefficients for all individual items are satisfactory. The means of correct responses indicate that the scale included items with various levels of difficulty ($.30 < M_i > .90$).
Table 2.1.
Physical knowledge about CO$_2$ and the greenhouse effect: response distribution and Mokken scale scalability coefficients ($H_i$)

<table>
<thead>
<tr>
<th>Items</th>
<th>Response distribution</th>
<th>$H_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Burning oil, among other things, produces CO$_2$.</td>
<td></td>
<td>.39</td>
</tr>
<tr>
<td>2. The warming of the Earth’s atmosphere caused by greenhouse gases is called the greenhouse effect.*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Carbon dioxide (CO$_2$) is a greenhouse gas.</td>
<td></td>
<td>.40</td>
</tr>
<tr>
<td>4. Greenhouse gases partly retain the Earth’s heat radiation.</td>
<td></td>
<td>.33</td>
</tr>
<tr>
<td>5. CO$_2$ is harmful to plants. (–)</td>
<td></td>
<td>.39</td>
</tr>
<tr>
<td>6. Without humans, there would be no greenhouse effect. (–)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. The ozone hole is the main cause of the greenhouse effect. (–)</td>
<td></td>
<td>.41</td>
</tr>
<tr>
<td>8. At the same quantity, CO$_2$ is more harmful to the climate than methane. (–)</td>
<td></td>
<td>.41</td>
</tr>
<tr>
<td>9. Water vapor is a greenhouse gas.*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$n = 868; H = .39; \rho = .65$

*Note.* (–) Denotes items with an incorrect statement. Accordingly, responses were reversed to indicate correct and wrong answers. For the Mokken scale analysis, the items were changed into a dichotomous response format of 0 (wrong or did not know) and 1 (correct). Items marked with * were not included in the Mokken scale as they reduced the scale’s quality; therefore, $H_i$ is not reported for these items.
2.3.2 Knowledge concerning climate change and causes

In the knowledge domain of climate change and its causes, the participants were most knowledgeable about the CO$_2$ increase in the atmosphere (see Table 2.2, item 1), followed by the changes in the spatial extent of snow cover in the northern hemisphere (item 2). Although the majority was aware that humans seem to be the main cause of the increase of greenhouse gases in the atmosphere (item 3), the participants appeared to be less sure about the influence of natural variations (item 6). The respondents also seemed to be less knowledgeable about the temperature changes in the past decades (item 8) and centuries (items 5 and 7).

The Mokken scale analysis resulted in a scale of seven items with moderate scalability (Loevinger’s scalability coefficient $H = .41$) and a satisfactory reliability of $\rho = .70$ (see Table 2.2). All items showed satisfactory scalability coefficients ($H_i > .33$). The means of correct responses varied between $.27$ and $.87$, indicating a wide range of item difficulties.
Table 2.2.
Knowledge concerning climate change and causes: response distribution and Mokken scale scalability coefficients ($H_i$)

<table>
<thead>
<tr>
<th>Items</th>
<th>Response distribution</th>
<th>$H_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The global CO$_2$ concentration in the atmosphere has increased during the past 250 years.</td>
<td>87 10</td>
<td>.40</td>
</tr>
<tr>
<td>2. In past centuries, the average spatial extent of the snow blanket in the northern hemisphere remained unchanged. (<em>-</em>)</td>
<td>83 10 7</td>
<td>-</td>
</tr>
<tr>
<td>3. The increase of greenhouse gases is mainly caused by human activities.</td>
<td>82 9 9</td>
<td>.48</td>
</tr>
<tr>
<td>4. With a high probability, the increase of CO$_2$ is the main cause of climate change.</td>
<td>79 12 10</td>
<td>.47</td>
</tr>
<tr>
<td>5. In Switzerland, the number of hot days has increased in past centuries.*</td>
<td>72 14 15</td>
<td>-</td>
</tr>
<tr>
<td>6. Climate change is mainly caused by natural variations (such as changes in solar radiation intensity and volcanic eruptions). (*-)</td>
<td>70 16 15</td>
<td>.39</td>
</tr>
<tr>
<td>7. The last century’s global increase in temperature was the largest during the past 1000 years.</td>
<td>67 23 10</td>
<td>.36</td>
</tr>
<tr>
<td>8. The ’90s were globally the warmest decade during the past century.</td>
<td>52 35 12</td>
<td>.33</td>
</tr>
<tr>
<td>9. If today’s greenhouse gas content in the atmosphere stabilized, the climate would still warm for at least another 100 years.*</td>
<td>48 41 11</td>
<td>-</td>
</tr>
<tr>
<td>10. In the last century, the temperature increase in Switzerland was significantly smaller than the global average. (<em>-</em>)</td>
<td>44 39 17</td>
<td>-</td>
</tr>
<tr>
<td>11. Today’s global CO$_2$ concentration in the atmosphere already occurred in the past 650,000 years. (*-)</td>
<td>26 50 24</td>
<td>.45</td>
</tr>
</tbody>
</table>

$n = 886; H = .41; \rho = .70$

Note. (*-) Denotes items with an incorrect statement. Accordingly, responses were reversed to indicate correct and wrong answers. For the Mokken scale analysis, the items were changed into a dichotomous response format of 0 (wrong or did not know) and 1 (correct). Items marked with * were not included in the Mokken scale as they reduced the scale’s quality; therefore, $H_i$ is not reported for these items.
2.3.3 Knowledge regarding the expected consequences of climate change

When it came to the expected consequences of climate change, the majority of participants knew about the increase of extreme weather events (see Table 2.3, item 1) and the melting of polar ice (item 2). Most of the respondents also knew that the sea level is expected to rise; however, they mainly associated this effect with the melting of polar ice. Only half of the participants were aware that this increase is also (and mainly) due to thermal expansion of sea water (item 9). Respondents seemed to be somewhat less knowledgeable about the expected patterns in climate and precipitation change (items 8 and 10).

Knowledge about the health-related consequences was mixed. Most of the participants knew that health consequences would not exclusively affect people living in tropical areas (item 3). Fewer were aware about the increased risk of infectious diseases in northern regions (item 6) or the increased risk of heat–related cardiovascular problems in Switzerland (item 7). The misconception of increased UV radiation due to CO$_2$ increase was prevalent among a large fraction of the participants (item 11).

Table 2.3 shows that the Mokken scale analysis dismissed all health–related knowledge items and yielded a scale of six items with moderate scalability (Loevinger’s scalability coefficient $H = .44$) and a reliability of $\rho = .66$. All items’ scalability coefficients were acceptable ($H_i > .38$). Again, various levels of item difficulty were apparent from the means of correct responses ($.43 < M_s > .96$).
Table 2.3.
Knowledge concerning expected consequences of climate change: response distribution and Mokken scale scalability coefficients ($H_i$)

<table>
<thead>
<tr>
<th>Items</th>
<th>Response distribution</th>
<th>$H_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the next few decades, the majority of climate scientists expect...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. ... an increase in extreme events, such as droughts, floods, and storms.</td>
<td><img src="image1" alt="Bar chart" /></td>
<td>.61</td>
</tr>
<tr>
<td>2. ... a warmer climate to increase the melting of polar ice, which will lead to an overall rise of the sea level.</td>
<td><img src="image2" alt="Bar chart" /></td>
<td>.60</td>
</tr>
<tr>
<td>3. The health effect that might come up due to climate change during the next 50 years concerns only humans who reside in tropical areas. (–)*</td>
<td><img src="image3" alt="Bar chart" /></td>
<td>–</td>
</tr>
<tr>
<td>4. ... a cooling-down of the climate. (–)</td>
<td><img src="image4" alt="Bar chart" /></td>
<td>.41</td>
</tr>
<tr>
<td>5. ... a warmer climate to increase water evaporation, which will lead to an overall decrease of the sea level. (–)</td>
<td><img src="image5" alt="Bar chart" /></td>
<td>.38</td>
</tr>
<tr>
<td>6. A warmer climate will foster the spread of infectious diseases (such as yellow fever or malaria) in the northern regions.*</td>
<td><img src="image6" alt="Bar chart" /></td>
<td>–</td>
</tr>
<tr>
<td>7. A warmer climate would lead to an increase of heat-related cardiovascular problems in Switzerland, too.*</td>
<td><img src="image7" alt="Bar chart" /></td>
<td>–</td>
</tr>
<tr>
<td>8. ... the climate to change evenly all over the world. (–)</td>
<td><img src="image8" alt="Bar chart" /></td>
<td>.40</td>
</tr>
<tr>
<td>9. ... that with a warmer climate, the sea water will warm and expand, which will lead to a rise in the sea level.*</td>
<td><img src="image9" alt="Bar chart" /></td>
<td>–</td>
</tr>
<tr>
<td>10. ... a precipitation increase in every region worldwide. (–)</td>
<td><img src="image10" alt="Bar chart" /></td>
<td>.43</td>
</tr>
<tr>
<td>11. An increasing amount of CO$_2$ risks will cause more UV radiation and therefore a larger risk for skin cancer. (–)*</td>
<td><img src="image11" alt="Bar chart" /></td>
<td>–</td>
</tr>
</tbody>
</table>

$n = 896; H = .44; \rho = .66$

Note. (–) Denotes items with an incorrect statement. Accordingly, responses were reversed to indicate correct and wrong answers. For the Mokken scale analysis, the items were changed into a dichotomous response format of 0 (wrong or did not know) and 1 (correct). Items marked with * were not included in the Mokken scale as they reduced the scale’s quality; therefore, $H_i$ is not reported for these items.
2.3.4 Action–related knowledge

As an indicator of knowledge that might affect climate–related actions (such as transportation choice, heating behavior, or energy use), we presented respondents a set of ten items to measure a broad range of action–related knowledge (see Table 2.4). At least half of the participants answered nearly all items correctly, indicating that, among Swiss consumers, action–related knowledge is generally higher than factual knowledge. A large majority knew how to aerate a room in a climate–friendly way (item 1) and they were also aware that, usually, cars emit more CO$_2$ than trains (item 2). While most of the participants knew about that the transportation sector belongs to the main emitters of CO$_2$ (item 3), fewer were aware that, in Switzerland, this is also true for the heating of buildings (item 7). Regarding food–related actions, more respondents knew about the CO$_2$ emissions due to greenhouse production (item 4) than about the greenhouse gas emissions associated with meat production (item 6). Items comparing CO$_2$ emissions of diesel–engine and petrol–engine vehicles (item 10), or short– versus long–haul flights (item 8), appeared to be the most difficult ones to answer.

Interestingly, the items did not result in a satisfactory Mokken scale, as the items could not monotonously be ordered difficulty–wise across all participants. We therefore used the mean score of the items as an indicator of action–related knowledge, a higher score indicating more knowledge. Reliability analysis resulted in a Cronbach’s alpha coefficient of $\alpha = .61$, which represents a rather low reliability. This is probably due to the different degrees of difficulty of the items and the fact that the items covered different domains.
Table 2.4.
Action–related knowledge: response distribution

<table>
<thead>
<tr>
<th>Items</th>
<th>Response distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To get in fresh air in winter, it is most climate friendly to keep a window open for a longer period of time. (–)</td>
<td>![Response分布图] 93</td>
</tr>
<tr>
<td>2. A car's average CO₂ emission per person and kilometer exceeds that of a train many times over.</td>
<td>![Response分布图] 84</td>
</tr>
<tr>
<td>3. A large part of the CO₂ emissions in Switzerland is caused by the transport sector. *</td>
<td>![Response分布图] 77</td>
</tr>
<tr>
<td>4. Lettuce from a heated greenhouse causes less CO₂ emissions than field-grown lettuce. (–)</td>
<td>![Response分布图] 76</td>
</tr>
<tr>
<td>5. Reducing the temperature of a gas-heated room by 1 degree decreases CO₂ emissions.</td>
<td>![Response分布图] 70</td>
</tr>
<tr>
<td>6. The production of 1 kg of beef produces more greenhouse gases than the production of 1 kg of wheat.</td>
<td>![Response分布图] 67</td>
</tr>
<tr>
<td>7. A large part of CO₂ emissions in Switzerland is produced by heating.</td>
<td>![Response分布图] 61</td>
</tr>
<tr>
<td>8. On short-haul flights (e.g., within Europe) the average CO₂ emission per person and kilometer is lower than on long-haul flights (e.g., Europe to America). (–)</td>
<td>![Response分布图] 57</td>
</tr>
<tr>
<td>9. In a nuclear power plant, CO₂ is emitted during the electricity production. (–)</td>
<td>![Response分布图] 57</td>
</tr>
<tr>
<td>10. A diesel-engine vehicle causes more CO₂ per person and kilometer than a comparable petrol-engine vehicle. (–)</td>
<td>![Response分布图] 50</td>
</tr>
</tbody>
</table>

Note. (–) Denotes items with an incorrect statement. Accordingly, responses were reversed to indicate correct and wrong answers. The scale was changed into a dichotomous response format of 0 (wrong) and 1 (correct). The item marked with * was not included in the action–related knowledge scale as it reduced the scale’s quality.
2.3.5 Correlations of the knowledge scales with each other and with education

All knowledge scales showed significant positive correlations between each other (see Table 2.5), although physical knowledge was only weakly correlated with knowledge about climate change and causes. A higher level of knowledge about the expected consequences was associated with more knowledge on the other two factual knowledge scales. There were positive correlations for action–related knowledge with all three subtypes of factual knowledge.

Education was positively related to all knowledge types. It, however, showed only a weak relationship with knowledge about climate change and causes.

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Physical knowledge</th>
<th>Climate change &amp; causes</th>
<th>Consequences</th>
<th>Action-related knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical knowledge</td>
<td>.63</td>
<td>.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climate change &amp; causes</td>
<td>.66</td>
<td>.25</td>
<td>.23**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consequences</td>
<td>.74</td>
<td>.23</td>
<td>.46**</td>
<td>.38**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action-related knowledge</td>
<td>.68</td>
<td>.22</td>
<td>.51**</td>
<td>.35**</td>
<td>.48**</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>–</td>
<td>–</td>
<td>.39**</td>
<td>.17**</td>
<td>.28**</td>
<td>.36**</td>
</tr>
</tbody>
</table>

Note. M reports the proportion of correct responses in the respective knowledge scale; SD denotes its standard deviation. **p < .01.

2.3.6 Regression analyses predicting concern about climate change, skepticism, and feeling of powerlessness

The attitudinal items were analyzed using a principal component analysis. Based on the eigenvalues (> 1), a visual inspection of the screeplot, and interpretability, we selected a
solution with three dimensions among our 16 items: (1) concern about climate change, (2) feeling of powerlessness, and (3) skepticism. All three scales showed satisfactory internal reliabilities ($\alpha$s > .70). The scale items, means, standard deviations, and reliabilities (Cronbach’s $\alpha$ coefficient), and factor loadings of the items are reported in the Appendix.

Overall, the respondents seemed to be rather concerned about climate change ($M = 5.18, SD = 0.91$, on a 6-point Likert scale). They did not appear to feel powerless ($M = 2.87, SD = 1.00$) or seemed to be very skeptical about the topic of climate change ($M = 2.69, SD = 1.05$).

Table 2.6 displays the result of the three regression analyses predicting concern about climate change, skepticism, and feeling of powerlessness. Of all the knowledge subscales, knowledge about climate change and causes was the strongest predictor of all these outcome variables. A higher level of knowledge about climate change and causes was related to more concern about climate change, less feeling of powerlessness, and less skepticism about climate change. The second–most powerful predictor of all three attitudes was political affiliation, except for feeling of powerlessness where the respondents’ political affiliation was equally predictive as knowledge about climate change and causes. Respondents with right–of–center political views tended to be less concerned about climate change, more skeptical, and felt less powerless to do something about climate change. Concern about climate change was also significantly influenced by knowledge about the consequences; respondents knowing more about the expected outcomes of climate change were more concerned about it. The feeling of powerlessness was reduced by having more action-related knowledge.
### Table 2.6
Regression analyses for concern about climate change, skepticism, and feeling of powerlessness predicted by socio-demographic variables, political affiliation, and climate-related knowledge

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>Concern</th>
<th>Skepticism</th>
<th>Powerlessness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.6</td>
<td>1.17</td>
<td>0.47</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.15</td>
<td>-0.13</td>
<td>-0.19</td>
</tr>
<tr>
<td>Age</td>
<td>0.00</td>
<td>1.11</td>
<td>-0.72</td>
</tr>
<tr>
<td>Education</td>
<td>0.00</td>
<td>-0.06</td>
<td>0.16</td>
</tr>
<tr>
<td>Political affiliation</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Physical knowledge</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Knowledge: Climate change &amp; causes</td>
<td>-1.63</td>
<td>-1.33</td>
<td>-1.75</td>
</tr>
<tr>
<td>Knowledge: Consequences</td>
<td>-0.38</td>
<td>-0.36</td>
<td>-0.18</td>
</tr>
<tr>
<td>Knowledge-related knowledge</td>
<td>1.46</td>
<td>1.43</td>
<td>0.11</td>
</tr>
</tbody>
</table>
| Note. $R^2 = 30\%$ for concern about climate change; $R^2 = 36\%$ for skepticism; $R^2 = 16\%$ for feeling of powerlessness.

* $p<.05$, ** $p<.01$, *** $p<.001$. 

Sex was coded 0 = male, 1 = female. 
Political affiliation was measured on a 7-point Likert scale, 1 = left-wing, 4 = center, 7 = right-wing.
2.4 Discussion

In this study, we aimed to develop a comprehensive climate-related knowledge scale consisting of various subscales measuring different areas of knowledge. We further intended to describe the level of climate-related knowledge that currently exists among the Swiss population. Finally, we examined the relationship between the different knowledge scales and, in the second step, between the knowledge scales and attitudinal variables.

Our climate-related knowledge scale finally consisted of three subscales measuring factual knowledge (physical knowledge, knowledge about climate change and causes, and knowledge about the expected consequences) and one action-related knowledge scale. Overall, our findings about the Swiss public’s understanding confirm several misconceptions among laypeople found in past research (e.g., confusion with ozone depletion), but also indicate that the current knowledge about CO$_2$ is generally high (e.g., CO$_2$ is a greenhouse gas).

Of all knowledge scales, knowledge about climate change and causes was most strongly related to attitudinal variables, such as concern about climate change, feeling of powerlessness, or skepticism. Our findings are discussed in more detail in the following.

2.4.1 Climate-related knowledge scale

We developed three reliable factual knowledge scales concerning climate change. The resulting subscales covered physical knowledge about CO$_2$ and the greenhouse effect, knowledge about climate change and causes, and knowledge about the expected consequences of climate change. We believe the three subscales contribute to the existing literature, as they offer a reliable, statistically tested way of measuring public knowledge about climate change comprehensively. The division into several subscales enables a closer examination of the different factual knowledge domains. Furthermore, all three subscales include items of different difficulty levels.

The Mokken scale analysis proved to be very useful for developing the knowledge scales. First, it allows the use of items with different degrees of difficulty. This way, both ceiling and floor effects can be avoided. Thus, even very well-informed respondents will find some items challenging, while less knowledgeable participants will still find some items they can answer. At the same time, the different levels of item difficulties allow a broad range of knowledge to be assessed with a relatively small set of items. Second, the Mokken scale
analysis ranks items according to their difficulty and ensures that all respondents perceive the items in the same rank order (Van Schuur, 2003). The uniform ordering of items across (sub)groups of persons makes it particularly suited for international comparisons of knowledge levels. Overall, the use of Mokken scale analysis seems to be very fruitful for future knowledge research.

The development of an action-related knowledge scale proved to be more difficult. The items’ difficulty levels seemed to vary across the respondents. One reason might be that the items covered different dimensions of action-related knowledge. While some respondents might have been knowledgeable in one domain (e.g., heating) and more nescient in another field (e.g., mobility), this might have been the other way round for other participants. Furthermore, it is also possible that action-related knowledge is evenly distributed throughout the population. This would make it difficult to develop items that are able to discriminate between persons with a high level of knowledge and less knowledgeable people. Although the variance in the items’ distributions impaired the scale’s internal consistency in the reliability test, the action-related knowledge scale may still function as an indicator for that type of knowledge. For future research, it might be promising to develop an action-related knowledge scale consisting of several subscales (e.g., items covering transportation, heating, and electricity). However, the action-related knowledge domain might be difficult to compare between different populations, since, depending on the country, different types of action might be climate-relevant. As in Switzerland, for instance, electricity is mainly produced by hydro-electric or nuclear power, electricity saving is not a priority for climate-friendly behavior. This might be different for countries generating electricity from coal or gas.

In contrast to the action-related knowledge scale, the resulting Mokken scales covering factual knowledge (i.e., physical knowledge, knowledge about climate change and causes, and knowledge about the expected consequences) included only items that are independent of the participants’ country of residence. Thus, these three factual knowledge scales could be applied in an international context, whereas the action-related knowledge scale probably has to be adjusted to the specific country’s situation.

We measured climate-related knowledge by counting each respondent’s correct answers, without differentiating between incorrect responses and the answer don’t know. As we were interested only in the participants’ knowledge, we interpreted incorrect responses and don’t know as lack of knowledge. Such a procedure is commonly applied in knowledge surveys (e.g., Connor & Siegrist, 2010; DiClemente, Boyer, & Morales, 1988; Durant,
Evans, & Thomas, 1992), but can be disputed. Uninterested respondents, for instance, might tend to choose the answer don’t know, which would reflect indifference rather than lack of knowledge (Mondak & Davis, 2001). In contrast, participants with high levels of confidence and a propensity to take risks might be inclined to guess and therefore increase their chances of correct answers. Mondak and Davis (2001) therefore suggested eliminating the systematic factor of propensity to guess by omitting the response option don’t know. For items that are left unanswered by participants, the answers should be randomly assigned to the available response categories. The authors argue that this way, knowledge scales are a function of one systematic factor (i.e., knowledge) and one unsystematic factor, namely chance. Future researchers applying the climate-related knowledge scales might take this recommendation into consideration.

With the climate-related knowledge scale, we aimed to measure a broad range of knowledge about climate change. Although we took a variety of knowledge domains into consideration, there might be also other types of knowledge relevant for people’s climate-related behavior or support of climate mitigation policies. Future research might, for instance, also go one step further and consider effectiveness knowledge, addressing the climate-related benefit associated with certain behaviors or policy measures (see Frick et al., 2004).

### 2.4.2 Climate-related knowledge among the Swiss population

Overall, our results are in line with past research examining people’s climate-related knowledge. In agreement with past studies, many respondents seemed unaware of the fact that the greenhouse effect is a natural process (Read et al., 1994; Reynolds et al., 2010). A large part of our respondents also believed the ozone hole to be the main cause of the greenhouse effect, confirming this misconception’s persistent existence (e.g., Bord et al., 2000; Bostrom et al., 1994; Dunlap, 1998; Leiserowitz, 2007; Read et al., 1994; Reynolds et al., 2010). Our findings also confirmed the misconception that increased UV radiation and risk of skin cancer are a consequence of climate change, which is probably influenced by the confusion with ozone depletion (Bostrom et al., 1994; Read et al., 1994; Reynolds et al., 2010). Similarly, we confirmed the finding that, while people know about the expected sea-level rise due to ice melting, they seem to be less aware of the (larger) contribution of thermal expansion of the oceans (Read et al., 1994; Reynolds et al., 2010).

Generally, our participants were rather knowledgeable about the issue of CO₂. The vast
majority knew that CO\textsubscript{2} is a greenhouse gas and that it is emitted when oil is burnt. A similarly high fraction was also aware that the global CO\textsubscript{2} concentration in the atmosphere has increased. The majority of our respondents knew that the CO\textsubscript{2} increase is mostly caused by human activities and that this increase is the main cause of climate change. Compared to past research (e.g., Diekmann & Meyer, 2008; Read et al., 1994), this understanding seems to have generally increased. Items regarding other greenhouse gases, namely water vapor and methane, were more challenging for the participants. These findings were somewhat expected, since the media coverage of greenhouse gases usually highlights CO\textsubscript{2} as the most influential contributor to the greenhouse effect and climate change. This might explain why our respondents were quite knowledgeable about CO\textsubscript{2} whereas their knowledge about other greenhouse gases was rather low.

Finally, our findings indicate that Swiss people seem to have only a few misunderstandings regarding action-related knowledge, as virtually every item was answered correctly by at least half of the participants. This finding is plausible, as Swiss environmental organizations mainly try to convey this type of knowledge to raise public awareness and motivate people to engage in climate-friendly behavior. It is also possible that action-related knowledge is easier to memorize for most people since, unlike factual knowledge, it is related to their daily lives and therefore more tangible.

However, men were overrepresented in our sample, and our participants were somewhat older and had slightly more education than the average population. Thus, our sample was not entirely representative of the Swiss population. We cannot exclude the possibility that people indifferent to climate change did not participate in our survey. Therefore, the consumers who did not respond might be less knowledgeable about climate change. Thus, our results might slightly overestimate public knowledge about climate change among Swiss consumers. Future studies might consider using quota sampling to examine climate-related knowledge in a more representative sample.

### 2.4.3 Correlations of the knowledge scales with each other and with education

All three factual knowledge scales correlated significantly and positively with action-related knowledge. Having factual knowledge might therefore be beneficial for the acquisition of information related to behaviors and actions. Therefore, it seems worthwhile to equip people with both factual and action-related knowledge.
Knowledge about the expected consequences of climate change was also moderately related to physical knowledge and knowledge about climate change and causes. It therefore appears that, to know what could happen in the future (e.g., rising of the sea level), it is necessary to understand what has happened in the past (e.g., temperature rise) and to know how the physical mechanisms influence these consequences (e.g., warming of sea water leads to thermal expansion).

Higher levels of education were associated with more knowledge in all knowledge domains. This relationship was, however, weak with knowledge about climate change and causes. As most of our respondents received their basic education before climate change was a public issue, this topic was most likely not discussed in school. Our findings indicate that knowledge about climate change and causes is more evenly spread among the population, probably due to the wide media coverage, which provided almost uniform information to a broad segment of people.

### 2.4.4 Regression analyses predicting concern about climate change, skepticism, and feeling of powerlessness

Generally, our sample appeared to be rather concerned about climate change. The respondents did not appear to feel powerless, and the average level of skepticism about climate-change was rather low. There is a possibility of self-selection bias, leading only concerned people to fill out our questionnaire about this subject. A biased sample would, however, reduce the variance, which means that our results might underestimate the influence of knowledge on attitudes and that, actually, this relationship might be even stronger. Nevertheless, due to the large response rate and the fairly representative sample, we can still conclude that a substantial fraction of the Swiss population currently is worried about climate change. This public awareness might be due to the broad media coverage in the recent past, particularly related to the UN Climate Change Conference 2009 (COP15) in Copenhagen. However, we did not compare the respondents’ concern about climate change to other current issues, such as the financial crisis or crime. It is very probable that, despite its high level in our study, concern about climate change is not one of people’s main concerns when it is compared to other issues (e.g., see Diekmann & Meyer, 2008; European Commission, 2009).

Overall, knowledge about climate change and causes was the strongest predictor for the attitudinal variables, such as concern about climate change, feeling of powerlessness,
or skepticism. This knowledge domain in particular correlated positively with concern about climate change and negatively with skepticism. People knowledgeable about climate change and causes thus seem to be less prone to believe that climate change is a racket or that its consequences are exaggerated in the media, and therefore tend to show higher levels of concern. However, as these are cross-sectional data, we cannot draw any conclusions about the causal direction of this relationship. It is conceivable that people already skeptical about the matter of climate change know about the scientists’ positions but simply do not accept them as true. Persons skeptical about climate change often negate human activities to be a cause of climate change. Since the causes of climate change are an essential part of this knowledge scale, it is of little surprise that this type of knowledge has the highest and most negative correlation with skepticism. This finding is also in line with past research suggesting that climate-related knowledge is not merely a matter of accepting facts but also involves the decision about whom and what to believe (Bulkeley, 2000). However, it appears that this type of knowledge should be given priority in climate education, as it is most strongly related to attitudes that might influence people to act or support climate policy measures.

There is a great scientific consensus that the warming of the climate system is unequivocal and that human activities have contributed to climate change (IPCC, 2007). At the same time, these findings appear to be the most important notions influencing consumers’ attitudes toward climate change. It therefore seems particularly important not only to inform the public about these results but also to illustrate the consensus among climate scientists and the certainty of these findings. As people often acquire climate-related knowledge from the media (Antilla, 2005; Kahlor & Rosenthal, 2009; Stamm et al., 2000), it would probably be worthwhile to address journalists, as they often act as intermediaries between scientists and the public. It seems particularly important to inform journalists about the large body of research that led to the conclusions about climate change and its causes. Furthermore, it might be helpful if reporters were introduced to the meaning of scientific uncertainty.

Political affiliation was another significant predictor of concern, skepticism, and feeling of powerlessness. People who positioned themselves at the right side of the political spectrum tended to be less concerned, more skeptical, and felt less powerless. This finding is supported by past research indicating a relationship between climate-related attitudes and political ideology (e.g., Leiserowitz, 2006; Zia & Todd, 2010). Thus, providing right-wing voters with information about climate change probably will not suffice to change
their attitudes toward this issue, as it might be outweighed by their political ideology. Relating environmental issues to concerns that are more of interest to them, such as economic concerns, might be more fruitful to arouse interest in environmental issues of people on the right wing of the political spectrum rather than trying to change their political affiliation.

Knowledge about the consequences of climate change was significantly related to increased climate-related concern; thus, people who were aware about the possible (negative) outcomes of climate change tended to worry more about it. Furthermore, having more action-related knowledge appeared to reduce the feeling of powerlessness about contributing to climate change mitigation. Both findings are very plausible and support the validity of the respective subscales.

Overall, the climate-related knowledge scale needs to be tested in further studies, preferably with different populations, to test its general applicability. Generally, our proposed scale could be useful for cross-cultural comparisons to first examine whether the measurement models are identical across countries. Second, the scale would allow for the identification of differences in knowledge across countries. It would also be interesting to expand the knowledge about the relationships of knowledge, attitudes, and willingness to act by using structural equation modeling. As knowledge might not be the most important predictor of behavior, future research could compare the effect of knowledge to the influence of other factors. Based on the outcomes of such studies, one could conclude whether a focus on knowledge acquisition would be worthwhile in future campaigns or educational material or if other methods (such as incentives) might be more promising.

References


## Appendix

**Table 2.7.**

Items, means, standard deviations (SD), internal consistencies (α), and factor loadings of the attitudinal scales (English translations of original items)

<table>
<thead>
<tr>
<th>Items</th>
<th>Mean</th>
<th>SD</th>
<th>α</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concern about climate change</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. We must protect the climate’s delicate equilibrium.</td>
<td>5.18</td>
<td>0.91</td>
<td>.83</td>
<td>.77</td>
</tr>
<tr>
<td>2. Climate protection is important for our future.</td>
<td></td>
<td></td>
<td></td>
<td>.75</td>
</tr>
<tr>
<td>3. I worry about the climate’s state.</td>
<td></td>
<td></td>
<td></td>
<td>.70</td>
</tr>
<tr>
<td>4. Climate change has severe consequences for humans and nature.</td>
<td></td>
<td></td>
<td></td>
<td>.70</td>
</tr>
<tr>
<td><strong>Feeling of powerlessness</strong></td>
<td>2.87</td>
<td>1.00</td>
<td>.71</td>
<td></td>
</tr>
<tr>
<td>1. Climate protection measures are determined by a few powerful persons; as a single citizen, I have no effect.</td>
<td></td>
<td></td>
<td></td>
<td>.73</td>
</tr>
<tr>
<td>2. With my behavior, I cannot influence the climate, as, in fact, it rests in the hands of the industry.</td>
<td></td>
<td></td>
<td></td>
<td>.69</td>
</tr>
<tr>
<td>3. As an ordinary citizen, I can influence governmental decisions regarding climate protection. (–)</td>
<td></td>
<td></td>
<td></td>
<td>.66</td>
</tr>
<tr>
<td>4. I feel able to contribute to climate protection. (–)</td>
<td></td>
<td></td>
<td></td>
<td>.49</td>
</tr>
<tr>
<td>5. If I tried to behave in a climate-friendly way, that would surely have a positive effect on the climate. (–)</td>
<td></td>
<td></td>
<td></td>
<td>.49</td>
</tr>
<tr>
<td><strong>Skepticism</strong></td>
<td>2.69</td>
<td>1.05</td>
<td>.83</td>
<td></td>
</tr>
<tr>
<td>1. Climate change and its consequences are being exaggerated in the media.</td>
<td></td>
<td></td>
<td></td>
<td>.74</td>
</tr>
<tr>
<td>2. Climate change is a racket.</td>
<td></td>
<td></td>
<td></td>
<td>.68</td>
</tr>
<tr>
<td>3. As long as meteorologists are not even able to accurately forecast weather, climate cannot be reliably predicted either.</td>
<td></td>
<td></td>
<td></td>
<td>.68</td>
</tr>
<tr>
<td>4. There are larger problems than climate protection.</td>
<td></td>
<td></td>
<td></td>
<td>.62</td>
</tr>
<tr>
<td>5. I do not feel threatened by climate change.</td>
<td></td>
<td></td>
<td></td>
<td>.61</td>
</tr>
<tr>
<td>6. The impacts of climate change are unpredictable; thus, my climate-friendly behavior is futile.</td>
<td></td>
<td></td>
<td></td>
<td>.58</td>
</tr>
<tr>
<td>7. Climate protection needlessly impedes economic growth.</td>
<td></td>
<td></td>
<td></td>
<td>.56</td>
</tr>
</tbody>
</table>

*Note.* (–) Reversed in coding. Ratings ranged from 1 ("strongly disagree") to 6 ("fully agree").

73
Chapter 3

Organic tomatoes versus canned beans: How do consumers assess the environmental friendliness of vegetables?

Manuscript accepted for publication as:
Abstract

The environmental assessment of a food product is highly challenging for consumers since such an assessment requires the consideration of various product characteristics. Furthermore, products often show conflicting features. This study used a choice task and a questionnaire to examine how consumers judge the environmental friendliness of several vegetables. The consumers’ environmental assessment was compared with life cycle assessment (LCA) results, which represent the overall environmental impact of a product throughout its lifespan. In contrast to the LCA, consumers considered transportation distance rather than transportation mode and perceived organic production as very environmentally relevant. Furthermore, consumers assessed the environmental impact of packaging and conservation as more important than the LCA results show. Findings also suggested the current product information for vegetables is insufficient for judging their environmental quality. Implications for information campaigns and ecological food labeling are discussed.
3.1 Introduction

Food consumption has been estimated to contribute to 20% to 30% of the total environmental impact in the Western world (Tukker & Jansen, 2006), and food consumption patterns in industrialized countries exceed the recommended greenhouse gas emission for sustainable development by a factor of 4 (Carlsson-Kanyama, 1998). Greenhouse gas emissions from different meals with the same caloric and protein content can vary by a factor of 9, depending only on the ingredients. Thus, with food choices, consumers can substantially contribute to sustainable development. So far, little research has examined which factors consumers pay attention to when choosing environmentally friendly food products. The present study therefore aimed to investigate how consumers choose the most environmentally friendly alternative. Moreover, we wanted to find out whether laypeople’s assessments differ from life cycle assessment (LCA) results.

Past research on consumers’ perception and behavior related to sustainable food has focused on the consumption of organically produced food (e.g., Grunert & Juhl, 1995; Magnusson, Arvola, Koivisto Hursti, Aberg, & Sjödén, 2003; Squires, Juric, & Cornwell, 2001; Tregear, Dent, & McGregor, 1994; Wandel & Bugge, 1997). However, the environmental assessment of a product requires the consideration of additional product features such as transportation, conservation, and packaging (Jungbluth, 2000). Ideally, an ecological food product is domestically produced rather than imported from abroad; furthermore, it is organically grown, seasonal, fresh (rather than frozen), and unwrapped (Tanner, Kaiser, & Kast, 2004; Tanner & Kast, 2003).

Tanner and Kast (2003) considered all these dimensions and found green food purchases were facilitated when consumers had the knowledge to distinguish between environmentally friendly and environmentally harmful products. Thus, if consumers judge the environmental friendliness of food products correctly, they may be better able to choose green food products.

However, the environmental assessment of a food product is challenging for consumers. First, the environmental impact of a food product is not directly observable and therefore has to be deduced in a rather complex procedure (Tanner & Jungbluth, 2003). Second, food products rarely fulfill all ecological requirements, but instead frequently show conflicting features (e.g., a regional vegetable that stems from greenhouse production or a field-grown alternative that is imported from overseas). Thus, consumers have to weigh
Making tradeoffs is one of the most difficult challenges in decision making because different objectives have to be pursued simultaneously, and each objective has its own basis of comparison (Hammond, Keeney, & Raiffa, 2002). Decision difficulty is substantially increased when attribute values show negative correlations between different alternatives (Hastie & Dawes, 2001). Few studies have examined how consumers judge the environmental friendliness of food products if they are faced with such conflicting product features (e.g., Tanner, 2008; Tanner & Jungbluth, 2003).

LCAs of products use a multiattribute assessment method. All environmental impacts are measured and weighted according to their ecological importance. Such an elaborate assessment method is difficult for consumers, since working memory capacity limits the amount of information they can process within a reasonable time frame (Bettman, Johnson, & Payne, 1991). We therefore assume laypeople use few information cues and that consumers’ environmental assessments accordingly differ from LCA results. To the best of our knowledge, no study has directly compared consumers’ environmental assessments of food products to LCA results. Such a comparison seems worthwhile, since it could reveal consumers’ misconceptions about the environmental impact of food characteristics. This would provide useful information for campaigns or education material addressing ecological food consumption.

In sum, the present research aimed to determine what consumers believe to be environmentally relevant food characteristics and to find out if consumers are able to correctly assess the environmental quality of food products. Consumers’ environmental assessment of various product features was compared to LCA results to determine if the assessments differed, and if so, in what respect. Furthermore, we tried to investigate how consumers evaluate the environmental friendliness of various vegetable products. For this purpose, participants repeatedly chose the environmentally friendlier alternative between pairs of vegetable products. Consumers’ environmental assessments of vegetables and the LCA results were then compared.
3.2 Methods

3.2.1 Sample

We randomly selected 375 addresses in and around Zurich (three urban districts and three municipalities) from the telephone book. The selected households first received a letter informing them about the study. To avoid self-selection bias, they were informed only that the study aimed to investigate people’s evaluation of food items; the subject of environmental friendliness was not mentioned. We then contacted the selected households by phone, and the person responsible for the household shopping was asked to participate. Seventy-nine persons participated, of whom 70% were women. Since we asked the primary shoppers to take part in the experiment, women were overrepresented. The mean age was 49 years ($SD = 16$), and the mean household size was 2.4 people ($SD = 1.4$); both demographics are in line with the Swiss census data (BFS, 2009). The majority of the participants (49.4%) had attended upper secondary vocational school or business school, and 26.6% had a college or university degree. A smaller fraction indicated upper secondary school (8.9%), lower secondary school (7.6%), or other (7.6%) as their highest education level. Compared with Swiss census data (BFS, 2009), the sample’s education level was slightly higher.

3.2.2 Procedure

The study took place in a university laboratory. Participants were seated in cubicles with laptop computers and introduced to the task and, if necessary, to handling the computer. Participants then completed a choice task and a questionnaire on environmental criteria and demographic variables. They progressed through the slides at their own pace, with no time limit. After participants had completed the computer-based choice task and questionnaire, the experimenter debriefed, thanked, and paid them CHF 50 (approximately US$45).

Since answering questions about environmentally relevant dimensions could affect the subsequent choice task and vice versa, we asked half of the participants about the environmentally relevant dimensions before the choice task. The other half started with the choice task and answered the questions about the environmentally relevant dimensions afterwards.
3.2.3 Materials

Choice task

Overall, we presented 10 vegetable products, consisting of green beans, tomatoes\(^1\), and potatoes in different varieties in the way they are offered for sale in Swiss grocery stores. We selected the products according to the following criteria: (a) all products should be offered by one of the main retailers in Switzerland and therefore be known to the general public, (b) all environmental product features (such as Swiss origin, European, and imported from overseas) should be represented, and (c) there should be LCA data of each product available in the life cycle inventory database. Each vegetable product was shown by means of a photo and a short description, which corresponded to the information provided in the shops. Before the choice task started, we presented each vegetable product individually so the participants were familiar with the products. During the choice task, we repeatedly showed pairs of vegetable products and asked the participants to choose the one that is environmentally friendlier during the winter season. All 45 possible pairs were displayed on a computer screen (see Figure 3.1 for an example). The order of pairs and screen side of the stimuli (right/left) was set in an optimal order to avoid regular repetitions (Ross, 1934).

Questionnaire

Similar to the choice task, the questionnaire on environmental criteria and demographic variables was computer-based. In an open-ended question, we asked which environmental criteria the participants believed to be relevant for food products. The participants could mention as many criteria as they wanted. They then assessed the environmental friendliness of 19 given criteria, such as greenhouse production or air transport from overseas (see Table 3.1), which could be rated on a 7-point Likert scale (higher scores indicated more environmental friendliness). Since not all criteria given were environmentally relevant, the scale midpoint was labeled as neutral. Finally, participants provided information about their demographics (gender, age, education, and household size).

\(^1\) Vegetable is a purely culinary term. Botanically, tomatoes are berries and, therefore, fruits. However, since tomatoes are usually served as part of a salad or a main course, they are culinarily classified as vegetables.
Life cycle assessment (LCA)

To compare the consumers’ assessments with an objective evaluation, the ecological impact of the product criteria and the vegetable products presented was estimated by an LCA. LCA is a method that assesses the overall environmental burden of a food product by calculating the environmental impacts associated with production, packaging, conservation, and transportation (Jungbluth, 2000; Jungbluth, Tietje, & Scholz, 2000).

For the present study, we used the most recent version of the Swiss method Ecological Scarcity (UBP06 – Umweltbelastungspunkte06). This eco-factor calculation aggregates manifold environmental impacts (use of resources and emissions into the air, soil, and water) according to politically defined scarcity (Frischknecht, Steiner, Braunschweig, Egli, & Hildesheimer, 2006). The ecological performance therefore refers to the current political agenda and is based on Swiss environmental legislation. The one-score-impact assessment allows a comparison between different products and characteristics (Jungbluth et al., 2000). The scale is open-ended; higher scores indicate higher environmental impact.
3.2.4 Data analysis

We conducted data analysis with SPSS (version 17.0, SPSS Inc.) and SYSTAT (version 12, SYSTAT Software Inc., Chicago, IL, USA). Consumers rated the environmental criteria with regard to the products’ environmental friendliness, since this term is more prevalent in the media and advertising than environmental harmfulness. To enable comparison with LCA results, which indicate negative environmental impacts, the environmental friendliness ratings of the consumers were recoded so higher scores indicated more environmental harm. As these ratings were not normally distributed ($D(79) > .15, p < .001$), we report the medians and 95% confidence intervals of the medians next to the mean values. The medians and confidence intervals were calculated with the bootstrap method (Efron & Tibshirani, 1993; Johnson, 2001). For this procedure, we drew 1,000 samples with replacement with size $n = 79$ from the dataset. For further analysis of the environmental criteria, we used nonparametric tests.

We performed a multidimensional scaling analysis (MDS PROXSCAL) to explore to what extent the perceived environmental friendliness of products differed in the consumers’ view. MDS is a method that represents (dis)similarity among pairs of objects as distances in a low-dimensional space (Borg & Groenen, 2005). Thus, the data and its structure can be explored visually. In the present study, we aggregated the preferences for each of the 45 pairs in percentages and transformed them into dissimilarity data by measuring their deviation from 50%. If 50% of the participants chose either product, we assumed that in their view the products were very similar. Following this assumption, the more each aggregated percentage of choice deviated from 50%, the more distinctly consumers perceived these two products. Overall, the multidimensional structures of the matrix consisted of 45 dissimilarities (choices) between the 10 products. To indicate how well the configuration matched the data, stress was computed as a measure of goodness of fit (ranging from 0.00 to 1.00). Smaller stress means a better fit, and a value of zero would mean perfect fit (Borg & Groenen, 2005; Kruskal, 1964).
3.3 Results

3.3.1 Manipulation check

We applied Mann-Whitney tests to analyze whether task order affected the respondents’ assessment of environmental criteria. With the exception of the environmental assessment of plastic packaging, no significant difference was found between the group that started with the choice task and the group that started with the environmental rating of provided criteria ($U$ values $< 774.50$, $p$ values $> .05$). Participants who carried out the choice task first assessed plastic packaging as less environmentally harmful ($Mdn = 4$) than those who rated the environmental criteria first ($Mdn = 5$), $U = 450.50$, $p = .001$ (the Bonferroni correction for multiple comparisons was applied, $\alpha = .05/19 = .003$). Since this was the only criterion that differed significantly, and because the divided sample size would have been too small for meaningful results, we aggregated the sample for all further analyses.

3.3.2 Spontaneously mentioned environmental criteria

The open-ended question on perceived environmental criteria showed most participants spontaneously mentioned production method as a relevant criterion (78%). A majority (66%) also believed provenance is important for the environmental friendliness of food products. Season (19%) and packaging (19%) were mentioned less frequently. Finally, 8% percent of the consumers named conservation methods, degree of processing, and health aspects (such as naturalness, freshness, and ingredients).

A closer look at the category of production method revealed that participants mainly named organic production (41%) and/or related aspects, such as use of chemicals (20%) or use of fertilizers (9%). Open-field production was mentioned by 5% of the consumers, and only 4% named greenhouse production as environmentally relevant. Many participants remained unspecific and mentioned energy and water use (16%) or production method in general (8%).

In the category of transportation, most consumers referred to the product’s provenance (30%) and/or the transportation distance (24%). Transportation mode was mentioned by only 3% of the participants, whereas 14% remained unspecific and just mentioned transportation in general.
In sum, when asked about environmental criteria, most consumers spontaneously thought about production methods and mainly referred to organic production. A majority also mentioned transportation as environmentally relevant and, in doing so, mostly considered provenance and transportation distance.

### 3.3.3 Evaluation of the environmental criteria presented

We then asked participants to rate the environmental impact of the 19 environmental criteria presented. Table 3.1 shows that participants rated water scarcity as most environmentally harmful, followed by air transportation, genetic modification, and transportation by truck or ship. Consumers rated organic production and consideration of biodiversity as most environmentally friendly.

In the further analyses, we included only criteria used in the LCA. Items assessed by laypeople alone, such as genetic modification, are therefore omitted here.

Figure 3.2 shows the LCA results and consumers’ environmental assessments of product criteria. In both the consumers’ assessment and the LCA results, air transportation appeared as the most important determinant of environmental friendliness. To simplify our comparison, the extreme points of the consumers’ ratings and the LCA outcomes were scaled equally, using the air transportation ratings as the calibration point.

According to the LCA, all product characteristics contributed to some extent to the environmental impact of a vegetable product. However, compared to air transportation, the LCA assessed all other criteria as considerably less environmentally harmful. According to the LCA results, greenhouse production was the second most harmful dimension, followed by refrigeration. With the exception of glass packaging, packaging was less environmentally relevant in the LCA results.

In contrast to the LCA, consumers rated truck or ship transportation as similarly harmful to air transportation. Greenhouse production, the second most harmful criterion according to the LCA, ranked only sixth in the consumers’ assessment after air, truck, or ship transportation, metal and plastic packaging, and refrigeration. Relative to the perceived environmental impact of air transportation, consumers rated metal and plastic packaging as more environmentally harmful than the LCA did. In contrast to the LCA, consumers rated glass packaging as the most environmentally friendly packaging material.
Note. The life cycle assessment (LCA) data were calculated by Niels Jungbluth, ESU-services.

Figure 3.2. LCA results versus consumers’ environmental assessments of product characteristics
### Table 3.1.
Mean scores ($M$), medians ($Mdn$), and 95% confidence intervals (95% CI) for the medians of perceived environmental harmfulness for each criterion provided

<table>
<thead>
<tr>
<th>Environmental criterion</th>
<th>$M$</th>
<th>$Mdn$</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water scarcity</td>
<td>6.77</td>
<td>7.0</td>
<td>7.0–7.0</td>
</tr>
<tr>
<td>Air transport</td>
<td>6.42</td>
<td>7.0</td>
<td>7.0–7.0</td>
</tr>
<tr>
<td>Genetic modification</td>
<td>6.13</td>
<td>7.0</td>
<td>6.0–7.0</td>
</tr>
<tr>
<td>Truck or ship transport</td>
<td>6.05</td>
<td>6.0</td>
<td>6.0–7.0</td>
</tr>
<tr>
<td>Metal packaging</td>
<td>5.46</td>
<td>5.0</td>
<td>5.0–6.0</td>
</tr>
<tr>
<td>Impairment of biodiversity</td>
<td>5.35</td>
<td>6.0</td>
<td>5.0–6.0</td>
</tr>
<tr>
<td>Deep-frozen</td>
<td>4.86</td>
<td>5.0</td>
<td>5.0–5.0</td>
</tr>
<tr>
<td>Plastic packaging</td>
<td>4.81</td>
<td>5.0</td>
<td>4.0–5.0</td>
</tr>
<tr>
<td>Greenhouse production</td>
<td>4.57</td>
<td>5.0</td>
<td>4.0–5.0</td>
</tr>
<tr>
<td>Preserved (e.g., dried or heated)</td>
<td>4.04</td>
<td>4.0</td>
<td>4.0–4.0</td>
</tr>
<tr>
<td>Glass packaging</td>
<td>3.70</td>
<td>4.0</td>
<td>3.0–4.0</td>
</tr>
<tr>
<td>Healthiness</td>
<td>3.49</td>
<td>4.0</td>
<td>4.0–4.0</td>
</tr>
<tr>
<td>Unchilled storage</td>
<td>2.96</td>
<td>3.0</td>
<td>2.0–3.0</td>
</tr>
<tr>
<td>Fair trade</td>
<td>2.68</td>
<td>2.0</td>
<td>2.0–3.0</td>
</tr>
<tr>
<td>Open-field or integrated(^a) production</td>
<td>2.47</td>
<td>2.0</td>
<td>2.0–3.0</td>
</tr>
<tr>
<td>Regional production</td>
<td>2.38</td>
<td>2.0</td>
<td>2.0–2.0</td>
</tr>
<tr>
<td>Unpacked</td>
<td>2.22</td>
<td>2.0</td>
<td>2.0–2.0</td>
</tr>
<tr>
<td>Biodiversity consideration</td>
<td>1.77</td>
<td>1.0</td>
<td>1.0–2.0</td>
</tr>
<tr>
<td>Organic production</td>
<td>1.61</td>
<td>1.0</td>
<td>1.0–2.0</td>
</tr>
</tbody>
</table>

**Note.** Environmental assessment was done on a 7-point Likert-type scale and recoded (1 = not environmentally harmful at all to 7 = very environmentally harmful).

\(^a\) Integrated production denotes an agricultural practice that limits use of chemical fertilizer and pesticides (Tanner & Jungbluth, 2003).

### 3.3.4 Consumers’ environmental assessment of all products in the choice task

To explore consumers’ environmental assessment of different vegetable products, a choice task was conducted. The aggregated choice preferences were analyzed with an MDS. PROXSCAL displayed a one-dimensional solution (Figure 3.3, y–axis), implying that
consumers’ choice preferences were based on just one dimension. Stress-I was .15, indicating an acceptable fit between the configuration and the data (Borg & Groenen, 2005; Kruskal, 1964).

Organic Swiss potatoes ranked at the lower end, indicating they were perceived as the least environmentally harmful option of all vegetable products presented. In second position were conventional Swiss potatoes. Hence, consumers perceived potatoes as the most ecological vegetable overall.

Potatoes were followed by regional green beans and Swiss tomatoes, both from greenhouse production. All four products that explicitly indicated Swiss origin in their descriptions were ranked at the lower end and thus perceived as environmentally friendly.

These products were followed by frozen beans, tomatoes from Morocco, canned beans, and open-field beans from Egypt. Tomatoes from the Netherlands and dried beans from China were located at the upper end of the scale. This indicated that our participants perceived these two products as the most environmentally harmful compared to the other vegetable products.

If we compare the outcomes of the MDS with the LCA results (Figure 3.3, x-axis), it appears consumers’ assessment of vegetable products differed from the LCA results. All vegetable products were rather evenly distributed in terms of environmental impact in the average consumer’s mind. In the LCA results, however, there was a major difference between the environmental harmfulness of Egyptian beans and the other products.

Consumers seemed to overestimate the environmental harm caused by Chinese dried beans and greenhouse tomatoes from the Netherlands. Compared to the LCA, consumers also rated the environmental burden from canned beans as relatively high. Consumers appeared to estimate the environmental harmfulness of Egyptian and regional greenhouse beans, however, lower than the LCA.
CHAPTER 3. CONSUMERS’ ENVIRONMENTAL FOOD ASSESSMENTS

Note. The life cycle assessment (LCA) data were calculated by Niels Jungbluth, ESU-Service.

Scale of MDS coordinates (Y-axis) was reversed so that higher values represent higher environmental impact.

Figure 3.3. LCA results versus consumers’ perceived environmental harm of each vegetable.
3.3.5 Assessments within the vegetable categories

For a more elaborate comparison between LCA results and consumers’ environmental assessments, product rankings by consumers and the LCA are now compared within the vegetable categories.

Green beans

In the choice task, consumers seemed to consider provenance as important, since regional beans from greenhouse production ranked lowest in the consumers’ perspective, whereas dried Chinese beans ranked highest. Beans from Egypt, however, were perceived as moderately environmentally harmful.

Since green beans are out of season in winter, the conserved alternatives were considered the most environmentally friendly options in the LCA. Canned, dried, and refrigerated beans were assessed as similarly environmentally friendly. Producing regional beans in a greenhouse is very energy-intensive due to the heating required. The LCA assessed this product as not ideal with regard to the environment. Because Egyptian open-field beans were imported by airplane, they ranked highest on the environmental harmfulness scale.

A comparison between LCA results and consumers’ assessments of green beans revealed considerable differences. Chinese dried beans as well as the canned alternatives had the best LCA results, but consumers rated these products as the worst. The regional beans were viewed as environmentally suboptimal by LCA, whereas consumers assessed this product as the best option for the environment.

Tomatoes

Consumers rated Swiss tomatoes from greenhouse production as more environmentally friendly than the organic alternatives from Morocco. Due to the warmer climate in Morocco, tomatoes are field-grown, and energy-intensive greenhouse heating can be avoided. Therefore, in the LCA, the Moroccan tomatoes were considered more environmentally friendly than the Swiss alternatives. The tomatoes from the Netherlands included intensive greenhouse production as well as transportation from abroad; accordingly, they ranked as the least environmentally friendly tomato product both among consumers and in the LCA.
Potatoes

Consumers ranked organic potatoes as more environmentally friendly than the conventional ones. However, due to the use of copper as an insecticide in place of chemical insecticides, the LCA assessed the organic potatoes as less environmentally friendly than conventional ones.

In sum, the product rankings within the vegetable categories suggest that consumers mainly used two criteria to estimate environmental friendliness, namely transportation distance and production method (preferring organic production). The LCA method, however, considered a multiplicity of environmental criteria, particularly transportation mode and heated greenhouse production.

3.4 Discussion

To the best of our knowledge, it has been unknown how consumers evaluate the environmental friendliness of food products and how these assessments differ from the objective measure of an LCA. This study therefore aimed to investigate what consumers believed to be environmentally relevant product features. In addition to asking participants directly to assess the environmental friendliness of several criteria, we studied the participants’ environmental assessment by letting them choose the environmentally friendlier alternative between several pairs of vegetable products. We then compared consumers’ assessments of environmental criteria and environmental assessments of vegetable products to the LCA results to see if they differed.

Overall, the consumers’ environmental assessments and the LCA results differed substantially. In contrast to the LCA method, consumers mainly considered transport distance rather than means of transportation. Furthermore, consumers seemed to overestimate both the environmental benefit of organic production and the environmental harm of packaging and conservation. These findings are discussed in more detail in the next sections.
3.4.1 Transportation

Overall, consumers seemed to be aware of the environmental impact of transportation in general. However, they appeared to consider transportation distance rather than means of transportation. This conclusion appears to be supported by three different findings. First, respondents spontaneously mentioned transportation when thinking of environmentally relevant criteria and thereby mainly named transportation distance or country of origin. Second, respondents rated transportation from abroad as very environmentally harmful in the list with the 19 criteria. Unlike the LCA results, however, consumers perceived air transportation as being similarly environmentally harmful to truck or ship transportation. Third, in the choice task, the four products that consumers assumed to be most environmentally friendly were all labeled as Swiss in origin. These findings suggest consumers tend to rate domestic products as more environmentally friendly than imported products or products with unspecified provenance. This is even the case when the domestic products were produced in a heated greenhouse.

Consumers’ environmental evaluations of the foreign vegetable products allow two alternative explanations. The finding that the participants assessed the Egyptian beans as less environmentally harmful than the dried Chinese alternatives, contrary to the LCA results, can be used as an example for these possible explanations. First, it is possible consumers had difficulties inferring transportation mode from the available information. Consumers might therefore have assumed that both bean products were imported by the same means of transportation. The consumers’ environmental assessments would thus differ from LCA results because the consumers were unsure about how a product was transported. A second possible explanation for this finding might be that consumers had other nonenvironmental reservations concerning the Chinese provenance, for instance, associations with social or political problems. The consumers might have generalized these reservations to their environmental assessment of this product.

Overall, consumers’ environmental assessment of food products seemed to be excessively influenced by the products’ provenance. This finding is supported by past research, which found that country of origin has a strong influence on consumers’ product evaluation. Consumers generally seem to rate domestic products more favorably and tend to believe products from less developed countries are lower in quality and performance (see Verlegh & Steenkamp, 1999).
3.4.2 Production method

The results indicate organic production seems to dominate consumers’ minds when they think of environmentally friendly food characteristics. A majority of the respondents spontaneously mentioned organic production, which was, furthermore, rated as the most environmentally friendly product characteristic. This finding was somewhat expected since organic products are visibly labeled in Switzerland, and retailers and farmers actively promote these products as the environmentally friendly alternative. This salience of organic labels probably strengthened consumers’ association with environmental friendliness. Consumers could therefore easily recall organic production in this context, which might have led them to believe that organic production is of high environmental importance.

3.4.3 Other environmental criteria

The ratings of the different environmental criteria in the questionnaire showed that consumers seemed to attribute more environmental harm to packaging and conservation than was done in the LCA. This difference in the assessments is supported by the fact that respondents perceived canned beans as rather environmentally harmful in the choice task, while, according to the LCA results, canned beans are fairly benign for the environment. Consumers’ overestimation of the environmental relevance of packaging is in line with the results of Van Dam (1996), who concluded that consumers judge the environmental friendliness of food products mainly based on the postconsumption treatment of the packaging waste. This overrating of packaging might be due to media coverage and campaigns that, for example, promote recycling behavior. This media presence might have raised consumers’ awareness of the environmental impact of packaging. In the context of environmental friendliness, it was therefore easily brought to mind and, similar to organic production, overestimated in terms of environmental importance. Furthermore, both packaging and conservation are cues that consumers can easily identify. This could therefore influence their environmental assessment.

Consumers also rated genetic modification as very environmentally harmful. Its impact on the environment has not yet been considered by LCA methods. There are, however, indications that some forms of genetic modification could actually increase the environmental friendliness of a product (see Batista & Oliveira, 2009). Introduction of insect
resistance, for instance, could reduce use of pesticides. However, the generally low public acceptance of genetic modification (e.g., Gaskell et al., 2000; Magnusson & Koivisto Hursti, 2002; Siegrist, 2003) might have influenced the environmental assessment of this criterion.

Water scarcity, which consumers rated as most environmentally harmful, has received only limited attention in the LCA, mainly due to a lack of methodological basis (Koehler, 2008). Currently, LCA experts are trying to develop a method for assessing the environmental impacts of freshwater consumption (e.g., Milà i Canals et al., 2009; Pfister, Koehler, & Hellweg, 2009). Fair trade was rated as relatively environmentally friendly among consumers, and LCA experts have also shown an increasing interest in the inclusion of social aspects in the LCA. However, the development of the so-called Social Life Cycle Assessment (SLCA) is still in its infancy and faces issues such as which impacts should be included and how to measure them (Hunkeler & Rebitzer, 2005; Jørgensen, Le Bocq, Nazarkina, & Hauschild, 2008). Consumers rated healthiness as being somewhat positive for the environment. According to the LCA, however, healthiness from consumption has no direct relationship with environmental friendliness.

3.4.4 Limitations

This study faced several limitations. First, comparisons between the LCA results and the consumers’ scores were difficult because the two consisted of different assessment scales. The LCA scale on the environmental impact of product criteria was open-ended, whereas consumers rated perceived environmental harmfulness on a predetermined 7-point scale. The decision at which point to calibrate the LCA results and consumers’ extreme values was arbitrary, since it was unknown whether the highest perceived environmental impact by consumers corresponded to the maximum LCA rating. The LCA results and the consumers’ environmental assessment therefore should be compared with caution. Nevertheless, we believe this study offers some insights into how consumers differ from LCA results in environmental assessments of product criteria. For instance, the finding that consumers seem to perceive little difference between different transportation modes, in contrast to the LCA, is unaffected by this limitation.

Consumers’ environmental product assessment on a rating scale might yield different results than a choice task. However, we decided on a choice task, as previous studies demonstrated that consumers’ assessments depend on whether products are evaluated
individually or jointly (Hsee, 1996; Tanner, 2008). This joint evaluation also seemed to be a more realistic test of consumer choice since Swiss grocery stores usually offer a wide variety of products.

LCA methods are also reported to have a few limitations (e.g., Ayres, 1995; Finnveden, 2000). Nevertheless, LCA is the only tool available for comparing the environmental impact of products over the entire life cycle (Finnveden, 2000).

This study solely focused on consumers’ environmental food assessment. We were interested in determining whether consumers are able to assess the environmental friendliness of food products. However, we did not investigate a realistic shopping situation. Thus, our findings report only on how consumers would choose vegetable products if they were willing to behave in an environmentally friendly way. In real shopping situations, other criteria such as taste, price, or healthiness might play a more important role (e.g., Steptoe, Pollard, & Wardle, 1995; Van Birgelen, Semeijn, & Keicher, 2009).

3.4.5 Implications and suggestions for further research

Past research indicated most consumers mainly include taste and cost aspects in food decision making (e.g., Lennernäs et al., 1997; Magnusson, Arvola, Koivisto Hursti, Aberg, & Sjödén, 2001; Wandel & Bugge, 1997). Environmental friendliness, however, does not seem to be the most important purchase criterion. As discussed, consumers associate environmental friendliness with organic production, which usually is more costly. Environmental friendliness might therefore be perceived to conflict with consumers’ usual purchasing criteria. However, the LCA results indicate that from the ecological perspective it is most important to avoid air transportation, heated greenhouse production, and refrigeration. All these requirements can be met by the consumption of seasonal and domestic vegetables. Since this consumption pattern is not associated with higher costs, consumers might be more willing to contribute to such a sustainable consumption pattern. The environmental benefits of the consumption of seasonal and domestic vegetables should therefore be highlighted in information campaigns.

Consumers also seem to associate locally produced food with higher quality, particularly in terms of freshness and taste (Chambers, Lobb, Butler, Harvey, & Traill, 2007). Support of local producers and farmers might serve as an additional motivation to consume domestic food. Such additional nonenvironmental benefits should be emphasized when this behavior is promoted. As consumers might not be aware of which vegetables are cur-
rently seasonal, this should be tackled through a labeling scheme. However, there would still be the problem that consumers place value on the variety and year-round choice that imported foods provide (Chambers et al., 2007).

To develop environmentally friendly consumption patterns, consumers need to be able to identify environmentally friendly products. Our results, however, reveal that consumers seem to lack the knowledge required for an adequate environmental assessment. The identification of such knowledge gaps is useful for education material. Only if consumers’ misconceptions are identified can they be tackled through information campaigns. It seems consumers are aware of the environmental benefit of organic production and the environmental harm caused by the production and disposal of packaging material. Educational information should therefore highlight the environmental harm of air transportation and greenhouse production because consumers seem to be oblivious to these environmental criteria. As the transport mode of products is usually not indicated, an indication on the products of at least air transport would help consumers to avoid such environmentally harmful products.

However, since environmental food assessment is too complex for consumers, it seems insufficient to merely inform them about all the environmentally relevant dimensions. A simple communication tool, as suggested in the domain of nutrition labels, would be more beneficial to facilitate ecological food consumption. Similar to nutritional value information, such a communication tool would have to be easy to understand and interpret. For example, a three-level eco-label system, adapting the design of a traffic light system, could inform consumers about positive as well as negative environmental outcomes associated with the product. Accordingly, a red label would indicate that the overall environmental impact of this product is assessed as worse than average, a yellow-labeled product would be ecologically average, and a green label would denote an environmentally friendly product. Such differentiated information about environmental consequences has been shown to influence product preference for consumers with both intermediate and strong environmental concerns (Grankvist, Dahlstrand, & Biel, 2004). However, a labeling scheme that indicates not only environmentally benign products would have to be implemented by legislation, since it is unlikely that producers and retailers would voluntarily label their products as environmentally harmful (Grankvist et al., 2004).

Furthermore, such a labeling scheme would require a useful and meaningful tool to describe the environmental impact of products. Thus, LCAs should be further improved and account for freshwater-use related environmental impacts (Koehler, 2008). Since the
environmental friendliness of vegetables (and fruits) is subject to seasonal changes, consumers would need to be informed about the reasons why the environmental friendliness of the same product varies over the year.

Our results indicate that consumers tend to view organic production as very important for the environment. The ecological relevance of organic labels could be increased by strengthening their regulations, such as prohibition of air transport or limitations on greenhouse heating. Thus, consumers could still use organic labels as environmentally relevant cues and thereby contribute to more environmentally friendly food consumption.

A suggestion for further research would be to determine whether additional product information or labels (as for transportation mode) would improve consumers’ environmental assessment. It also seems worthwhile to investigate whether our findings can be generalized to other food products with high environmental impact, such as dairy or meat products.

References


Van Dam, Y. K. (1996). Environmental assessment of packaging: The consumer point of
Chapter 4

Addressing climate change:
Determinants of consumers’ willingness to act and to support policy measures

Manuscript submitted for publication as:
Abstract

Public acceptance is an important precondition for implementing climate mitigation policy measures. Furthermore, consumers influence greenhouse gas emissions with their consumption patterns. Both climate-friendly actions and policy support comprise a broad range of options, which vary in manifold ways, for instance in terms of costs or perceived climate benefit. Accordingly, different options of addressing climate change might be influenced by a variety of factors. Thus, the aims of the study were two-fold: first, we intended to find a meaningful way to classify different ways of addressing climate change, namely consumers’ willingness to behave climate-friendly and to support policy measures. Second, we aimed to examine which determinants influence the willingness to engage in these behaviors. We conducted a large-scale mail survey in Switzerland in which we presented an extensive list of possible actions and mitigations measures. A principal component analysis yielded three factors of voluntary actions: climate-friendly low-cost behaviors (e.g., recycling), indirect behaviors (e.g., offsetting CO$_2$ emissions), and mobility behaviors (e.g., reduction of car use). Mitigation measures could be divided into supportive measures (e.g., subsidies) and CO$_2$ restrictions (e.g., taxes on heating oil). With the exception of mobility, perceived climate benefit had the strongest influence on people’s willingness to act or to support climate mitigation policy measures. For mobility, however, perceived costs turned out to be the most influential factors.
4.1 Introduction

When dealing with environmental issues, such as climate change, consumers play an important role. Not only do they have a substantial influence through their consumption patterns, but as citizens and voters, they also support or dismiss policies that implement environmental measures. In this study, we therefore examined consumers’ willingness to take climate-friendly actions. We aimed to classify different ways of addressing climate change and examined which factors influence climate-friendly actions.

Past studies indicate that the majority of people in industrialized countries are aware of climate change and consider it a serious problem (Leiserowitz, 2007b; Lorenzoni & Pidgeon, 2006; Poortinga, Pidgeon, & Lorenzoni, 2006). Similar results have been found in Switzerland. Specifically, 82% of the Swiss public rated greenhouse effect and global warming as highly dangerous (Diekmann & Meyer, 2008). However, positive attitudes towards the environment or environmental concerns are not necessarily consistent with the according behavioral patterns. Meta-analyses of a large body of research found only moderate relationships between environmental attitudes and pro-environmental behavior (Bamberg & Möser, 2007; Hines, Hungerford, & Tomera, 1986/87). This might be due to an undifferentiated view on environmental behavior, as different pro-environmental activities and their determinants have often been examined together, regardless of their different characteristics.

In this study, our aims were therefore two-fold: First, we intended to find a meaningful categorization of climate-friendly actions. Second, we aimed to examine which determinants influence these different types of climate-friendly actions. The various options of addressing climate change thereby ranged from individual behavior to political measures. The two aims of our study are presented in more detail in the following.

4.1.1 Classifying climate-friendly action

Finding and examining patterns of behaviors might prove worthwhile (Swim et al., 2009), as this would allow, for instance, to examine whether there is a positive spillover (Crompton & Thörgersen, 2009). In other words, it would be possible to investigate whether a person’s change of one behavior increases his or her motivation to adopt a second and more ambitious behavior; or if people who engage in pro-environmental behavior (per-
haps an easy and effortless step) use this as a justification for not adopting other (more difficult) behaviors (see Crompton & Thørgersen, 2009). As many environmental campaigns encourage people to adopt small behavioral changes, examining the effect of these messages on people’s propensity to show a wider set of pro-environmental behaviors is crucial.

In several studies, Kaiser and colleagues measured general ecological behavior as a unidimensional construct, by taking the difficulties of several pro-environmental behaviors into consideration (Kaiser & Biel, 2000; Kaiser & Wilson, 2000; Kaiser, Wölfing, & Fuhrer, 1999). Yet, ecological behavior can also be seen as a ”disparate and multi-faceted phenomenon” (Diekmann & Preisendörfer, 1998, p. 86), which differs not only in terms of difficulty but also regarding the consumption domain and other characteristics. Therefore, a more precise discrimination of behaviors might result in higher correlations with predictors, because various kinds of activities might be influenced by different determinants. This assumption is substantiated by Balderjahn (1988), who found that different behavioral patterns have their own cluster of predictors. Therefore, we would like to examine whether pro-environmental behavior is multidimensional and defined by more characteristics than just its difficulty.

In the literature, two alternative ways to differentiate pro-environmental actions have been suggested: (a) according to the actions’ directness, indicating whether an action has an direct impact on greenhouse gas emissions (Kollmuss & Agyeman, 2002), or (b) costs, differentiating between actions associated with high or low level of personal or behavioral costs or efforts (Diekmann & Preisendörfer, 2003). The two suggested ways of distinguishing pro-environmental behaviors are presented in the following sections.

Direct and indirect behaviors

One can distinguish between two different manners that consumers can contribute to climate change mitigation: (a) as citizens and voters, they can support government initiatives to mitigate climate change, and (b) as consumers and actors, they can decide to alter their own lifestyle in order to reduce greenhouse gas emissions (see Bord, Fisher, & O’Connor, 1998). The first option is an indirect form of pro-environmental action: although it is of substantial importance, it has no direct impact on the environment. The second option has a direct, but smaller impact on the environment (see Kollmuss & Agyeman, 2002). Since both actions differ substantially (e.g. in terms of regularity and
effort) it is conceivable that they might be influenced by different factors. Thus, Kollmuss and Agyeman (2002) suggested that environmental knowledge and attitude might have a more powerful influence on people’s indirect actions than on their direct pro-environmental behaviors. Accordingly, people with high levels of environmental concern might not necessarily be willing to change their lifestyle, but they might be more willing to accept political changes that encourage pro-environmental behaviors (e.g. higher fuel taxes).

Past research indicates that direct and indirect actions are, in fact, influenced by different factors. For instance, environmental concern seems to be a good predictor of intentions to act pro-environmentally (e.g., willingness to sign a petition or to pay more for cleaner energy), whereas personal norms seem to be a more influential determinant for pro-environmental behavior, such as recycling or ecological product choice (Minton & Rose, 1997). Another study found that determinants of voluntary actions (e.g., driving less or installing insulation) and voting intentions (e.g., regarding gasoline taxes) differed, indicating that these two forms of addressing climate change are influenced by different factors (O’Connor, Bord, & Fisher, 1999). For example, women were more likely to take voluntary actions, whereas men were more willing to support policies to reduce greenhouse gas emissions.

Yet, the authors also found considerable variability within both voluntary actions and voting intentions. Although people were willing to install more insulation or to replace older appliances, they seemed more reluctant to drive less and use public transportation more often. Similarly, consumers were in favor of raising car fuel efficiency standards but clearly rejected an increase in gasoline taxes. These results indicate that among both voluntary action and voting intentions, consumers’ acceptance seems to vary across the different options. Thus, a further differentiation within these two groups might be necessary.

**High- and low-cost behaviors**

Another approach to classify climate-relevant behavior is offered by the low-cost hypothesis, which postulates that behavioral costs moderate the effects of attitudes on behavior (Diekmann & Preisendörfer, 2003). Cost in this context is not merely defined in an economical sense, but also includes other factors, such as the requirement of additional time, discomfort, or effort (Diekmann & Preisendörfer, 1998; Kollmuss & Agyeman, 2002).
Typically, recycling is considered a low-cost domain while mobility belongs to the high-cost domain (Diekmann & Preisendörfer, 2003). In line with this assumption, consumers generally seem to be most willing to recycle waste, followed by shopping ecologically and saving electricity, while being more resistant to changing travelling behavior (Diekmann & Preisendörfer, 2003; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Whitmarsh, 2009). Furthermore, technical measures seem to be more accepted than behavioral measures, and shifts in consumption tend to be least acceptable (Poortinga, Steg, Vlek, & Wiersma, 2003).

Generally, environmental concern is assumed to influence ecological behavior primarily when it is connected to low costs and little inconvenience. Lower costs ease the transformation of attitudes into the corresponding behavior (Diekmann & Preisendörfer, 2003). However, for behaviors that are associated with higher costs or inconveniences, environmental concern alone is not sufficient to overcome the barriers. This assumption is substantiated by studies finding that environmentally concerned people generally tend to show low-cost behaviors such as recycling but do not necessarily engage in activities that are more costly or inconvenient, such as reducing driving or flying (Diekmann & Preisendörfer, 1998, 2003; Kollmuss & Agyeman, 2002). Past research also found that the main effects of costs on environmental behavior were far stronger than those of environmental concern (Diekmann & Preisendörfer, 2003).

Similarly, Stern (1992) concluded that psychological factors, such as attitudes and personal norms, have a stronger influence on actions that are relatively inexpensive and easy to perform. For more expensive or difficult behaviors, however, financial aspects and education might mediate the link between attitude and behavior. In fact, a recent study found that knowledge and norms had a stronger influence on high-cost recycling (metal, plastic, and organic waste) than on low-cost recycling (glass, paper, and batteries) (Andersson & von Borgstede, 2010).

Accordingly, theories focusing on moral obligations to act pro-environmentally (e.g. the norm-activation model or the value-belief-norm theory) seem to be successful in explaining low-cost environmental behavior and consumers’ willingness to change their behavior (see Steg & Vlek, 2009). However, for situations with higher behavioral costs or constraints (e.g. reducing car use) the theory of planned behavior appears to be more powerful in explaining environmental behaviors.

Of course, the two suggested ways of categorizing climate-friendly actions, namely in
terms of costs and directness, are not mutually exclusive. As a matter of fact, it is also conceivable that there are both low- and high-cost direct behaviors (e.g., energy conservation vs. changing travelling behavior) as well as low- and high-cost indirect behaviors (e.g., support for incentives and technological solutions vs. support for taxes or higher bills). A past study, for instance, not only distinguished between voting intentions and voluntary actions but also separated the latter into three types: buying green (e.g., buying more efficient appliances), suffering discomfort (e.g., lowering the thermostat) and driving less (O’Connor, Bord, Yarnal, & Wiefek, 2002). These categories of voluntary actions could also indicate different cost levels. Accordingly, people’s willingness of taking these actions decreased when they became more difficult or costly (e.g., installing solar panels), or if they threatened people’s lifestyle (e.g., driving less).

However, to the best of our knowledge, no previous study has attempted to systematically classify climate-friendly actions by taking a broad variety of behaviors and policy measures into account. Therefore, the first aim of this study was to find a meaningful grouping of consumers’ willingness to address climate change. We examined various climate related behaviors, ranging from recycling to mobility behavior. In addition, we included different policy measures, some involving taxes and others encompassing subsidies. We expected to find a mixed categorization, namely that direct behaviors could be divided into high-cost direct behaviors (such as mobility) and low-cost ones (e.g., recycling). Similarly, we believed that policy measures would be separated into high-cost measures (involving higher personal costs, such as taxes) and low-cost policies (involving costs that are born by the society, such as subsidies).

4.1.2 Determinants of consumers’ willingness to address climate change

Finding determinants influencing consumers’ willingness to address climate change could prove particularly useful for developing information strategies and campaigns motivating consumers to act climate-friendly. Therefore, we aimed to identify the specific factors that influence these resulting types of climate-friendly behaviors. We examined the influence of respondents’ concern about climate change, feeling of powerlessness, and level of skepticism. Furthermore, we studied the influence of perceived climate benefit and costs on consumers’ inclination to address climate change. These variables will be described in more detail in the following.
Concern about climate change

People’s perception of climate change influences their level of concern, which ultimately affects their motivation to act (Swim et al., 2009). In line with this assumption, past research indicates that concern about climate change increases consumers’ willingness to change their behaviors (e.g., Semenza et al., 2008).

A review of major studies on public views of climate change demonstrated widespread awareness of and concern about climate change (Lorenzoni & Pidgeon, 2006). However, compared with other problems (e.g., personal or social issues), it was considered less important. Similarly, a very recent American study found that about half of the respondents indicated they were somewhat or very worried about climate change (Leiserowitz, Maibach, Roser-Renouf, & Smith, 2011a). Yet about 40% reported that climate change was not a very important issue to them personally. As lack of concern about climate change might impede consumers addressing the issue, we included this determinant as a predictor in our analyses.

Feeling of powerlessness

If people feel they cannot change a situation, they will very likely retreat into apathy and resignation and thus will be less likely to address environmental issues (Kollmuss & Agyeman, 2002; Moser, 2007; Moser & Dilling, 2004). One concept for measuring this feeling of powerlessness is the locus of control, which describes the degree to which individuals believe they can influence outcomes through their actions (McCarty & Shrum, 2001). Individuals with an internal locus of control believe that their actions can bring about change (Kollmuss & Agyeman, 2002). In contrast, persons with an external locus of control feel that their actions are insignificant; these persons attribute outcomes to powerful others rather than their own actions.

Meta-analyses of past studies demonstrated that internal locus of control or similar constructs (e.g., self-efficacy or perceived behavioral control) are positively correlated with pro-environmental behavior (Bamberg & Möser, 2007; Hines et al., 1986/87). However, as climate change is a global problem, many individuals might feel they cannot do anything about it (Swim et al., 2009). A recent study demonstrated that almost half of American adults to some extent believed that the actions of a single individual would not make any difference in climate change (Leiserowitz et al., 2011a; Leiserowitz, Maibach,
Roser-Renouf, & Smith, 2011b). Such beliefs might ultimately discourage people from acting; therefore, it seemed important to include the concept feeling of powerlessness as a predictor in our study.

**Skepticism**

Most people’s experience of climate change is indirect and mediated by news coverage and film documentaries (Swim et al., 2009). Almost every new story about climate change brings more bad news, which might overwhelm the public (Moser, 2007). Therefore, people might develop defense mechanisms that result in skepticism, such as denying the existence of the threat, believing that the problem will not happen here or to oneself, or emphasizing the uncertainty. In fact, anthropogenic climate change is a widely discussed issue and not universally accepted as a reality (e.g., Reynolds, Bostrom, Read, & Morgan, 2010). In the past two years, about 20% of Americans indicated that they believed climate change was not happening; a similar fraction was unsure (Leiserowitz et al., 2011a).

Lorenzoni and colleagues (2007) named uncertainty and skepticism as important barriers to engaging with climate change. Some people, for instance, feel unsure or skeptical about the causes of climate change, its seriousness, and the necessity and effectiveness of actions. Some also perceive a large scientific controversy about this issue. Similarly, Leiserowitz (2007a) identified a group of ”naysayers” among the U.S. public that had associations indicating skepticism or cynicism about the reality of climate change. This community believed that climate change is natural, and that there is hype about this subject. Furthermore, they doubted the science, denied the problem, and believed in conspiracy theories. Naysayers had a substantially lower risk perception than the rest of U.S. society.

Such mindsets can have an effect on the perception and interpretation of information about climate change and therefore might be an important barrier to addressing climate change (Lorenzoni et al., 2007). Therefore, we believed including a measurement of skepticism in our study was important.

**Perceived costs and climate benefit**

Psychological research has often focused on people’s characteristics but has often neglected how people perceive a certain action in terms of costs and benefits. As we put a strong fo-
Focus on the characteristics of the climate-related actions, we also examined how consumers’ perceptions of these actions influence their willingness to act. Past studies have demonstrated that pro-environmental behaviors are influenced by people’s knowledge about the monetary costs of these behaviors, perceptions of their difficulty, and knowledge about which actions have the largest impact (Stern, 1992). We therefore believe perceived costs and benefits to be important determinants for a close examination of climate-friendly actions, and assume that they can largely contribute to the explanation of willingness to act and the acceptability of policy measures.

In a study testing the low-cost hypothesis, Diekmann and Preisendörfer (2003) relied on indirect cost measures by using the frequency of a behavior as an indicator of its average cost intensity. However, they suggested that future research might use subjective measures of costs and proposed including financial expenditures, additional time, discomfort, or other subjectively defined inhibitions of behavior (Diekmann & Preisendörfer, 1998). Therefore, we included perceived costs as a predictor and, in contrast to Diekmann and Preisendörfer (2003), considered consumers’ perception of behavioral costs, defining behavioral costs in a broad sense according to their suggestions. Lastly, we also took into account to what extent people believed a certain action to be beneficial for the climate, because knowing which actions have the largest impact might motivate people to show the respective behaviors (Stern, 1992).

In sum, we studied whether the respondents’ characteristics (sociodemographics, concern about climate change, skepticism, and feelings of control) or perceptions of the behaviors’ characteristics (perceived climate benefit and costs) were more successful in explaining consumers’ willingness to act and to support policy measures.

### 4.2 Methods

#### 4.2.1 Participants

We sent questionnaires to randomly selected households in the German-speaking part of Switzerland. To ensure a random sample, we asked the household member who was 18 years or older and whose birthday was next to participate. We sent two reminders to non-responders, the second one containing another copy of the questionnaire. A total of 916 persons returned completed questionnaires, which resulted in a response rate of 39%.
Our final sample consisted of 60% men \((n = 546)\) and 39% women \((n = 354)\), and 2% \((n = 16)\) did not disclose their gender. Our respondents’ mean age \((M = 55, SD = 16)\) was somewhat higher than in the adult Swiss population \((M = 49\text{ years})\) (BFS 2009). The self-reported education level ranged from primary school \((5\%, n = 41)\), lower secondary school \((8\%, n = 75)\), upper secondary vocational school or business school \((41\%, n = 374)\), and upper secondary school \((17\%, n = 157)\) to college or university \((27\%, n = 251)\). Two percent \((n = 18)\) did not indicate their highest level of education. Compared with Swiss census data (BFS, 2009), men were overrepresented and the sample had a slightly higher education level than the general Swiss population.

4.2.2 Questionnaire

The questionnaire consisted of 16 pages, covering a broad range of constructs, which were each measured by a variety of items. Unless stated otherwise, the items were presented as statements and participants rated each item on a 6-point Likert scale, indicating to what extent they agreed, from 1 ("strongly disagree") to 6 ("fully agree").

We included both the willingness to exhibit climate-friendly behavior and the willingness to accept climate mitigation policy measures as dependent measures. As independent variables, we examined perceived climate benefit, perceived costs, attitudes, and demographics. These measures are introduced in the following.

Willingness to act and to support policy measures

We presented an extensive list of possible activities and policy measures. We developed 15 behavioral items and included various behaviors that were measured in past studies, such as buying a fuel-efficient car, using less heat during the winter, or donating money to an organization working to reduce global warming (e.g., Bord et al., 1998; Bord, O’Connor, & Fisher, 2000; Diekmann & Preisendörfer, 2003; Leiserowitz, 2007b; Leiserowitz et al., 2011b). We also included behaviors recommended by environmental organizations (e.g., World Wildlife Fund [WWF]), for instance, reducing meat consumption or avoiding flights for holidays. We thereby chose items that were appropriate for the Swiss situation. For instance, as only a third of the Swiss population own the home they live in (BFS, 2009), we did not include insulation in houses. Similarly, we chose to include only one item about energy savings, as in Switzerland electricity is mostly produced by hydro-electric
or nuclear power.

Overall, we aimed to cover a wide range of behaviors from different domains (e.g., habitation, mobility) with different characteristics (such as effort, repetition, costs). We also included behaviors with high relevance for climate change (e.g., flying, heating), behaviors that are considered generally environmentally friendly (e.g., recycling) or even regarded as not very relevant for climate change (avoiding spray cans with CFC) (see Table 4.1). Participants could rate their willingness to show these behaviors on a 7-point Likert scale ranging from 1 (“not willing at all”) over 6 (“very willing”) with the additional response option “already showing this behavior” (7).

For the policy measures, we included items measured in previous research, such as a tax on gasoline or requirements for automobile fuel efficiency (e.g., Bord et al., 2000; Diekmann & Meyer, 2008; Leiserowitz, 2006; Leiserowitz et al., 2011b), which were adapted to the Swiss situation. We also added policy measures that are currently being discussed in Switzerland, such as an increase in the CO\(_2\) tax on heating oil. For these nine items (see Table 4.2), participants indicated how acceptable they found the presented policies on a 6-point Likert scale from 1 (“not acceptable at all”) to 6 (“very acceptable”).

**Perceived climate benefit**

To measure perceived climate benefit, we presented the same list of climate-friendly behaviors (shown in Table 4.1) and asked participants how significant they believed the climate benefit to be if they were to engage in the respective behavior. Similarly, we also presented the above mentioned policy measures (see Table 4.2) and asked the participants how significant they estimated the climate benefit of these policies to be. Participants indicated their perceived climate benefit on a 6-point Likert scale, ranging from 1 (“no benefit”) to 6 (“very large benefit”). We built the subscales for perceived climate benefit according to the resulting categorization of respondents’ willingness to act and to support policy measures, which will be explained in Section 4.3. Thus, the subscales of perceived climate benefit included the same items as the subscales of willingness to act and to support policy measures. With Cronbach \(\alpha\)s > .75, all scales showed satisfactory reliabilities.
Perceived costs

Following Diekmann and Preisendörfer’s (2003) suggestions, we asked, if applicable for the actions, whether participants perceived the behaviors as costly in terms of financial costs (e.g., ”Avoiding flights for holidays would involve higher costs for me”), time (e.g., ”Avoiding car use for commuting to work would be too time-consuming for me”), discomfort (e.g., ”Taking a shower instead of a bath would reduce my quality of life”), and inconvenience (e.g., ”Eating less meat would be inconvenient for me”). As policy measures usually do not involve behavioral costs, we assessed to what extent participants perceived the policies as costly for themselves, society, and the economy.

As the length of the questionnaire did not allow us to assess the perceived costs of all climate-friendly actions, we measured only the costs of selected behaviors and policy measures. However, to ensure that all types of climate-friendly actions were represented in the perceived costs, we chose behaviors and policy measures that differed considerably from each other. We measured the perceived costs of the hypothesized low-cost direct behavior, namely of inrush airing (2 items), taking a shower instead of a bath (2 items), and reducing meat consumption (4 items). The costs of the assumed high-cost direct behavior were represented by mobility behaviors, namely reducing car use in spare time, reducing car use for work, and avoiding flights for holidays (4 items each). We assessed the costs of the hypothesized indirect behavior with one item about donating money to climate projects. The expected low-cost policy measures were represented by one item about the perceived costs of subsidies for renewable energy. For the hypothesized high-cost policy measures, we assessed the perceived costs of an increased CO2 tax on heating oil (3 items) and of a bonus malus system for car taxes (3 items). For each type of action, we used the mean score as an indicator of respondents’ perception of how costly this kind of behavior or policy was. For the scales with more than one item, the reliabilities were satisfactory with $\alpha > .73$.

Attitudes and sociodemographics

To predict willingness to address climate change, we examined the influence of concern, feeling of powerlessness, and skepticism, which are described below.

Concern about climate change included several items related to risk perception, including concern about climate change and the seriousness of its consequences (similar to the
risk perception scale; see Leiserowitz, 2006). Additionally, we added consumers’ perception of the importance of climate protection. Overall, concern about climate change was measured with four items (e.g., ”I worry about the climate’s state”). The scale included statements that the climate’s delicate equilibrium must be protected, that climate protection is important for the future, and that climate change has severe consequences for humans and nature.

Feeling of powerlessness described the feeling of being unable to do something about climate change and represented an external locus of control. For the scale, we included items measuring locus of control from the literature (McCarty & Shrum, 2001; Smith-Sebasto, 1992) and adapted to the subject of climate change (e.g., ”Climate protection measures are determined by a few powerful persons; as a single citizen, I have no effect”). The five items generally measured the feeling that climate protection lies in the hands of others (a few powerful persons, or the industry) and the feeling that one cannot contribute to climate protection, for instance, as a citizen or with one’s behavior.

Skepticism assessed people’s doubts regarding the sources of information and the extent to which they feel unthreatened by climate change. The seven skepticism items were developed based on past studies (Leiserowitz, 2007a; Lorenzoni et al., 2007). We included statements indicating distrust (e.g., ”Climate change and its consequences are being exaggerated in the media” or ”Climate change is a racket”). Further aspects included respondents’ perception of climate change as a low or nonexistent danger (such as the notion that there are more important problems than climate protection, or that respondents did not feel threatened by climate change).

Finally, the respondents indicated their gender, age, level of education, and political affiliation. The latter was rated on a 7-point Likert scale, ranging from 1 (”left-wing”) over 4 (”center”) to 7 (”right-wing”).

4.2.3 Data analysis

We used principal principal component analysis with varimax rotation to test whether the dependent variables (willingness to act and to support policy measures) could be grouped into different types of climate-related action. With the same procedure, we examined the underlying factors among the items measuring perceived climate benefit, costs, and attitudes. All resulting scales were then tested for reliability.
To test the different determinants’ influence on willingness to act and to support policy measures, we conducted multiple linear regression analyses, where all predictor variables were entered simultaneously. We used different predictors, namely (1) personal characteristics, such as the respondents’ sociodemographic variables and attitudes related to climate change, and (2) characteristics of the respective behaviors or policies, namely the perceived climate benefit and the perceived costs.

The interpretation of the significance level depends on the sample size; thus, achieving $p < .05$ can be very uninformative in a large sample (Lindley & Scott, 1984; Royall, 1986). Due to our large sample size, we therefore judged the results to be significant at the minimum significance level of $\alpha < .01$ in all our analyses.

### 4.3 Results

#### 4.3.1 Principal component analyses

In order to find a meaningful categorization of the willingness to behave in a climate-friendly manner and the willingness to accept climate policy measures. The resulting categories are described in the following sections.

**Willingness for climate-friendly behavior**

Based on the scree plot and interpretability, we identified three dimensions of climate-friendly behaviors, which confirmed our expected categorization: (a) low-cost behaviors mainly included routine consumer behaviors, such as airing, recycling paper, meal choice, and saving electricity and water, (b) indirect behavior comprised actions that delegate climate-friendly activities, such as electing politicians committed to climate protection, offsetting CO$_2$ emissions, and donating money to climate protection projects, and (c) mobility covered avoiding using the car for commuting to work and for regular purchases, as well as avoiding flights for holidays (see Table 4.1). The item about meat reduction actually loaded higher on the mobility dimension. However, since its content was better suited for the low-cost behaviors scale (and had a similarly high loading on this dimension), we decided to include it in the low-cost behaviors scale. The three dimensions could explain 49% of the variance. Cronbach’s $\alpha$s for the three types of climate-friendly behavior
were: $\alpha = .77$ for low-cost behaviors, $\alpha = .62$ for mobility, and $\alpha = .75$ for indirect behavior.

**Willingness to accept climate policy measures**

Table 4.2 shows that the acceptability of policy measures resulted in two dimensions: (a) *supportive measures*, offering incentives and infrastructure for climate-friendly action, such as subsidies for sustainable building and renovating, and the extension of public transportation, and (b) *CO$_2$ restrictions*, limiting and charging CO$_2$ emissions, such as CO$_2$ taxes on heating oil or gasoline. With these two components, we explained 65% of the variance. The reliabilities of the scales were good ($\alpha = .83$ for supportive measures and $\alpha = .85$ for CO$_2$ restrictions).

Across all climate-friendly behaviors (i.e., low-cost behaviors, mobility, and indirect behavior), respondents were most willing to engage in low-cost climate-friendly behaviors, the high mean indicating that the majority already exhibited this type of behavior (see Table 4.1). The participants’ willingness to avoid car and plane use was substantially lower, followed by their willingness to show indirect climate-friendly behavior. With regard to the policy measures, participants were more willing to accept supportive measures than CO$_2$ restrictions.

Table 4.3 shows that, generally, all manners of addressing climate change were positively correlated. Particularly, the relationships between indirect behavior and the support of climate policy measures proved to be strong and positive. Furthermore, there was a strong positive relationship between the willingness to show climate-friendly low-cost behaviors and the acceptability of supportive measures.
Table 4.1.
Items measuring the willingness to act, including means, standard deviations, and factor loadings

<table>
<thead>
<tr>
<th></th>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>Low-cost behaviors</th>
<th>Indirect behavior</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Airing the rooms briefly but efficiently during the cold seasons (Inrush airing)</td>
<td>6.75</td>
<td>0.76</td>
<td>.71</td>
<td>.01</td>
<td>.02</td>
</tr>
<tr>
<td>2.</td>
<td>Recycling paper</td>
<td>6.73</td>
<td>0.82</td>
<td>.71</td>
<td>.09</td>
<td>.02</td>
</tr>
<tr>
<td>3.</td>
<td>Using warm water sparingly (e.g., taking a shower instead of a bath)</td>
<td>6.43</td>
<td>1.16</td>
<td>.71</td>
<td>.01</td>
<td>.10</td>
</tr>
<tr>
<td>4.</td>
<td>Avoiding spray cans containing CFC</td>
<td>6.34</td>
<td>1.08</td>
<td>.63</td>
<td>.25</td>
<td>-.06</td>
</tr>
<tr>
<td>5.</td>
<td>Consuming seasonal food whenever possible</td>
<td>6.22</td>
<td>1.21</td>
<td>.65</td>
<td>.05</td>
<td>.26</td>
</tr>
<tr>
<td></td>
<td>Saving electricity (e.g., by using energy-efficient light bulbs or by completely switching off appliances)</td>
<td>6.15</td>
<td>1.29</td>
<td>.63</td>
<td>.16</td>
<td>.14</td>
</tr>
<tr>
<td>7.</td>
<td>Preferring fuel-efficient vehicles when buying a car</td>
<td>5.98</td>
<td>1.19</td>
<td>.46</td>
<td>.32</td>
<td>.11</td>
</tr>
<tr>
<td>8.</td>
<td>Setting your thermostat to 20 degrees Celsius or lower during the cold season</td>
<td>5.59</td>
<td>1.57</td>
<td>.40</td>
<td>.22</td>
<td>.22</td>
</tr>
<tr>
<td>9.</td>
<td>Reducing meat consumption (max. 3 times a week)</td>
<td>5.36</td>
<td>1.79</td>
<td>.37</td>
<td>.18</td>
<td>.42</td>
</tr>
<tr>
<td>10.</td>
<td>Electing politicians committed to climate protection</td>
<td>5.10</td>
<td>1.75</td>
<td>.22</td>
<td>.76</td>
<td>.17</td>
</tr>
<tr>
<td>11.</td>
<td>Offsetting CO₂ emissions (e.g., from flights) financially</td>
<td>4.28</td>
<td>1.78</td>
<td>.14</td>
<td>.70</td>
<td>.20</td>
</tr>
<tr>
<td>12.</td>
<td>Donating money to climate protection projects</td>
<td>3.84</td>
<td>2.01</td>
<td>.08</td>
<td>.83</td>
<td>.12</td>
</tr>
<tr>
<td>13.</td>
<td>Avoiding flights for holidays</td>
<td>5.13</td>
<td>1.88</td>
<td>.20</td>
<td>-.05</td>
<td>.65</td>
</tr>
<tr>
<td>14.</td>
<td>Avoiding car use for commuting to work</td>
<td>4.90</td>
<td>2.32</td>
<td>-.02</td>
<td>.24</td>
<td>.72</td>
</tr>
<tr>
<td>15.</td>
<td>Avoid car use for regular purchases</td>
<td>4.66</td>
<td>2.10</td>
<td>.02</td>
<td>.32</td>
<td>.72</td>
</tr>
</tbody>
</table>

Note. Willingness to act was rated on a 7-point Likert scale ranging from 1 (not willing at all) to 7 (already showing this behavior). The factor loadings > .3 are set in bold.
Table 4.2.
Items measuring the acceptability of climate policy measures, including means, standard deviations, and factor loadings.

<table>
<thead>
<tr>
<th></th>
<th>Subsidies for building and renovating according to the MINERGIE(^a) standard (with low energy demand)</th>
<th>Supportive measures</th>
<th>CO(_2) restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>5.32 1.03</td>
<td>.82</td>
<td>.21</td>
</tr>
<tr>
<td>2.</td>
<td>Subsidies for electricity generation from renewable energy (such as solar or wind energy)</td>
<td>5.23 1.16</td>
<td>.80</td>
</tr>
<tr>
<td>3.</td>
<td>Subsidies for research projects in the field of climate-friendly technology</td>
<td>5.19 1.10</td>
<td>.70</td>
</tr>
<tr>
<td>4.</td>
<td>Extension of public transportation</td>
<td>5.07 1.18</td>
<td>.44</td>
</tr>
<tr>
<td>5.</td>
<td>Subsidies for alternative heating systems (such as wood firing or heat pumps)</td>
<td>5.01 1.23</td>
<td>.80</td>
</tr>
<tr>
<td>6.</td>
<td>Binding CO(_2) emission limits for new cars</td>
<td>5.19 1.25</td>
<td>.44</td>
</tr>
<tr>
<td>7.</td>
<td>Bonus malus system for car taxes</td>
<td>4.68 1.60</td>
<td>.28</td>
</tr>
<tr>
<td>8.</td>
<td>Increase of CO(_2) tax on heating oil (from now 9 Rp/Lt to 18 Rp/Lt)</td>
<td>3.79 1.74</td>
<td>.16</td>
</tr>
<tr>
<td>9.</td>
<td>CO(_2) tax on gasoline and diesel (15 Rp/Lt)</td>
<td>3.78 1.79</td>
<td>.13</td>
</tr>
</tbody>
</table>

Note. Acceptability of policy measures was rated on a 6-point Likert scale ranging from 1 (not acceptable at all) to 6 (very acceptable). The factor loadings > .3 are set in bold.

\(^a\)Sustainability brand for new and refurbished buildings
Table 4.3.
Means, standard deviations (SD), and Pearson correlations for the willingness to act and the acceptability of climate policy measures.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low-cost behaviors</td>
<td>6.18</td>
<td>0.74</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Mobility</td>
<td>4.92</td>
<td>1.58</td>
<td>.34**</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Indirect behavior</td>
<td>4.41</td>
<td>1.51</td>
<td>.42**</td>
<td>.41**</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>4. Supportive measures</td>
<td>5.15</td>
<td>0.89</td>
<td>.51**</td>
<td>.25**</td>
<td>.55**</td>
<td>–</td>
</tr>
<tr>
<td>5. CO₂ restrictions</td>
<td>4.34</td>
<td>1.35</td>
<td>.40**</td>
<td>.38**</td>
<td>.60**</td>
<td>.57**</td>
</tr>
</tbody>
</table>

**p < .001

a Willingness to act was rated on a 7-point Likert scale.

b Acceptability of policy measures was rated on a 6-point Likert scale.

With the dimensions low-cost behaviors and indirect behavior, our results distinguished between direct and indirect behaviors, as suggested in the literature. To test whether the three different types of climate-friendly behaviors also differed in terms of perceived costs, we performed a one-way repeated-measures ANOVA and post hoc pairwise comparisons. The mean perceived costs differed significantly across the three different climate-friendly behaviors, $F(2, 1784) = 273.36, p < .001$, and all pairwise comparisons yielded significant differences ($p < .001$). Indirect behaviors were perceived as the most costly behaviors ($M = 3.15, SD = 1.66$). The costs of changing mobility behavior ($M = 2.74, SD = 1.20$) were perceived as higher than the costs of climate-friendly low-cost behaviors ($M = 1.93, SD = 0.78$). Thus, compared to the low-cost behaviors, mobility could be considered high cost.

A $t$-test showed that among the policy measures’ costs, the costs of supportive measures ($M = 2.85, SE = .05$) were perceived as significantly lower than those of CO₂ restriction measures ($M = 3.11, SE = .04$), $t(898) = -4.99, p < .001$. Accordingly, we viewed supportive measures as low-cost policy options while CO₂ restriction measures were perceived as high-cost policy measures. Thus, overall, our results support the assumption that we were able to differentiate the various behaviors and policy measures according to their costs.
4.3.2 Regression analyses

Based on the results of the previous principal component analyses, we conducted multiple regressions separately for all three types of climate-friendly behavior and both types of climate policy measures to examine which predictors influenced them.

To build the attitudinal scales, we conducted a principal component analysis among our 16 attitudinal items. Based on the scree plot and Kaiser’s criterion (eigenvalues > 1), we constructed three scales with satisfactory reliabilities: (a) concern about climate change ($\alpha = .83$), (b) feeling of powerlessness ($\alpha = .71$), and skepticism ($\alpha = .83$).

Climate-friendly low-cost behaviors

Table 4.4 shows that the perceived climate benefit of low-cost behaviors was the most influential factor of all predictors on willingness to show climate-friendly low-cost behaviors. The more respondents thought that low-cost behaviors were beneficial for the climate, the more they were willing to exhibit these behaviors. This factor was followed by perceived behavioral costs and concern about climate change. Older individuals also tended to be more willing to show climate-friendly low-cost behaviors. The determinants could explain 42% of the variance, $F(9, 728) = 59.25$, $p < .001$.

Indirect behavior

Perceived climate benefit was the strongest predictor of participants’ willingness to show indirect climate-friendly behavior (see Table 4.4). Political affiliation was the second most influential determinant; participants who allocated themselves on the right end of the political spectrum were less willing to show indirect behavior. High perceived costs and skepticism further decreased the willingness to show indirect behavior. The regression model explained 61% of the variance, $F(9, 723) = 126.11$, $p < .001$. 
Table 4.4.
Summary of multiple regression analyses predicting the willingness for climate-friendly actions.

<table>
<thead>
<tr>
<th>Predictor variables</th>
<th>Low-cost behavior</th>
<th>Indirect behavior</th>
<th>Mobility</th>
<th>Supportive measures</th>
<th>CO₂ restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Constant</td>
<td>3.54</td>
<td>.29</td>
<td>3.62</td>
<td>.49</td>
<td>5.51</td>
</tr>
<tr>
<td>Sociodemographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.09</td>
<td>.04</td>
<td>.06</td>
<td>-.12</td>
<td>.08</td>
</tr>
<tr>
<td>Age</td>
<td>.00</td>
<td>.00</td>
<td>.10*</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>Education</td>
<td>.01</td>
<td>.02</td>
<td>.01</td>
<td>-.04</td>
<td>.03</td>
</tr>
<tr>
<td>Political affiliation</td>
<td>-.03</td>
<td>.02</td>
<td>-.05</td>
<td>-.29</td>
<td>.03</td>
</tr>
<tr>
<td>Attitudes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concern</td>
<td>.12</td>
<td>.03</td>
<td>.15**</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>Skepticism</td>
<td>.01</td>
<td>.03</td>
<td>.01</td>
<td>-.14</td>
<td>.05</td>
</tr>
<tr>
<td>Powerless</td>
<td>.00</td>
<td>.02</td>
<td>.00</td>
<td>-.03</td>
<td>.04</td>
</tr>
<tr>
<td>Costs &amp; benefits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived climate benefit</td>
<td>.40</td>
<td>.03</td>
<td>.44**</td>
<td>.65</td>
<td>.04</td>
</tr>
<tr>
<td>Perceived costs</td>
<td>-.18</td>
<td>.03</td>
<td>-.20**</td>
<td>-.14</td>
<td>.02</td>
</tr>
</tbody>
</table>

*R² = .42  R² = .61  R² = .55  R² = .68  R² = .74

*p < .01, **p < .001

Gender was coded 1 = male, 2 = female.

Political affiliation was measured on a 7-point Likert scale, 1 = left-wing, 4 = center, 7 = right-wing.
Mobility

If respondents perceived the renouncement of cars and flights as costly, this significantly decreased their willingness to reduce car and plane use (see Table 4.4). Another influential factor was the perceived climate benefit of changing mobility behavior. Further significant, but substantially weaker determinants were sociodemographic variables: people of younger age and with higher education were less willing to reduce car and plane use. Fifty-five percent of the variance in the willingness to change mobility behavior could be explained by the model, $F(9, 724) = 98.96, p < .001$.

Supportive policy measures

Table 4.4 shows that perceived climate benefit of supportive policy measures was, by far, the most predictive factor explaining the willingness to accept supportive policy measures. This determinant was followed by political affiliation: people who oriented themselves on the right wing of the political spectrum were less willing to accept supportive measures. The acceptability of supportive measures was further decreased by perceived costs and skepticism, and increased by concern about climate change. The regression model could explain 68% of the variance in the acceptability of supportive policy measures, $F(9, 725) = 167.79, p < .001$.

CO$_2$ restrictions

Perceived climate benefit was clearly the strongest predictor for the acceptability of measures restricting CO$_2$ emissions (see Table 4.4). If these measures’ costs were perceived as high, respondents’ willingness to accept them decreased. Left-wing political affiliation further increased respondents’ willingness to accept CO$_2$ restrictions. Seventy-four percent of the variance in acceptability of CO$_2$ restrictions could be explained by the model, $F(9, 725) = 229.32, p < .001$.

In sum, perceived costs and climate benefits were the strongest predictive determinants for all five approaches to addressing climate change. In particular, perceived climate benefit proved to be a strong predictor, increasing both people’s willingness to show climate-friendly behavior and to support mitigation policy measures.

Among the sociodemographic variables, political affiliation was the most influential de-
terminant. People on the right wing of the political spectrum were less willing to show indirect climate-friendly behavior and to support any type of climate mitigation policy measures. Older participants were more willing to adopt climate-friendly low-cost behaviors and to reduce car and plane use. Participants with higher education tended to be less willing to reduce the use of cars and flights.

Concern about climate change increased participants’ willingness to show climate-friendly low-cost behaviors and to accept supportive policy measures. Skepticism negatively influenced people’s willingness to engage in indirect behaviors, whereas feeling of powerlessness had no significant influence on people’s willingness to address climate change.

Overall, the chosen determinants seemed appropriate to explain willingness to act in a climate-friendly manner and to support policy measures as, with the exception of the model predicting mobility behavior ($R^2 = 42\%$), all models could explain more than 55% of the variance.

4.4 Discussion

In this study, we aimed to find a meaningful classification for a broad range of climate-friendly actions, ranging from recycling to accepting CO$_2$ taxes. Furthermore, we intended to determine which factors influence the different types of climate-friendly action.

4.4.1 Classification of climate-friendly actions

Based on the literature, we considered a distinction between direct and indirect behaviors for classifying climate-friendly actions (Kollmuss & Agyeman, 2002). In fact, we found one dimension in our study for indirect behavior, namely actions that delegate climate-friendly activities to others, such as electing politicians committed to climate protection, offsetting CO$_2$ emissions, and donating money to climate protection projects. Additionally, we found that direct behavior split into (a) low-cost behaviors, mainly consisting of routine consumer behaviors, such as airing, recycling paper, meal choice, or saving electricity and water, and (b) mobility, which included avoiding car use and flights. Thus, a classification in terms of directness does not seem to suffice and an additional distinction might be needed.

As a second way of classifying climate-friendly action, we considered financial and behavioral costs (such as inconvenience or loss of time). Among the direct behaviors, mobility
and low-cost behaviors differed in terms of perceived costs. Reducing car and plane use was perceived as more costly and inconvenient than the low-cost behaviors. Indirect behaviors, however, were perceived as most costly, perhaps because they merely involved financial costs and no direct benefits that might reduce cost perceptions.

Climate mitigation policy measures could be divided into (a) supportive measures that enable climate-friendly action (e.g., subsidies), and (b) CO₂ restrictions putting charges on CO₂ emissions, (e.g., CO₂ taxes on heating oil or gasoline). Supportive measures were perceived as less costly than CO₂ restriction measures, indicating that supportive measures represent low-cost policy options, whereas CO₂ restriction measures belong to high-cost policy measures. Taken together, these results therefore indicate that both a distinction in terms of a behavior’s directness as well as a differentiation according to perceived costs seem to be appropriate to classify climate-friendly actions.

Not surprisingly, consumers were most willing to perform climate-friendly low-cost actions, but not to avoid car or plane use. This result highlights the fact that people prefer to show their environmental concern in low-cost areas (Diekmann & Preisendörfer, 1998). Generally, the willingness to address climate change was, however, positively correlated among all types of climate-friendly actions. Thus, different forms of pro-environmental behavior seem to be based on the same motivational roots, which could be considered a general conservation stance (Thøgersen, 2004). This finding to some extent supports the assumption of a positive spillover. People showing some kind of climate-friendly behaviors might thus be willing to adopt other climate-friendly actions. However, the extent of this positive spillover seems to vary among the different types of climate-friendly action. There was a particularly strong positive relationship between the willingness to show indirect behavior and the support of both types of climate policy measures, probably because they all represent an indirect way of addressing climate change. Willingness to perform low-cost climate-friendly behaviors and the acceptability of supportive policy measures were also strongly and positively correlated. This might be due to the fact that both involve relatively low costs and generate benefits that go beyond climate mitigation (e.g., saving money).

### 4.4.2 Determinants of climate-friendly actions

For all five types of climate-friendly action, we examined which factors predict consumers’ willingness to address climate change. Across all forms of action addressing climate
change, costs and climate benefit of the respective behaviors or policies turned out to be the strongest predictors for willingness to act or to support climate policy measures.

This finding might support the assumption that consumers make reasoned decisions, weighting costs and benefits of an action and choosing the option they believe to have the best balance. However, it is important to note that, whereas respondents were directly affected by costs (e.g., in terms of inconveniences, loss of time, or financial costs), they would not immediately profit from the benefit of their actions, as these were related to the climate. Still, climate benefit outweighed perceived costs as the most influential determinant for most types of climate-relevant actions.

This could indicate that consumers were concerned about the climate’s state and altruistically put more weight on climate benefit than on personal costs. However, climate benefit, like climate change, cannot be experienced because the connection between today’s action and its effects on the climate is difficult to perceive (Moser, 2007). Thus, respondents’ perceptions of the climate benefit of different types of climate-friendly actions may not necessarily mirror the actual benefit. In line with our results, a recent study found a discrepancy between the actions recommended by policy makers (e.g., using public transport) and those taken by the public (e.g., recycling) (Whitmarsh, 2009). The author concluded that the public might have an incomplete understanding of which actions are most effective in terms of climate mitigation. Whitmarsh suggested that people tend to overestimate their contribution to climate mitigation while underestimating the negative impact of their actions. Thus, the strong influence of perceived climate benefit in our study could also reflect a strategy of reducing cognitive dissonance (Festinger, 1957). As high-cost behaviors are more difficult to adopt, consumers might be unwilling to change their lifestyle, and therefore experience an uncomfortable tension. As a result, to reduce the cognitive dissonance, consumers might dismiss high-cost behaviors as not effective in terms of climate mitigation.

For mobility behavior, however, perceived costs and inconveniences did prevail over perceived climate benefit as the most influential factor. A possible explanation for this result might be that CO2 emissions by planes and cars are commonly known to have a major negative impact on the climate (e.g., Bord et al., 2000; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994; Reynolds et al., 2010). Thus, one cannot argue that renouncing cars and planes is not beneficial for the climate. As the climate benefit of these behaviors could not be denied, perceived costs might have outweighed this factor as the most influential determinant.
With regard to attitudes, we found that consumers concerned about climate change were more willing to show climate-friendly low-cost behaviors and accept supportive climate policy. Concern about climate change, however, did not significantly influence consumers’ willingness to reduce car and plane use, to show indirect behavior, or to support CO\textsubscript{2} restrictions. This stands in contrast to the suggestion that attitudes might have a stronger influence on indirect actions than on direct ones (Kollmuss & Agyeman, 2002). Rather, it appears that attitudes have a stronger influence on low-cost behaviors and policies, because high costs hamper the transformation of attitudes into the corresponding action (Diekmann & Preisendörfer, 2003; Lee & Holden, 1999). Therefore, consumers concerned about climate change seem to be willing to show climate-friendly low-cost behaviors and support low-cost policies, but not costlier and more inconvenient ways of addressing climate change (i.e., mobility, indirect behaviors, and CO\textsubscript{2} restrictions).

Our findings are in line with past research findings that attitudes and environmental concern were influential predictors for people’s indoor greenhouse gas reduction behaviors (such as turning off lights and recycling) but not for their automobile greenhouse gas emissions (Ngo, West, & Calkins, 2009). Poortinga and colleagues (2003) even found that consumers with a high level of environmental concern found measures with small energy savings more acceptable than measures resulting in large energy savings. They suggested that measures with small savings (such as switching off the light) could be highly symbolic. Therefore, particularly people concerned about the environment might believe that at least these should be adopted.

The willingness to avoid cars and planes was further influenced by the respondents’ age and education. Participants of a higher age were more willing to avoid cars and planes, probably because elderly people are less mobile. The negative influence of education was possibly related to the fact that qualified jobs often require more travelling to meetings abroad or commuting as, in many cases, they are situated in larger cities. However, compared to the perceived costs and climate benefits, the predictive strength of the other factors was rather weak. We therefore suggest focusing on the former two.

Political affiliation proved to be the most influential determinant among the sociodemographic variables. Participants on the right wing were less willing to show indirect climate-friendly behaviors, change their mobility behaviors, and to support any type of climate mitigation policy measures. These results are in line with past research indicating that a conservative political ideology has a negative effect on people’s concern for climate change (Dunlap & McCright, 2008; Zia & Todd, 2010), which, ultimately, might reduce
their willingness to address the subject. Climate-friendly low-cost behaviors, however, were not influenced by political affiliation. A possible explanation for that result might be that climate-friendly low-cost behaviors often include co-benefits that are not associated with climate change. Furthermore, among all tested types of climate-friendly actions, our determinants could explain the least variance in low-cost climate-friendly behaviors. Consumers’ willingness to show this type of behavior might be determined by further factors that are not necessarily related to climate change. Past research found that the reasons for engaging in several climate-related actions are not always connected to the environment (Whitmarsh, 2009). For instance, the most frequent reason for saving electricity was to save money, and eating organic food was primarily motivated by health concerns. Thus, in contrast to the other types of climate-friendly actions, the reasons for showing climate-friendly low-cost behaviors could be manifold.

4.4.3 Limitations

Our study has several limitations. For instance, we cannot claim that our sample was entirely representative. First, we only examined the German-speaking part of Switzerland. Although the German-speaking population represents the vast majority of Switzerland’s population in general, and the area covered by our mail survey comprised 78% of the population, we cannot exclude that the population of the French- and Italian-speaking part differs from the examined sample. Second, men were overrepresented in the sample. Despite our attempt to randomize within the household using the birthday method, we could not control which household member actually completed the questionnaire. As men were overrepresented, it is possible that they felt more inclined to participate. Thus, we cannot rule out a self-selection bias, leading only persons particularly interested in climate change to participate in the survey. However, the mean scores for concern about climate change covered the entire response spectrum (ranging from 1.00 to 6.00), indicating that all levels of concern were represented in our sample. Furthermore, the large response rate and the fairly representative sample still allow us to conclude that the results can be applied to a large percentage of the Swiss population.

Another limitation was that we measured self-reported willingness to act as the dependent variable, rather than actual behavior. Although intention is one of the key predictors of behavior for social psychologists, past research has shown that intentions to
act are not necessarily transformed into actual behavior. Meta-analyses show that intention explains about 27–28% of the variance across general behavior (Sheeran, 2002) and pro-environmental behavior (Bamberg & Möser, 2007). Furthermore, the responses might have been influenced by social desirability or other self-report distortions (such as recalling difficulties). As an alternative, we could have avoided these problems by directly observing the actual behavior. However, we aimed to classify a broad range of manners of addressing climate change and intended to compare the determinants of these different options. Therefore, our main focus was to include a large variety of climate-friendly actions. Unfortunately, the measurement of such a wide range of behaviors would not have been feasible by observation.

Lastly, we are aware that our list of predictors is not conclusive. The inclusion of additional determinants, such as values or social norms, could have added to the explanation of the willingness to act and to support climate policy measures. Although our models could explain a considerable fraction of the variance, further research could examine whether other determinants might be stronger predictors.

### 4.4.4 Conclusions and implications

Generally, people seem to be concerned about climate change, but perceive it as less important than other environmental, personal, or social issues (Leiserowitz, 2007b; Leiserowitz et al., 2011a; Lorenzoni & Pidgeon, 2006). The insufficient sense of urgency about climate change might be due to the time lags in the climate, the fact that climate change is largely invisible for individuals, and the existence of other, more immediate problems (Moser & Dilling, 2004). People communicating about climate change, therefore, might be tempted to use fear or guilt as a motivating force. Such appeals, however, could result in resentment, denial, or apathy if no potential solutions are offered. Moser and Dilling (2004), therefore, recommended that communication about climate change should rather highlight the effectiveness of the recommended action and address concerns about costs. Similarly, Ngo and colleagues (2009) concluded that green attitudes and knowledge of environmental problems might not be sufficient to encourage people to change consumption behaviors and suggested that public information campaigns should instruct the public about how they can feasibly reduce greenhouse gas emissions.

Our study provides empirical support for these recommendations. Although concern influenced some climate-friendly actions, it was not among the most influential factors
encouraging people to address climate change. The perceptions of climate benefits and
costs, however, were the strongest predictors of participants’ willingness to engage with
climate change. In line with Moser and Dilling’s (2004) and Ngo and colleagues’ (2009)
recommendations, our results indicate that future communication should highlight the
climate benefit of climate-friendly actions and aim to reduce consumers’ perceptions of
costs and inconveniences. Emphasizing the climate benefit of climate-friendly actions
might be particularly promising for two reasons: first, it represents a positive form of
communication, which might prove more successful in engaging and empowering individ-
uals to change their behaviors and support public policy changes (Moser, 2007; Moser &
Dilling, 2004). Second, contributing to climate mitigation might give people a feeling of
control.

It seems particularly important to communicate the climate benefits associated with
climate-friendly actions, especially if they involve higher costs. On the one hand, if
consumers actually misjudge the effectiveness of climate-friendly actions, such informa-
tion would help them to realistically estimate the consequences of their actions, and to
accordingly set priorities to change behaviors. Thus, consumers would, for instance, be
reminded that avoiding flights has a greater impact on climate mitigation than recycling.
On the other hand, knowledge about the actions’ actual climate benefit would impede the
strategy to reduce cognitive dissonance by dismissing more costly climate-friendly actions
as ineffective.

For high-cost behaviors, such as reduction of car use, it seems to be difficult to motivate
consumers to change their behavior by appealing to their concern about climate change.
As high personal costs prevent people from acting according to their attitudes, it seems
more important to focus on how consumers perceive the costs and inconveniences of
climate-friendly behavior and their estimation of its associated climate benefit. Changing
the perception of costs and inconveniences might be challenging but could substantially
increase people’s willingness to change their mobility behavior.

As political affiliation was another important predictor, it seems important to reach peo-
ple on the right wing of the political spectrum. This might be challenging, as this group
probably tends to distrust many information sources, such as scientists or environmen-
talists. Like skeptics, this group may be more approachable with arguments that are in
line with their values (Leiserowitz, 2007a). For instance, the economic opportunities of
technological innovations could be highlighted. Another possibility would be to address
the dependence on other countries for fossil fuel.
For future research, it might be interesting to examine how information about the actual climate benefit associated with climate-friendly actions influences consumers’ willingness to act. Furthermore, it could be worthwhile to investigate how an intervention could reduce the perceived costs of climate-friendly actions.

References


Chapter 5

Eating green:
Consumers’ willingness to adopt ecological food consumption behaviors

Manuscript accepted for publication as:
Abstract

Food consumption is associated with various environmental impacts, and consumers’ food choices therefore represent important environmental decisions. In a large-scale survey, we examined consumers’ beliefs about ecological food consumption and their willingness to adopt such behaviors. Additionally, we investigated in more detail how different motives and food-related attitudes influenced consumers’ willingness to reduce meat consumption and to buy seasonal fruits and vegetables. We found consumers believed avoiding excessive packaging had the strongest impact on the environment, whereas they rated purchasing organic food and reducing meat consumption as least environmentally beneficial. Similarly, respondents appeared to be most unwilling to reduce meat consumption and purchase organic food. Taste and environmental motives influenced consumers’ willingness to eat seasonal fruits and vegetables, whereas preparedness to reduce meat consumption was influenced by health and ethical motives. Women and respondents who preferred natural foods were more willing to adopt ecological food consumption patterns.
5.1 Introduction

In this study, we aimed to examine consumers’ willingness to consume food in an environmentally friendly manner and tested which motives and attitudes influence the respondents’ propensity to adopt green food consumption behaviors. Food consumption has been recognized as an environmentally significant behavior, because food production, transport, and consumption contribute to environmental problems, such as greenhouse gas emissions, farmland erosion, and excess wastage (e.g., Carlsson-Kanyama, 1998; Jungbluth, 2000; Tukker & Jansen, 2006). Overall, food consumption has been estimated to account for about 20% to 30% of the total environmental impact in the Western world (Tukker & Jansen, 2006). Unlike other consumption goods, food is a basic need and cannot be renounced or substituted. Depending on the ingredients, greenhouse gas emissions from different meals containing the same amount of calories and protein can vary, however, by a factor of nine (Carlsson-Kanyama, 1998). Dietary choices form an important part of overall sustainable consumption, and with daily food choices, consumers make important environmental decisions. Whereas a large body of research has examined consumers’ willingness to purchase and consume organic food (e.g., Lockie, Lyons, Lawrence, & Grice, 2004; Magnusson, Arvola, Koivisto Hursti, Aberg, & Sjödén, 2001, 2003; Shepherd, Magnusson, & Sjödén, 2005; Squires, Juric, & Cornwell, 2001), only a few studies have investigated other factors of ecological food consumption, such as reducing meat consumption or purchasing local food products (Lea & Worsley, 2008). Therefore, we conducted a large-scale survey to examine consumers’ beliefs about ecological food consumption and their willingness to adopt such behaviors. Furthermore, we examined how different motives for eating ecologically and different food-related attitudes influenced consumers’ willingness to consume food in an environmentally friendly manner.

5.1.1 Perceived environmental benefits and willingness to consume food in an environmentally friendly manner

Making ecological food choices is difficult for consumers, as many different factors have to be taken into account. From the perspective of life cycle analysis (LCA), which examines the overall environmental impact of a product throughout its life cycle, it seems most important to avoid products transported by air, to prefer organic products, and to reduce meat consumption (Jungbluth, Tietje, & Scholz, 2000). Furthermore, heated
greenhouse production should be avoided. Food packaging, however, tends to be relatively less important in terms of environmental impact.

However, past research indicates that consumers are not necessarily aware of the environmental impact associated with product criteria. Although consumers generally believe that preferring locally produced and organic food is environmentally beneficial, they seem to overestimate the environmental impact caused by packaging material (Lea & Worsley, 2008; Tobler, Visschers, & Siegrist, 2011). Furthermore, consumers seem to be unaware of the environmental impact associated with meat consumption (Lea & Worsley, 2008). Similarly, consumers’ willingness to eat ecologically does not necessarily reflect the ecological impact order based on LCA results. While most consumers indicated they composted food scraps and bought locally produced foods, they were clearly less willing to reduce meat consumption and buy organic products (Lea & Worsley, 2008).

In this study, we aimed to investigate consumers’ perception of the environmental benefits associated with ecological food consumption. Furthermore, we intended to investigate which ecological food consumption patterns consumers are willing to adopt. Based on the idea that behavioral changes occur over time and unfold through a series of different stages (Prochaska, Redding, & Evers, 2008; Prochaska & Velicer, 1997), we also assumed that willingness to consume ecologically occurs in steps, ranging from unwillingness to do the desired behavior to performing the desired behavior. The transtheoretical model (TTM) assumes that people move from the precontemplation stage (no intention of taking action in the near future) through contemplation (wanting to change but feeling ambivalent toward the associated costs and benefits) and then preparation (intention to take action in the immediate future with a concrete plan of action) to action (lifestyle and behavior have changed) (Prochaska et al., 2008; Prochaska & Velicer, 1997). People in the modification and termination stages sustain their new behaviors with decreasing temptation to relapse.

Although this theory was traditionally used in the field of health behavior, consumers might also change their behavior toward ecological consumption through different stages of willingness. Changing behavior, in the domain of health behavior and ecological consumption, often requires consumers to overcome barriers, such as changing habits and lifestyle. Thus, the progress from willingness to change toward action might happen gradually. We therefore adapted the first four stages of the TTM to measure respondents’ willingness to consume in an environmentally friendly manner.

During the transition from unwillingness to act to performing the desired behavior, people
might be motivated by different benefits associated with the new behavior. Knowing which motives encourage consumers to adopt ecological food consumption patterns could be useful for future campaigns promoting these behaviors. For this reason, in the second step of our study we examined consumers’ motives for adopting ecological food consumption behaviors.

5.1.2 Motives for consuming food in an environmentally friendly manner

Consumers can have different motives underlying their food selection behaviors. Past research indicates that sensory appeal, healthiness, convenience, and price generally tend to be important factors influencing food choice (Scheibehenne, Miesler, & Todd, 2007; Steptoe, Pollard, & Wardle, 1995; Van Birgelen, Semeijn, & Keicher, 2009). The eco-friendliness of a food product, however, does not seem to have a major influence on consumers’ food choice. Nevertheless, some ecological food patterns also have additional nonenvironmental benefits. For instance, seasonal and regional fruits and vegetables might be perceived as fresher, as they can be harvested when ripe and do not have to be transported for a long time. In fact, past research has shown that consumers tend to perceive locally-produced food as of higher quality, particularly in terms of freshness and taste (Chambers, Lobb, Butler, Harvey, & Traill, 2007). Similarly, renouncing meat consumption can be motivated by health concerns or moral considerations regarding animal welfare (Beardsworth & Keil, 1991; Jabs, Devine, & Sobal, 1998). Thus, there might be several reasons for ecological food consumption behavior, which do not necessarily focus solely on the environmental outcome. Accordingly, ecological food consumption can have nonenvironmental benefits, which for many consumers might be more convincing for changing dietary choices than the environmental motive. To the best of our knowledge, no study has examined the different motives that might stimulate consumers to change toward ecological food consumption patterns that go beyond consuming organic products. Such information, however, would aid the development of persuasive campaigns to motivate consumers to adopt eco-friendly consumption patterns.

Therefore, we studied the influence of different motives on consumers’ willingness to eat ecologically. As discussed above, consumers can reduce the environmental impact of their food consumption by eating less meat, and avoiding air transportation and greenhouse
production (Jungbluth et al., 2000). The latter two criteria can be put in practice by eating seasonal fruits and vegetables, as these do not need heated greenhouse production and can be produced locally (thus avoid long haulage, particularly by air). Accordingly, we focused in this study on consumers’ willingness to reduce meat consumption and to eat seasonal fruits and vegetables.

In addition to the influence of motives, we also examined the influence of several food-related attitudes on reducing meat consumption and eating seasonal fruits and vegetables. Past research indicated that consumers strongly associate sustainability with naturalness (Verhoog, Matze, van Bueren, & Baars, 2003). Consumers concerned about the naturalness of food seem to be more willing to purchase organic food products (Lockie et al., 2004). Furthermore, people who buy organic food also seem to have a stronger health consciousness and seem to be willing to eat something else if they are convinced it improves their health (Schifferstein & Oude Ophuis, 1998). Although these relationships were found for organic food consumption, these attitudes might also influence other ecological food consumption behaviors. Hence, we included consumers’ preference for natural food and their attitude toward a food’s healthiness to test the influence of these two factors on willingness to reduce meat consumption and eat seasonal fruits and vegetables. As consuming seasonal fruits and vegetables allows consumers to avoid excessive packaging (such as tins), we additionally included participants’ attitude toward avoiding waste to predict willingness to consume ecological fruits and vegetables.

In sum, our study investigated consumers’ perception of the environmental benefit of several ecological consumption patterns and their willingness to choose these behaviors. In the second part, we tested which motives and attitudes might determine consumers’ willingness to reduce meat consumption and eat seasonal fruits and vegetables.

5.2 Methods

5.2.1 Participants

The present study was conducted within a large longitudinal research project examining the eating behavior of the Swiss population and related aspects of nutrition and food consumption. This project is a yearly study investigating how people’s food consumption patterns change over time and which factors are related to these changes.
In spring 2010, we sent a mail survey to randomly selected households in the German- and French-speaking regions of Switzerland. Persons who had not responded after 5 weeks received a reminder with another copy of the questionnaire. Our final sample consisted of 6,189 respondents (response rate = 29.6%), of whom 47.6% were men. The participants’ mean age was 54.4 years ($SD = 15.3$, range 2099), which is somewhat higher than the average age of the adult Swiss population of 49 years (BFS, 2009). The majority of our respondents (70.1%, $n = 4,336$) lived in the German-speaking part of Switzerland (census: 64%), and 29.9% ($n = 1,853$) resided in the French-speaking part (census: 20%). The Italian- and Romansh-speaking regions were not included in our survey.

Most participants indicated a monthly income between 5,001 and 7,000 Swiss Francs, which is comparable with the mean income in the Swiss population (6, 465 Francs). The majority of our respondents had attended vocational school (34%, $n = 2,056$) or higher secondary school (29%, $n = 1,762$). Twenty-eight percent ($n = 1,706$) had a college or university degree, and 10% ($n = 585$) indicated they had either no education, or primary or lower secondary school education. Compared to the general Swiss population, our sample had a higher educational level.

In an additional telephone survey, we examined the demographic variables of nonresponders. Among the random sample of 200 nonresponders from the German-speaking part, 72% ($n = 144$) were reached with a maximum of five telephone calls at different times a day. Compared to the participants, nonresponders were more likely to be male (56.3% of nonresponders vs. 47.6% of participants) and to have a lower educational level (primary or lower secondary school, 22.0% of nonresponders vs. 7.1% of participants). The nationality (Swiss 83.8% vs. 82.7%) and mean age (55.4 vs. 54.4) were similar between nonresponders and responders.

### 5.2.2 Questionnaire

We asked participants how they perceived the environmental benefit of six different ecological consumption patterns (see Table 5.1). Respondents could indicate the perceived environmental benefit of each pattern on a scale ranging from 1 (very small environmental benefit) to 6 (very large environmental benefit).

We also measured consumers’ willingness to show environmentally friendly food consumption patterns. The list of behaviors encompassed buying regional food products, eating seasonal fruits and vegetables only, reducing meat consumption (to a maximum of twice
a week), avoiding food products imported by airplane, and purchasing organic food (see Table 5.2). Based on the TTM (Prochaska et al., 2008; Prochaska & Velicer, 1997), we assessed people’s level of intention in the following four stages: we operationalized (1) precontemplation with the response option "I am not doing this and I am not willing to," whereas we measured (2) contemplation with the option "I would like to do this, but I do not know how." For the (3) preparation stage, we used the statement "I would like to do this, and I already know how to start," and we operationalized the (4) action stage with the option "I am doing this already." Respondents had to mark their current stage for each of the five behaviors.

As independent variables of willingness to show green food consumption patterns, we measured the respondents’ food-related attitudes, namely (1) importance of naturalness in food choices and (2) health consciousness (i.e., consumers’ importance of a food product’s healthiness). For the consumption of seasonal fruits and vegetables, we included awareness of waste production as a predictor. All items were presented as statements, and participants could rate their level of agreement on a 6-point Likert scale. We used a scale measuring the importance of naturalness in food choices (Cousin & Siegrist, in preparation), consisting of six items (e.g., "Natural foods taste better than other foods," "Natural foods are better for my health," \( \alpha = .87 \)). Participants’ health consciousness was assessed with two items ("I do not select foods according to their healthiness," "I eat what I like, I don’t care if it is healthy as well"; both items were reversed, \( \alpha = .75 \)). We measured awareness of waste production with three items (e.g., "I try to shop in such a way that I will not have leftovers to throw away," "I try to produce as little waste as possible," \( \alpha = .75 \)). For all three food-related attitude scales, we calculated the mean score for each participant.

We measured frequency of meat consumption with four items, asking participants how often they consumed beef or veal, pork, poultry, and sausages or other processed meat products. The response format was several times a day (5), daily (4), several times a week (3), several times a month (2), several times a year (1), and rarely or never (0).

To predict willingness to reduce meat consumption and eat seasonal fruits and vegetables, we asked participants how convincing they found different motives for changing the respective behavior. These motives addressed concerns for health, environment, price, taste, and animal welfare, if applicable to the behavior (see Tables 5.3 and 5.4). Participants could indicate the level of persuasiveness on a 6-point Likert-scale ranging from not convincing to very convincing. Finally, participants indicated their gender, age, education,
and household income.

5.2.3 Data analyses

In the descriptive part, we analyzed consumers’ perceived environmental friendliness of ecological consumption patterns as well as their willingness to show these behaviors. Past studies suggest gender differences: women tended to show higher levels of environmental concern but lower levels of environmental knowledge (Davidson & Freudenburg, 1996; Schahn & Holzer, 1990; Stern, Dietz, & Kalof, 1993). There might have been a gender difference in our participants’ environmental judgment of food consumption patterns. We therefore used independent t-tests to test whether men and women differed in their estimation of perceived environmental benefit.

In a further step, we analyzed consumers’ willingness to consume seasonal fruits and vegetables and their willingness to reduce meat consumption. The assumption of parallel lines for ordinal regression analyses was violated (p < .001); therefore, we conducted multinomial regression analyses to predict willingness to eat seasonal fruits and vegetables and reduce meat consumption. As the fractions of people in the contemplation and preparation stages were rather small (see Table 5.2), we grouped these respondents into one category for further analyses, called ”change stages.” We then used the combined category of contemplation and preparation (i.e., people who considered behavioral changes but had not yet implemented them) as a reference group and compared them to participants in the precontemplation (i.e., who were not willing to perform these behaviors) and action (i.e., who were already showing these behaviors) stages.

As predictors, we used sociodemographics (gender, age, education, and income), environmental and nonenvironmental motives for changing these behaviors, and different food-related attitudes (i.e., toward naturalness, healthiness, and waste production). We formed three education groups: (a) lower education (secondary school or lower), (b) vocational education, and (c) higher education (higher secondary school, college, or university). In Switzerland, the largest share of the population (44%) has a vocational school degree (BFS, 2009); therefore, we used this group as a baseline for education and compared the two other education levels with vocational education.
5.3 Results

We first examined the environmental benefit consumers associated with the six different ecological food consumption patterns and studied the consumers’ willingness to adopt five of these behaviors. In the second step, we investigated the influence of different motives and food-related attitudes.

5.3.1 Perceived environmental benefit of ecological food consumption patterns

Table 5.1 shows that consumers believed avoiding excessive packaging had the strongest impact on the environment, followed by purchasing regional food products. Avoiding air imported products and eating seasonal fruits and vegetables were perceived as somewhat less environmentally relevant. Consumers clearly rated purchasing organic food and foregoing meat as least environmentally beneficial.

To test for gender differences, we conducted an independent t-test for the perceived environmental benefit for each food consumption behavior. Women perceived all consumption patterns as more eco-friendly than men. The largest difference was found for purchasing organic food products. However, although the results were significant, the effect sizes of the gender differences were moderate.

Consumers’ perception of the environmental benefit of meat reduction could be influenced by their meat consumption. Participants eating more meat might be less willing to acknowledge that reducing this behavior could be ecologically relevant. Therefore, we used Pearson correlation to test the relationship between the perceived environmental benefit of meat reduction and the frequency of meat consumption. Generally, the more frequently consumers consumed meat, the smaller they perceived the environmental benefit of reducing meat consumption ($r = -0.18$ for beef or veal, $r = -0.24$ for pork, $r = -0.09$ for poultry, and $r = -0.18$ for sausages or other processed meat products, all $ps < .001$).

5.3.2 Willingness to adopt ecological food consumption patterns

Overall, most respondents indicated they already bought regional food and ate seasonal fruits and vegetables (“action stage”; see Table 5.2). A substantially lower fraction had
Table 5.1.
Means (and standard deviations) for perceived environmental benefit of food consumption patterns for total sample and each gender, including results of independent \( t \)-tests for gender.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Total (SD)</th>
<th>Men (SD)</th>
<th>Women (SD)</th>
<th>t</th>
<th>df</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid food products with excessive packaging</td>
<td>6082</td>
<td>5.37 (1.06)</td>
<td>5.17 (1.91)</td>
<td>5.56 (0.88)</td>
<td>−14.62**</td>
<td>6063</td>
<td>.18</td>
</tr>
<tr>
<td>Buy regional food</td>
<td>6082</td>
<td>5.29 (1.07)</td>
<td>5.10 (1.17)</td>
<td>5.46 (0.93)</td>
<td>−13.12**</td>
<td>6063</td>
<td>.17</td>
</tr>
<tr>
<td>Avoid food products that were imported by airplane</td>
<td>6067</td>
<td>5.10 (1.40)</td>
<td>4.91 (1.51)</td>
<td>5.27 (1.27)</td>
<td>−9.96**</td>
<td>6048</td>
<td>.13</td>
</tr>
<tr>
<td>Eat only seasonal fruits and vegetables</td>
<td>6082</td>
<td>4.95 (1.34)</td>
<td>4.70 (1.42)</td>
<td>5.17 (1.21)</td>
<td>−13.77**</td>
<td>6063</td>
<td>.17</td>
</tr>
<tr>
<td>Buy organic food</td>
<td>6056</td>
<td>4.15 (1.59)</td>
<td>3.80 (1.60)</td>
<td>4.46 (1.51)</td>
<td>−16.47**</td>
<td>6037</td>
<td>.21</td>
</tr>
<tr>
<td>Eat less meat (maximum once or twice per week)</td>
<td>6056</td>
<td>3.75 (1.71)</td>
<td>3.52 (1.70)</td>
<td>3.96 (1.69)</td>
<td>−10.21**</td>
<td>6037</td>
<td>.13</td>
</tr>
</tbody>
</table>

** \( p < .001 \)
reduced meat consumption and avoided products imported by air. The fewest consumers indicated they bought organic food products. In line with these results, we found the largest fraction of unwilling consumers in the domain of reducing meat consumption and buying organic food ("precontemplation stage").

Table 5.2.
Frequencies of respondents in the stages of willingness to show environmentally friendly food consumption patterns.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Precontemplation</th>
<th>Contemplation</th>
<th>Preparation</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy regional food</td>
<td>6095</td>
<td>10.0</td>
<td>5.2</td>
<td>17.1</td>
<td>67.7</td>
</tr>
<tr>
<td>Eat only seasonal fruits and vegetables</td>
<td>6104</td>
<td>15.5</td>
<td>5.3</td>
<td>16.3</td>
<td>62.9</td>
</tr>
<tr>
<td>Eat less meat (maximum once or twice per week)</td>
<td>6093</td>
<td>36.3</td>
<td>5.4</td>
<td>11.4</td>
<td>46.9</td>
</tr>
<tr>
<td>Avoid food products that were imported by airplane</td>
<td>6066</td>
<td>28.4</td>
<td>13.4</td>
<td>16.8</td>
<td>41.4</td>
</tr>
<tr>
<td>Buy organic food</td>
<td>6059</td>
<td>35.9</td>
<td>5.9</td>
<td>18.7</td>
<td>39.4</td>
</tr>
</tbody>
</table>

Generally, most consumers were in either the precontemplation stage or the action stage. That is to say, they were either unwilling to adopt a behavior or were already showing it. Only for avoiding air imported food products, there was a somewhat larger fraction of respondents in the contemplation stage compared to the other consumption patterns (i.e., consumers were willing to adopt the behavior but did not know how to do it).

Determinants influencing consumption of seasonal fruits and vegetables

For the multinomial regression analyses, we combined participants in the change stages (i.e., contemplation and preparation stages) and compared them to the respondents in the precontemplation (i.e., people unwilling to change their behavior) and action (i.e., people who showed the desired behavior) stages.
<table>
<thead>
<tr>
<th></th>
<th>Precontemplation (n = 889)</th>
<th></th>
<th>Action (n = 3,560)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SE)</td>
<td>OR 95% CI</td>
<td>B (SE)</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>Gender (^a)</td>
<td>.03 (.10)</td>
<td>1.03 0.85–1.24</td>
<td>.29** (.07)</td>
<td>1.34 1.16–1.54</td>
</tr>
<tr>
<td>Age</td>
<td>.01** (.00)</td>
<td>1.01 1.01–1.02</td>
<td>.01** (.00)</td>
<td>1.01 1.01–1.02</td>
</tr>
<tr>
<td>Lower vs. vocational education</td>
<td>−.07 (.18)</td>
<td>0.93 0.66–1.31</td>
<td>−.09 (.13)</td>
<td>0.92 0.70–1.19</td>
</tr>
<tr>
<td>Higher vs. vocational education</td>
<td>−.14 (.10)</td>
<td>0.87 0.71–1.06</td>
<td>−.23* (.08)</td>
<td>0.80 0.69–0.92</td>
</tr>
<tr>
<td>Seasonal fruits and vegetables are better for the environment</td>
<td>−.23** (.04)</td>
<td>0.80 0.74–0.85</td>
<td>.06 (.03)</td>
<td>1.06 1.00–1.13</td>
</tr>
<tr>
<td>Seasonal fruits and vegetables taste better</td>
<td>−.23** (.04)</td>
<td>0.80 0.74–0.86</td>
<td>.15** (.03)</td>
<td>1.16 1.09–1.24</td>
</tr>
<tr>
<td>By buying seasonal fruits and vegetables, one can save money</td>
<td>.06 (.03)</td>
<td>1.06 1.01–1.13</td>
<td>.04 (.02)</td>
<td>1.04 0.99–1.08</td>
</tr>
<tr>
<td>Naturalness</td>
<td>−.17* (.05)</td>
<td>0.84 0.76–0.93</td>
<td>.28** (.05)</td>
<td>1.32 1.21–1.45</td>
</tr>
<tr>
<td>Waste</td>
<td>−.01 (.04)</td>
<td>0.99 0.92–1.07</td>
<td>.18** (.03)</td>
<td>1.20 1.13–1.27</td>
</tr>
<tr>
<td>Health consciousness</td>
<td>−.10* (.04)</td>
<td>0.90 0.84–0.97</td>
<td>.06 (.03)</td>
<td>1.06 1.01–1.12</td>
</tr>
</tbody>
</table>

Note. \( R^2 = .20 \) (Nagelkerke). Reference category for the multinomial regression were the contemplation/preparation stages (\( n = 1,246 \)); significant coefficients (Bs) are shown in bold.

** \( p < .001 \), * \( p < .01 \)

\(^a\) Gender was coded 0 = male, 1 = female.
Table 5.3 shows that consumers’ preference for natural food was a strong predictor of their willingness to eat seasonal fruits and vegetables. If respondents prioritized their food’s naturalness, they were less likely to be in the precontemplation stage (i.e., unwilling to change their behavior) and more likely to be in the action stage (i.e., already showing this behavior) rather than being in the change stages. The motive addressing taste was the most influential argument for eating seasonal fruits and vegetables. If participants were convinced that seasonal fruits and vegetables taste better, the probability of being in the precontemplation stage decreased, and the likelihood of being in the action stage increased, compared to the change stages.

Older respondents had a higher probability of being in either the precontemplation or the action stage, rather than considering changing their behavior. Participants concerned about their health and convinced about the environmental benefits were more likely to be in the change stages than being in the precontemplation stage. However, these factors did not influence the likelihood of being in the action stage rather than considering changing the behavior.

Women, respondents with higher rather than vocational education, and those concerned about producing waste were more likely to eat seasonal fruits and vegetables (i.e., be in the action stage) than in the change stages. These factors, however, did not distinguish between people in the precontemplation stage and those considering changing their behavior. The motive addressing money did not significantly influence people’s willingness to eat seasonal fruits and vegetables.

Determinants influencing reduction of meat consumption

Gender was clearly the strongest predictor of respondents’ willingness to reduce meat consumption (see Table 5.4). Women were less likely to be unwilling (i.e., to be in the precontemplation stage) and more likely to have already reduced their meat consumption (i.e., be in the action stage) compared to the change stages. Another strong predictor was the conviction that reducing meat consumption is better for one’s health. People believing that reducing meat consumption had a positive effect on their health were less likely to be in the precontemplation stage and more likely to be in the action stage than in the change stages.

The influence of the ecological motive was mixed. Participants convinced about the environmental benefit of reducing meat consumption were less likely to be in the pre-
Table 5.4. Multinomial regression for willingness to reduce meat consumption, with $B$-values ($B$), standard errors ($SE$s), odds ratios ($OR$s), and 95% confidence intervals (95% $CI$s)

<table>
<thead>
<tr>
<th></th>
<th>Precontemplation ($n = 2,115$)</th>
<th>Action ($n = 2,686$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$B$ ($SE$)</td>
<td>$OR$</td>
</tr>
<tr>
<td>Gender $^a$</td>
<td>$-0.28^* (.09)$</td>
<td>$0.75$</td>
</tr>
<tr>
<td>Age</td>
<td>$0.00 (.00)$</td>
<td>$1.00$</td>
</tr>
<tr>
<td>Lower vs. vocational education</td>
<td>$-0.13 (.16)$</td>
<td>$0.88$</td>
</tr>
<tr>
<td>Higher vs. vocational education</td>
<td>$0.02 (.09)$</td>
<td>$1.02$</td>
</tr>
<tr>
<td>Reducing meat consumption is healthier</td>
<td>$-0.55^{**} (.03)$</td>
<td>$0.58$</td>
</tr>
<tr>
<td>Reducing meat consumption is better for the environment</td>
<td>$-0.09^* (.03)$</td>
<td>$0.92$</td>
</tr>
<tr>
<td>By reducing meat consumption, one can save money</td>
<td>$-0.01 (.03)$</td>
<td>$0.99$</td>
</tr>
<tr>
<td>By reducing meat consumption, one can prevent animals suffering</td>
<td>$-0.13^{**} (.03)$</td>
<td>$0.88$</td>
</tr>
<tr>
<td>Naturalness</td>
<td>$0.12 (.05)$</td>
<td>$1.13$</td>
</tr>
<tr>
<td>Health consciousness</td>
<td>$-0.08 (.04)$</td>
<td>$0.92$</td>
</tr>
</tbody>
</table>

*Note.* $R^2 = .35$ (Nagelkerke). Reference category for the multinomial regression were the contemplation/preparation stages ($n = 977$); significant coefficients ($B$s) are shown in bold.

**$p < .001$, * $p < .01$

$^a$ Gender was coded 0 = male, 1 = female.
contemplation stage than the change stages. However, they were more likely to consider changing their behavior than be in the action stage.

The motive addressing the suffering of animals was only partially influential. Participants convinced by this argument were more likely to consider reducing their meat consumption (i.e., be in the reference group) rather than being in the precontemplation stage. However, the motive about animals suffering did not significantly distinguish between respondents considering changing their behavior and participants in the action stage.

If respondents perceived the naturalness of their food as important, they were more likely to be in the action stage than in the change stages. This attitude, however, did not significantly distinguish between the precontemplation stage and the stage where people considered changing their behavior.

The motive concerning money had no significant influence on consumers’ willingness to reduce meat consumption. Neither age, nor educational level, nor health consciousness significantly influenced consumers’ willingness to reduce meat consumption.

5.4 Discussion

In this study, we aimed to examine consumers’ perception of the environmental benefits of different ecological food consumption behaviors, how willing consumers were to adopt these behaviors, and how different motives and attitudes influenced this willingness. The findings for these research questions are discussed in the following.

5.4.1 Ecological food consumption patterns: Perceived environmental benefit and willingness to adopt these behaviors

Among all ecological consumption patterns, participants believed that reducing waste by avoiding excessive packaging had the largest environmental benefit. This appraisal stands in contrast to the LCA results, which do not regard packaging as one of the most relevant environmental criteria (Jungbluth et al., 2000). Consumers’ tendency to overestimate the environmental harm associated with packaging is supported by similar findings in past research (Lea & Worsley, 2008; Tobler et al., 2011; Van Dam, 1996). One possible explanation for this overrating might be that, in contrast to production and
transportation, consumers personally experience the postconsumption of packaging (as they have to dispose of it), and this may therefore excessively influence their environmental assessment (Van Dam, 1996). Furthermore, waste reduction has been heavily promoted in Switzerland by environmental campaigns, which might have also raised consumers' awareness.

In contrast, consumers seem to be less aware of the environmental impacts associated with meat production. Whereas LCA results indicate that lowering meat consumption is very environmentally relevant (Jungbluth et al., 2000), consumers assessed reducing meat consumption as the least environmentally friendly of all consumption patterns. Since lowering meat consumption might be difficult for consumers, denying its environmental benefit may be a strategy for reducing dissonance. That is to say, consumers might excuse their unwillingness to reduce meat consumption by dismissing this behavior as not environmentally relevant. To test this assumption, we examined the relationship between meat consumption frequency and the perceived environmental benefit of reducing meat consumption. We found a significant negative correlation; people eating meat more frequently attributed less environmental benefit to reducing meat consumption. However, the relationship was not very pronounced, suggesting that consumers’ underestimation of the environmental relevance of meat consumption is not solely motivated by dissonance reduction, but might also reflect lack of knowledge.

Interestingly, organic food consumption was not assessed as a very environmentally beneficial consumption pattern. This is somewhat surprising as, in Switzerland, retailers and environmental organizations heavily promote organic food as an environmentally friendly option. Furthermore, a past study found that consumers strongly associate environmental friendliness with organic production (Tobler et al., 2011). A possible explanation for this discrepancy might be that there is a large variety of organic labels in Switzerland. These labels differ in terms of regulations and, therefore, may not necessarily be transparent to consumers. By assessing the consumption of organic foods as not very environmentally friendly, consumers might therefore express their distrust of organic labels. In a focus group study, consumers namely expressed mistrust about whether something labeled as organic was actually organic (Padel & Foster, 2005). Thus, on the one hand, consumers might believe that organic food actually is environmentally beneficial but, on the other hand, distrust that the products with organic labels are truly organically produced.

Consumers’ willingness to adopt ecological food consumption patterns mirrored their beliefs about the environmental benefits of these behaviors. Whereas the majority of con-
sumers reported they already consumed regional and seasonal food, a large fraction of respondents was unwilling to reduce their meat consumption or to buy organic food.

Eating seasonal and regional food requires only small dietary changes. All foods can still be eaten; consumers only have to consider and choose the fruits and vegetables that are currently in season. Thus, the meal compositions can mainly remain unchanged. Reducing meat consumption, however, often necessitates adaptations of the meal compositions. In the Western world, meat traditionally represents the centerpiece of a main course, which is typically accompanied by other foods as side dishes (Jensen & Holm, 1999; Sobal, 2005). Thus, meat appears to constitute an important meal component, which consumers might not be willing to forego. For vegetarian meals, meat substitutes often replace meat as a core meal constituent, or vegetables are prepared in a similar manner as in meat dishes. As these adaptations require more cooking skills and effort, it hardly surprising that consumers are less willing to reduce their meat consumption.

Overall, our results are supported by findings from an Australian study that consumers rated composting household food scraps and purchasing locally grown food as very environmentally friendly, and they also most frequently performed these behaviors (Lea & Worsley, 2008). As in our study, consumers also found buying organic food and reducing meat consumption least environmentally relevant and reported having adopted these behaviors least frequently. Thus, consumers’ misconceptions about the environmental importance of consumption patterns and their propensity to consume ecologically appear to be similar in Switzerland and Australia. It therefore seems conceivable that these results are also generalizable to other developed countries.

For all food consumption patterns, women estimated the environmental benefits significantly higher than men. However, with a large sample such as ours, tests tend to get significant results even with small effects (Royall, 1986). We found moderate effect sizes for all consumption patterns, indicating that the differences between men and women are limited. Furthermore, men and women put the different food consumption patterns in the same order with respect to their environmental benefit. Overall, our findings therefore indicate that the misconceptions about the environmental benefits of food consumption patterns are similar for both genders.

With regard to the stages of willingness to adopt behavior, we found the majority of the participants were either in the action stage, thus already showing ecological food consumption patterns, or in the precontemplation stage, unwilling to show these behaviors.
The transition over the different stages might therefore happen easily; once consumers decide to change toward a more ecological food consumption pattern, they appear to implement this rather quickly. Thus, consumers do not seem to encounter many barriers hindering them from transforming their willingness into action. However, compared to the other consumption patterns, a rather large fraction of consumers indicated they were willing to avoid air-imported products but did not know how to do this. Thus, consumers who are willing to avoid air-imported products might find it challenging, as retailers usually do not indicate a product’s means of transportation. Encouraging consumers to avoid air-imported products therefore does not seem to suffice without a labeling scheme indicating a product’s transportation mode.

5.4.2 Determinants of ecological food consumption

In the second part of our study, we investigated which factors influence consumers’ willingness to eat seasonal fruits and vegetables and reduce meat consumption. We particularly examined which motives for ecological food consumption influenced consumers’ willingness to adopt these behaviors.

Overall, the most influential motive for reducing meat consumption was the belief that it was beneficial for one’s health, whereas the better taste argument was the strongest motive for consumers’ willingness to eat seasonal fruits and vegetables. Interestingly, we found that the environmental benefit argument had a mixed effect on consumers’ willingness for both ecological food patterns. Participants convinced by the ecological claim were more likely to consider reducing their meat consumption and eating seasonal fruit and vegetables. However, for the consumption of seasonal food, this motive did not significantly influence the transition from considering changing to action. In the case of meat reduction, the effect was even counterintuitive; participants who believe that reducing meat consumption was environmentally beneficial were less likely to actually show this behavior. Similarly, the ethical aspect of animals suffering significantly influenced only consumers’ willingness to consider reducing their meat consumption, not the transition to actual behavior. Thus, some motives might encourage consumers to move from one stage to another, but not necessarily influence their transition through all stages. Consumers may need additional incentives or cues to reach this final stage.

The argument addressing the cost savings associated with ecological food patterns had no significant influence on consumers’ willingness to lower meat consumption and their
willingness to eat seasonal fruits and vegetables. This result is supported by the findings of another Swiss study, in which costs did not play an important role in green purchases (Tanner & Kast, 2003). Thus, the financial benefit of ecological food patterns seems to be either unconvincing or outweighed by stronger motives.

We also found that women were significantly more willing to eat less meat and were also more likely to eat seasonal fruits and vegetables. This gender difference was particularly large for meat consumption; men were substantially less willing to lower their meat intake. This is of little surprise as men compared to women generally eat more meat (e.g., Guenther, Jensen, Batres-Marquez, & Chen, 2005; Jensen & Holm, 1999) and appear to experience more hedonic pleasure of eating meat (Kubberød, Ueland, Rødibotten, Westad, & Risvik, 2002). Meat products are often associated with strength, power, and virility, and meat is considered an archetypical masculine food (Holm & Mehl, 2000; Jensen & Holm, 1999; Sobal, 2005). Men therefore might find it more difficult to reduce this type of consumption. Overall, our results suggest it might be most promising to address women when promoting ecological food consumption, as they seem to be more willing to adopt green food consumption patterns. Furthermore, women very often are a households gatekeeper, meaning that they decide what food is purchased and what the other household members eat (Tanner & Kast, 2003).

Consumers’ willingness to consume food in an environmentally friendly manner was further increased if consumers attached importance to their food’s naturalness and healthiness. This is in line with past research indicating that consumers have a strong association of sustainability with the naturalness of food (Verhoog et al., 2003). The transition from considering to consuming seasonal fruits and vegetables was additionally influenced by consumers’ awareness of waste production. Thus, consumers who try minimizing waste production probably avoid preserved fruits and vegetables as they are more excessively packaged (e.g., tins) and therefore favor fresh produce.

5.4.3 Limitations

Despite our large-scale survey and our ability to analyze the predictors of two ecological food consumption patterns in more detail than previous studies, our study also faced several limitations. For instance, our data were based on self-reported behavior, which does not necessarily equal actual behavior. On the one hand, consumers might mistake their consumption patterns as ecological because they lack information. For example, con-
Consumers might report eating seasonal vegetables without actually knowing which vegetables are seasonal at a given time. Similarly, which provenance consumers perceive as regional is uncertain. They might, for instance, consider products relatively regional if they come from neighboring countries. On the other hand, participants might overreport on their willingness to adopt such behaviors for reasons of social desirability. However, the survey was conducted anonymously, which lowers participants’ measures of social desirability to some extent (Joinson, 1999). Furthermore, measuring actual behavior would not have allowed insights into consumers’ stages of willingness to adopt ecological food consumption behaviors. Future studies, however, might take direct observations into account to measure consumers’ willingness to perform ecological food consumption behaviors.

In this survey, we focused on consumers’ food-related attitudes and beliefs. However, consumers’ green food consumption behaviors might be influenced by further factors. For future studies, additional determinants, such as ecological attitudes, knowledge, or values, should be included. It also seems worthwhile to examine in further experimental studies whether the identified motives actually persuade people to change their behavior.

5.4.4 Conclusions

Overall, our findings suggest that consumers generally appear to lack knowledge about the environmental relevance of various ecological food consumption patterns, which indicates that information campaigns about this topic might be worthwhile. Future environmental education campaigns should focus on the most environmentally relevant consumption patterns: for instance, emphasize the environmental impact associated with meat consumption, heated greenhouse production, and air transportation. Furthermore, campaigns should highlight the environmental benefits of organic food products and, to encourage organic food consumption, strengthen consumers’ trust in the organic labels.

However, even if consumers are given information about the environmental impacts of food consumption, assessing the ecological aspect of food products remains challenging. It might, for example, be necessary to indicate seasonal fruits and vegetables, as consumers may lack knowledge about seasonality. If a product shows conflicting features (e.g., a regional vegetable from heated greenhouse production), consumers have to make tradeoffs, which is considered one of the most difficult challenges in decision making (Hammond, Keeney, & Raiffa, 2002). Thus, it might be most promising to develop means of signaling a product’s overall environmental friendliness in a simple and understandable way. A
label based on LCA results, for instance, could facilitate ecological consumption.

Furthermore, our findings indicate consumers’ willingness to perform different ecological consumption patterns might be influenced by different motives. Accordingly, persuasive campaigns should take into account which motives might be most promising in order to encourage consumers to adopt these behaviors. For the consumption of seasonal fruits and vegetables, for instance, it might be most beneficial to combine the argument of better taste and environmental friendliness. Reducing meat consumption, however, might be best promoted by highlighting the associated health benefits as well as by claiming that by foregoing meat one can prevent animals’ suffering. The argument of saving money, however, does not seem to be a promising claim to persuade consumers to adopt ecological food consumption patterns, at least not for reducing meat consumption and eating seasonal fruits and vegetables.

Altogether, environmental motives alone might not be the strongest persuasion strategy to encourage ecological food consumption. They might encourage consumers to consider changing their behavior, but may not be sufficiently motivating for consumers to change their consumption patterns. As health or taste claims might have a stronger influence on consumers’ willingness to consume in an environmentally friendly way, these might be included in future campaigns promoting ecological food consumption. Such nonenvironmental benefits should be genuine and agreed upon by experts. Therefore, the cooperation of several organizations with different foci (such as health or animal welfare) could be very fruitful.

References


Environmental Ethics, 16(1), 29–49.
Chapter 6

General discussion
6.1 Introduction

People substantially influence the environment with their consumer behaviors. Their food choices and decisions about their modes of transportation, for instance, have an effect on GHG emissions and contribute to climate change. However, such environmental consequences are difficult to discern, and knowledge about the issue may be limited. Even if consumers are aware of their environmental impacts, they may be unwilling to change their behaviors because they may perceive such change as being too costly or inconvenient. This thesis, therefore, aimed to examine pro-environmental behavior and investigate what people know about the environmental consequences of human actions. The present work also analyzed consumers’ willingness to act pro-environmentally and examined factors that might encourage individuals to change their behavior. The research focused on the subject of climate change and the environmental impact of food consumption.

The two studies presented in first part of the thesis dealt with consumers’ environmental knowledge. In Chapter 2, an extensive knowledge scale was developed to measure people’s understanding of climate change. The study further explored the relationship between climate-related knowledge and attitudes toward climate change. The second study, which is described in Chapter 3, analyzed consumers’ knowledge of the environmental friendliness of various food products. Consumers’ assessments were compared with LCA results as an objective measure of environmental friendliness.

The second part of the thesis focused on consumers’ willingness to act pro-environmentally. Chapter 4 examined consumers’ propensity to show climate-friendly behaviors and support climate mitigation measures. The study aimed to classify different ways of addressing climate change. Furthermore, it attempted to identify the influential factors for these diverse types of climate-friendly actions. The fifth chapter addressed consumers’ beliefs about ecological food consumption and their willingness to adopt such behaviors. The study additionally investigated how different motives and food-related attitudes influence consumers’ willingness to reduce meat consumption and buy seasonal fruits and vegetables.

In the following section, the central findings of this thesis are summarized and discussed. The subsequent section evaluates the studies conducted and provides suggestions for future research. The thesis ends with general conclusions and implications regarding the promotion of pro-environmental actions.
CHAPTER 6. GENERAL DISCUSSION

6.2 Central findings

The first part of this thesis examined consumers’ environmental knowledge because people must be aware of environmental problems and the potential actions that can ameliorate them in order behave pro-environmentally (Kaiser & Fuhrer, 2003). Following the model of ecological behavior (Fietkau & Kessel, 1981), consumers’ perceived benefits and consequences of ecological behaviors were examined in the second part. This seemed particularly worthwhile, as this aspect has often been neglected in past research.

Overall, the results of the presented studies suggest that consumers have an incomplete understanding of their environmental impacts. They also indicate that the perceived benefits of ecological behaviors are important factors that affect consumers’ willingness to act pro-environmentally. Furthermore, different pro-environmental behaviors seem to be influenced by dissimilar factors. These conclusions will be discussed in more detail in the following sections.

6.2.1 Consumers’ environmental knowledge is limited

The findings regarding consumers’ environmental knowledge were mixed. Participants seemed to be rather knowledgeable about some aspects of environmental issues, but oblivious to others. This could be found in both the climate change and food consumption domains.

On one hand, participants were quite well-informed about the issue of CO₂. Most of the respondents, for instance, knew that the atmospheric CO₂ increase is caused by human activities and that this increase is one of the main factors responsible for climate change. Thus, compared to past research (e.g., Diekmann & Meyer, 2008; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994), this level of understanding may have increased. Participants also showed high levels of action-related knowledge. On the other hand, items regarding other GHGs, such as methane, were more difficult for the respondents. As in other studies, many respondents were oblivious to the fact that the greenhouse effect is a natural process (Read et al., 1994; Reynolds, Bostrom, Read, & Morgan, 2010). A large number of the participants also believed the hole in the ozone layer was the main cause of the greenhouse effect, this finding being in line with past research (e.g., Bord, O’Connor, & Fisher, 2000; Bostrom, Morgan, Fischhoff, & Read, 1994; Dunlap, 1998; Leiserowitz, 2007; Read et al.,
Consumers’ knowledge about the environmental friendliness of food products also varied. In contrast to the LCA results, consumers mainly considered transport distance rather than the means of transportation. Furthermore, consumers seemed to overestimate the environmental harm of packaging and preservation. In line with this finding, participants believed that reducing waste by avoiding excessive packaging had the largest environmental benefit among all ecological consumption patterns. This tendency to overestimate the environmental impact of packaging is in line with past findings (Lea & Worsley, 2008; Van Dam, 1996). Furthermore, consumers seemed to be unaware of the environmental impacts associated with meat production and assessed reducing meat consumption as the least environmentally friendly of all consumption patterns.

Overall, these results substantiate the assumption that the perception of environmental issues is challenging for consumers. If consumers are able to experience the environmental consequences of their behavior, they tend to be more aware of it. For instance, consumers are well aware that the production of waste is environmentally harmful, probably because they personally experience the post-consumption of packaging when they have to dispose of it (Van Dam, 1996). However, more abstract and complex issues, such as climate change, cannot be experienced, and consumers must rely on information sources, such as the mass media or environmental organizations. As a result, individuals are aware of the information covered by these sources, but are oblivious to the facts neglected by them. For instance, media reports often highlight CO₂ as the most influential contributor to the greenhouse effect and climate change. Accordingly, consumers were quite knowledgeable regarding CO₂. Their level of knowledge regarding other GHGs was rather low, however. Similarly, environmental organizations mainly try to convey action-related knowledge in order to raise public awareness and engage people to address climate change, which might explain why respondents were rather knowledgeable in this domain. It is also possible that action-related knowledge is easier for most people to memorize since, unlike factual knowledge, it is related to their daily lives and is therefore more tangible.

In sum, the results emphasize the importance of information sources, such as environmental organizations or the mass media, in helping consumers acquire environmental knowledge. The messages they choose to convey are absorbed by the public, form their environmental knowledge and, consequently, affect their ability and willingness to address environmental issues.
6.2.2 Perceived benefits are important factors in consumers’ willingness to adopt ecological behaviors

Perceived benefits, both environmental and non-environmental, were powerful predictors of consumers’ willingness to act pro-environmentally. All ways of addressing climate change were strongly influenced by the perceived climate benefit of the respective behaviors or policies. The most influential motive for reducing meat consumption was the belief that it was beneficial for one’s health, whereas the better taste argument was the strongest motive for consumers’ willingness to eat seasonal fruits and vegetables. The results regarding perceived costs, however, were mixed. Whereas perceived costs and inconveniences decreased consumers’ willingness to address climate change, the argument regarding saving costs did not significantly influence their propensity to reduce meat consumption or to eat seasonal fruits and vegetables.

Overall, these findings indicate that it is important to consider how consumers perceive the benefits and consequences of ecological behaviors. This strongly supports the model of ecological behavior by Fietkau and Kessel (1981), which takes these two factors into account (see Section 1.5.1). The study examining consumers’ willingness to address climate change included three factors proposed by the model of ecological behavior, namely attitudes, the perceived benefits of climate-friendly actions and their perceived costs. Of these determinants, the perceived benefits generally seemed to be the most important predictor, except for mobility, followed by perceived costs. Attitudes, however, appeared to play a less important role for consumers in addressing climate change. This is in line with the suggestion that models postulating people make reasoned choices might be more appropriate for more costly or inconvenient behaviors than models focusing on moral obligations (Steg & Vlek, 2009). However, consumers’ possibilities to act, such as external or infrastructural barriers, were not included and might prove to be another important predictor.

The finding that climate benefits outweighed perceived costs as the most influential determinant for most types of climate-relevant actions is particularly noteworthy because respondents were directly affected by costs – in terms of inconveniences, loss of time, or financial costs – but not by the climate benefit. However, respondents’ perception of the climate benefits of different climate-friendly actions may not necessarily mirror the actual benefits. The public may have an incomplete understanding of which actions are most effective in terms of climate change mitigation. People appear to overestimate their
contribution to climate change mitigation, while underestimating the negative impact of their actions (Whitmarsh, 2009).

In sum, perceptions of environmental and non-environmental benefits seem to encourage consumers to act pro-environmentally. People, however, are not necessarily aware of which behaviors are most environmentally beneficial. Informing consumers about the relative environmental impacts and benefits of their actions, therefore, seems worthwhile and will be discussed in more detail in Section 6.4.2.

6.2.3 Consumers’ willingness to act pro-environmentally is dependent on specific behavior

As discussed in the previous section, the perceived benefits increased consumers’ willingness to engage in pro-environmental behaviors, both those related to climate change and nutrition. However, the presented studies also suggest that there are different types of actions, which are influenced by dissimilar variables.

The study examining consumers’ willingness to address climate change found that a distinction in terms of a behavior’s directness as well as a differentiation according to perceived costs seemed to be appropriate to classify climate-friendly actions. One type of climate-friendly action found was indirect behavior, namely actions that delegate climate-friendly activities to others, such as electing politicians committed to climate protection or donating money to climate protection projects. Direct behavior could be divided into (a) low-cost behaviors, mainly consisting of routine consumer behaviors, such as recycling paper or saving electricity, and (b) mobility, which included avoiding car use and flights and was perceived as more costly than the low-cost behaviors. Climate mitigation policy measures were split into (a) supportive measures, which enable climate-friendly actions (e.g., subsidies) that were rather low-cost, and (b) CO$_2$ restrictions that levy charges on CO$_2$ emissions (e.g., CO$_2$ taxes on heating oil or gasoline), which were perceived as more costly. The results support the recommendation of the VBN theory (see Section 1.5.2) to differentiate between the various types of pro-environmental behaviors (Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). In contrast to the VBN theory, environmental activism, such as participation in demonstrations and involvement in organizations, was not considered in the study. However, similar to the suggestions of Stern and colleagues, there was a distinction between direct and indirect behaviors. Indirect behaviors found in the presented study might be comparable to citizenship as proposed by the VBN theory.
However, in contrast to the proposed types of environmentally significant behaviors in the VBN theory, changes in behaviors and policy support were both split into low- and high-cost options. This indicates that perceived costs play an important role in classifying pro-environmental behaviors.

As consumers’ willingness to address climate change was divided into different types of climate-friendly actions, these might also be influenced by different determinants. As a matter of fact, among all ways of addressing climate change, mobility proved to represent a special case. In contrast to the other types of climate-friendly actions, the perception of costs and inconveniences was the strongest determinant of mobility behavior. Thus, perceived costs and inconveniences did prevail over perceived climate benefit as the most influential factor in that case.

Furthermore, concern about climate change increased consumers’ willingness to show climate-friendly low-cost behaviors and accept supportive climate policy. However, it did not significantly influence respondents’ willingness to adopt costlier and more inconvenient ways of addressing climate change, such as mobility, indirect behaviors, and CO₂ restrictions. This is in line with past research that suggested attitudes and environmental concerns influenced people’s indoor greenhouse gas reduction behaviors, such as turning off lights and recycling, but not their automobile greenhouse gas emissions (Ngo, West, & Calkins, 2009). These results substantiate the low-cost hypothesis, which postulates that lower costs ease the transformation of attitudes into the corresponding behavior (Diekmann & Preisendörfer, 2003). For behaviors involving higher costs or more inconveniences, environmental attitudes seem to be insufficient to overcome these barriers. Thus, environmentally concerned individuals tend to show low-cost behaviors, such as recycling, but do not necessarily engage in activities that are more costly or inconvenient, such as reducing driving or flying (Diekmann & Preisendörfer, 1998, 2003; Kollmuss & Agyeman, 2002).

Political affiliation has been identified as an important determinant with regard to climate-related attitudes and actions (Dunlap & McCright, 2008; Leiserowitz, 2006; O’Connor, Bord, Yarnal, & Wiefek, 2002; Zia & Todd, 2010). However, it did not have a significant effect on all types of climate-friendly actions. Participants on the right wing seem to be less willing to show indirect climate-friendly behaviors, change their mobility behaviors or support climate mitigation policy measures. Consumers’ willingness to adopt climate-friendly low-cost behaviors, however, was not influenced by political affiliation. Climate-friendly low-cost behaviors might include benefits that are not associated with climate
change. Saving energy or recycling waste, for instance, might help consumers save money. Thus, in contrast to the other types of climate-friendly actions, there seem to be several reasons for showing climate-friendly low-cost behaviors.

Even in the more homogenous domain of nutrition, consumers’ willingness to perform different ecological consumption patterns appears to be influenced by dissimilar factors. People’s propensity to eat seasonal fruits and vegetables was mainly influenced by the motive of taste and naturalness, whereas their willingness to reduce meat consumption was primarily influenced by health motives and gender (women being more willing to eat less meat).

Overall, these findings suggest that different types of actions are influenced by dissimilar factors. The conclusion, to some extent, contests the universal validity of models explaining general pro-environmental behavior. However, in line with the model of ecological behavior (Fietkau & Kessel, 1981), perceived costs and benefits played an important role in consumers’ willingness to address climate change. Therefore, it seems important to take such models into account in order to establish potential determinants. As suggested by Steg and Vlek (2009), however, different models may vary in terms of explanatory power when applied to different types of pro-environmental actions.

### 6.3 Evaluation of the studies and suggestions for future research

The present work examined consumers’ environmental knowledge and their willingness to act pro-environmentally. It thereby used different methods for data collection and analysis, which strengthened the results. However, the research also had some limitations, which will be addressed in the following sections. Furthermore, suggestions for future research will be provided.

In the present research project, two studies examined climate-related knowledge, attitudes and behavior. Both studies were based on the model of ecological behavior (Fietkau & Kessel, 1981), which assumes that knowledge affects environmental attitudes, which, in turn, influence pro-environmental behavior (see Section 1.5.1). Accordingly, the first study identified a relationship between knowledge and attitudes, whereas the second study investigated the influence of climate-related attitudes on willingness to act. However,
future studies might want to integrate all the variables into one study. Future research could test the relationships between knowledge, attitudes and willingness to act, as well as validate the model of ecological behavior by using structural equation modeling.

The first study developed an extensive climate-related knowledge scale. In this context, Mokken scale analysis proved to be particularly useful. The uniform ordering of items across subgroups of persons enables international comparisons of knowledge levels. Thus, future studies could test the climate-related knowledge scale, preferably with different populations, and identify differences in knowledge across countries. In addition, future studies might consider a further use of Mokken scale analysis for knowledge research.

In the second study, consumers’ environmental assessment of food products was compared to an objective measurement: the LCA results. Although the LCA methods appear to have some limitations (e.g., Ayres, 1995; Finnveden, 2000), it is the only tool available for comparing the environmental impact of products over their entire life cycle (Finnveden, 2000). Further comparisons of laypeople’s assessments with LCA results, for instance regarding other consumer goods, might yield additional insights into consumers’ knowledge and misconceptions about the environmental consequences of their actions.

The present research allowed several conclusions regarding which information might motivate consumers to act pro-environmentally (see Section 6.4). A suggestion for further research would be to determine whether additional information or labels would improve consumers’ environmental assessment. The findings also propose that highlighting the environmental and non-environmental benefits of pro-environmental behaviors might encourage consumers to change their behaviors. However, further experimental studies might examine whether such arguments are actually able to persuade people to change their behaviors.

Most of the research presented in this thesis was based on mail surveys, which implies several constraints. One limitation of this method is the possibility of self-selection bias. Persons particularly interested in the topic of the studies were more likely to participate in the survey than those indifferent to the subject. As a result, the samples were not entirely representative: men were overrepresented in the studies examining climate change, and there were more women in the studies dealing with food consumption. Such distortions in the samples might have impeded the representativeness of the results. Future studies might therefore consider using quota sampling for a more representative sample.

Another limitation of the surveys used in these studies was the measurement of self-
reported behaviors, which does not necessarily equal actual behavior. Participants’ indications of their behaviors might have been influenced by social desirability, and this might result in an over-reporting of their willingness to adopt pro-environmental behaviors. Similarly, respondents might have overstated their pro-environmental attitudes and motivations. To lower participants’ measures of social desirability to some extent, the surveys were conducted anonymously. However, self-reported behavior might also be biased by other distortions. For instance, consumers might report eating seasonal vegetables without actually knowing which vegetables are seasonal at a given time. Future studies might consider taking observations into account in order to measure consumers’ willingness to act ecologically.

Finally, the list of predictors and independent variables in the presented studies was by no means conclusive. For instance, including other behaviors or policies in the survey about climate change might have yielded different categories. Despite taking a variety of knowledge domains into consideration, there might also be other types of knowledge relevant to people’s climate-related actions (e.g., effectiveness knowledge, see Section 1.4.1). Thus, future studies might want to include additional determinants, such as norms or values, and measure a wider range of environmental knowledge or behaviors.

### 6.4 Conclusions and implications for promoting pro-environmental actions

Several implications for promoting pro-environmental behaviors can be concluded from the findings of the present thesis. These are discussed in the following sections.

#### 6.4.1 Enhancing consumers’ environmental knowledge

The results of the first two studies indicate that consumers lack environmental knowledge. The identification of such knowledge gaps is useful for educational material. Only after consumers’ misconceptions are identified can they be tackled through information campaigns.
Climate-related knowledge

There is a scientific consensus that the warming of the climate system is unequivocal and that human activities have contributed to climate change (IPCC, 2007). Consumers’ knowledge about these facts appears to be the most important factor influencing their attitudes regarding climate change. People who know more about climate change and its causes are less likely to believe that climate change is a fraud or that its consequences are exaggerated in the media. Generally, knowledge of climate change and its causes was most strongly related to climate-related attitudes, namely concern, skepticism, and feelings of powerlessness. Therefore, this type of knowledge should be given priority in climate education.

It also seems important not only to inform the public about scientific results, but also to illustrate the consensus among climate scientists and the certainty of these findings. As people often acquire climate-related knowledge from the media (Antilla, 2005; Kahlor & Rosenthal, 2009; Stamm, Clark, & Eblacas, 2000), it would probably be worthwhile to address journalists, as they often act as intermediaries between scientists and the public. It seems particularly important to inform journalists about the large body of research that led to the conclusions about climate change and its causes. Furthermore, it might be helpful if reporters were introduced to the meaning of scientific uncertainty.

Environmental knowledge about food consumption

Consumers must be able to identify ecological food products to develop environmentally friendly consumption patterns. The results of this work, however, demonstrate that consumers generally lack knowledge about the environmental consequences of various ecological food consumption patterns. Thus, information campaigns about this topic might be worthwhile. Future environmental education campaigns should focus on the most environmentally relevant consumption patterns. They should particularly highlight the environmental impacts associated with meat consumption, heated greenhouse production and air transportation. As the transport mode of products is usually not indicated, an indication of at least air transport would help consumers avoid such environmentally harmful products.

Nevertheless, even if consumers are given information about the environmental impacts of food consumption, assessing the ecological quality of food products remains challeng-
ing. Consumers, for instance, may lack knowledge about the seasonality of fruits and vegetables. Furthermore, if a product shows conflicting features (e.g., a regional vegetable produced in a heated greenhouse), consumers have to make tradeoffs, which is very difficult for individuals (Hammond, Keeney, & Raiffa, 2002). Thus, merely providing information about all environmentally relevant dimensions is probably insufficient. It might be the most promising option to indicate a product’s overall environmental friendliness in a simple and understandable way. A label based on LCA results, for instance, could facilitate ecological consumption. In fact, information about environmental impacts has been shown to influence product preference for consumers with moderate and strong environmental concerns (Grankvist, Dahlstrand, & Biel, 2004).

6.4.2 Highlighting the benefits of pro-environmental actions

Several results in this thesis point out the importance of perceived benefits in encouraging consumers to act pro-environmentally. Perceived benefits, in this context, refer to both environmental and non-environmental advantages. Consumers’ willingness to address climate change was influenced by the perceived climate benefits of the respective behaviors or policies. The belief that reducing meat was beneficial for one’s health increased participants’ propensity to eat less meat, whereas better taste motivated consumers to eat seasonal fruits and vegetables.

People communicating about climate change should refrain from using fear or guilt to convince people of the urgency of climate change (Moser, 2007; Moser & Dilling, 2004). Such appeals may evoke resentment, denial or apathy if no potential solutions are offered. Instead, communication about climate change should point out the effectiveness of the recommended actions and instruct the public about how they can feasibly reduce GHG emissions (Moser & Dilling, 2004; Ngo et al., 2009). In line with these recommendations, the findings of this research indicate that future communication should highlight the benefits of climate-friendly actions. On the one hand, emphasizing the climate benefits of climate-friendly actions represents a positive form of communication, which might be more successful in encouraging individuals to address climate change (Moser, 2007; Moser & Dilling, 2004). On the other hand, contributing to climate mitigation might also give people a feeling of control.

When communicating the benefits of addressing climate change, it seems particularly important to focus on costlier or more inconvenient types of climate-friendly actions. This
way, consumers can realistically estimate the consequences of their actions and set priorities accordingly to change behaviors. In this sense, such communications would enhance consumers’ effectiveness knowledge. Thus, consumers would, for instance, be reminded that avoiding flights has a greater impact on climate mitigation than recycling. However, lower-cost behaviors should not be dismissed as ineffective. The positive correlations of consumers’ willingness to show different types of climate-friendly actions indicate the possibility of a positive spillover. Accordingly, people who had adopted low-cost behaviors might also be willing to show climate-friendly actions associated with higher costs or inconveniences.

However, emphasizing the environmental benefits of ecological actions might not suffice to promote such behaviors. In fact, the reasons for engaging in several climate-related actions do not always seem to be connected to the environment. Saving electricity, for instance, might be motivated by the possibility of saving money (Whitmarsh, 2009). Some consumers, for instance right-wing voters, may not be encouraged by the climate benefit of changing their behaviors. Therefore, it might be more fruitful to relate environmental issues to concerns that are more of interest to them, such as the economic opportunities of technological innovation or the dependence on other countries for fossil fuels.

The importance of highlighting non-environmental benefits holds particularly true in the domain of food consumption. Environmental motives did not appear to be the strongest persuasion strategy to encourage ecological food consumption. In line with this finding, past studies indicated that most consumers mainly include taste and cost aspects in their food choices (e.g., Lennernäs et al., 1997; Magnusson, Arvola, Koivisto Hursti, Aberg, & Sjödén, 2001; Wandel & Bugge, 1997), but not necessarily environmental friendliness. However, consumers also appear to associate locally-produced food with a higher level of quality, particularly in terms of freshness and taste (Chambers, Lobb, Butler, Harvey, & Traill, 2007). Therefore, such additional non-environmental benefits could encourage consumers to change their food consumption patterns. In fact, the results of the fourth study indicate that it might be most beneficial to combine the arguments of better taste and environmental friendliness to promote the consumption of seasonal fruits and vegetables. Reducing meat consumption, however, might be best encouraged by emphasizing the health benefits and claiming that this consumption pattern prevents animals’ suffering.

In sum, different types of pro-environmental behaviors might be influenced by dissimilar factors. However, to promote all types of ecological actions, it seems promising to highlight both environmental and non-environmental benefits. Combining various motives might
address different concerns consumers may have, for instance concerns about their budgets or health. Furthermore, such positive information may be more fruitful than appeals to guilt or fear. It might, as well, counterbalance consumers' perceptions of costs and inconveniences.

References


Acknowledgments

This thesis marks the end of a journey and many people have supported me during the past three years. I would, therefore, like to take this opportunity to express my gratitude to everyone who contributed to this work.

The research project would not have been possible without Prof. Michael Siegrist, and I would like to thank him for his valuable guidance, feedback and advice. Furthermore, I am deeply grateful to Vivianne Visschers. I could not have wished for a better supervisor and I benefitted tremendously from her extraordinary support. I would also like to thank Prof. Heinz Gutscher for taking an interest in my work and for accepting to be my co-examiner.

The members of the Consumer Behavior research group supported me in numerous ways and I wish to thank them for everything. I am particularly grateful to my (past and present) office colleagues, Simone Dohle, Maria Dickson, Lasse Wallquist, Tamara Bucher, and Selma L’Orange Seigo, for creating such a pleasant and enjoyable working environment. I would also like to express my heartfelt gratitude to Rebecca Hess for being such a great friend, both during and outside of work.

Finally, I would also like to thank my family, and my father in particular, for their constant support and encouragement. Last, but not least, I am deeply grateful to Martin for his endless love and support. Thank you for being my rock.