AN EXAMINATION OF BARRIERS TO CONSUMERS' CLIMATE ACTION – IMPLICATIONS FOR ENHANCED CLIMATE CHANGE COMMUNICATIONS

Jyväskylä University
School of Business and Economics

Master's Thesis

2021

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ABSTRACT

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Title
An examination of barriers to consumers' climate action – Implications for enhanced climate change communications

Discipline	Type of work
Corporate Environmental Management	Master's thesis
Date	Number of pages
05/2021	78 pp + 5 pp

Abstract

As the threats presented by human-induced climate change have been recorded in increasing volume and detail, the need to engender public engagement has become more urgent. While not sufficient on its own, voluntary mitigation by consumers adopting climate-friendly lifestyle choices presents a prospect for immediate and substantial greenhouse gas savings. Consequently, understanding consumers' perceptions of climate change as well as their drivers and barriers for action is integral for effectively responding to the challenge. As part of a climate change communications thesis project commissioned by Climate Communications Studio Oy, this master's thesis sets out to investigate the prevailing perceptions and barriers experienced by Finnish university students, and the implications the results hold for enhancing climate communications.

The primary aim of the research is to further the understanding of various barriers to consumers' climate action, while the secondary aim is to explore the general climate awareness and consumption-related climate action of Finnish university students. Specific research objectives relating to climate action, knowledge, perceived risk, and perceptions of powerlessness are formed based on preliminary literature review. The study is approached through a quantitative survey carried out as an online questionnaire in spring 2021.

The results hold several implications for climate change communications. Most significantly, the research establishes the need to enhance communication about the relative effectiveness of different climate actions, with focus on high impact measures. The importance of climate change risk communication is affirmed and it is suggested to give focus to geographically and temporally relevant threats. Evidence is also presented to support the positive correlation between perceived powerlessness and the commons dilemma, and recommendations are offered on how these psychological barriers can potentially be alleviated by targeted climate communications.

Key words
Climate change, climate communications, barriers to action, consumer behavior, risk perception, climate knowledge, perceived powerlessness

Place of storage
Jyväskylä University Library

TIIVISTELMÄ

Tekijä
Veera Natunen

Työn nimi
Tutkimus esteistä kuluttajien ilmastotoimille – Päätelmiä ilmastoviestinnän tehostamiseksi

Oppiaine	Työn laji
Corporate Environmental Management	Pro gradu -tutkielma
Päivämäärä 05/2021	Sivumäärä 78 s + 5 s

Tiivistelmä

Samalla kun ihmisen aiheuttamasta ilmastonmuutoksesta johtuvat uhat on dokumentoitu yhä enenevässä määrin ja yhä tarkemmin, kansalaisten osallistamisesta on tullut yhä kiireellisempää. Vaikka ei yksistään riittävää, kuluttajien tietoisesti valitsemat ilmastoystävälliset elintavat tarjoavat mahdollisuuden välittömiin ja huomattaviin kasvihuonekaasuvähennyksiin. Tästä johtuen kuluttajien ilmastonmuutosta koskevien näkemysten sekä heidän toimintansa vaikutinten ja esteiden ymmärtäminen on ensiarvoista, jotta haasteeseen voidaan vastata tehokkaasti. Osana Climate Communications Studio Oy:n toimeksi antamaa ilmastoviestinnän tutkielmahanketta, tämä Pro gradu -tutkielma tarkastelee suomalaisten yliopisto-opiskelijoiden vallitsevia käsityksiä ja heidän kokemiaan esteitä sekä näistä johdettavia päätelmiä ilmastoviestinnän tehostamiseksi.

Tutkimuksen päätarkoituksena on edistää ymmärrystä erilaisista esteistä kuluttajien ilmastotoimille, kun taas toissijaisena tarkoituksena on kartoittaa suomalaisten yliopisto-opiskelijoiden yleistä ilmastotietoutta ja kulutukseen liittyviä ilmastotoimia. Tarkemmat tutkimustavoitteet liittyen ilmastotoimiin, -tietoon, riskinkäsityksiin ja koettuun voimattomuuteen luodaan alustavan kirjallisuuskatsauksen perusteella. Tutkimusta lähestytään kvantitatiivisella tutkimuksella, joka toteutettiin verkkokyselynä keväällä 2021.

Tutkimuksen tuloksista on johdettavissa useita ilmastoviestintää koskevia päätelmiä. Merkittävimpänä tutkimus osoittaa tarpeen tehostaa viestintää eri ilmastotoimien suhteellisesta tehokkuudesta keskittyen toimenpiteisiin, joiden vaikutukset ovat suurimmat. Tutkimus vahvistaa osaltaan ilmastonmuutosriskiviestinnän tärkeyden ja tuloksiin pohjaten ehdotetaan, että huomiota kohdistetaan maantieteellisesti ja ajallisesti merkityksellisiin uhkiin. Tutkimus antaa myös näyttöä koetun voimattomuuden ja yhteismaan dilemman välisestä positiivisesta korrelaatiosta ja tuloksiin perustuen tarjotaan suosituksia siihen, miten näitä psykologisia esteitä voidaan mahdollisesti lievittää kohdennetun ilmastoviestinnän avulla.

Asiasanat
Ilmastonmuutos, ilmastoviestintä, ilmastotoimien esteet, kulutuskäyttäytyminen, riskinkäsitys, ilmastotieto, voimattomuus

Säilytyspaikka
Jyväskylän yliopiston kirjasto

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1 INTRODUCTION

As part of a climate change communications thesis project commissioned by Climate Communications Studio Oy, this master's thesis sets out to investigate the prevailing perceptions and barriers to climate action experienced by Finnish university students, and the implications the results hold for enhancing climate communications. The thesis begins with a background review introducing the pressing matter of climate change, what part consumers play in it, and why research for better communication strategies is needed. Next the specific research aims and objectives of the study are justified based on existing literature, and the structure of the thesis is presented in the last section of this introductory chapter.

1.1 Background

Global climate change poses an unprecedented threat and challenge to the populations of the world. While the Earth's changing climate is not a new phenomenon nor unnatural one, the current pace and effects are predominantly caused by human activities (e.g. Gifford et al., 2011) – a fact that is supported by a robust scientific consensus that has been increasingly present among climate scientists for at least 30 years (Cook et al., 2016). The major greenhouse gases (GHGs) contributing to climate change emitted from anthropogenic sources include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (Liu & Wu, 2017). In 2018 the Intergovernmental Panel on Climate Change (IPCC) published a special report calling for greater and immediate global action to curtail GHG emissions and limit global warming to 1.5 °C above pre-industrial levels – as opposed to the limit of 2 °C already proposed before – with premonitory projections of expected impacts should this goal not be met (IPCC, 2018). The report informs that the rise in mean global temperature is likely to reach 1.5 °C as soon as between 2030 and mid-century if the present warming rate continues. The increased mean global temperature and related disruptions in climate patterns threaten biodiversity and present humans with a growing array of physical, psychological, and economic threats including heat-related mortality and diseases, critically reduced food and water security, mass population displacement, and disruption of infrastructure systems and crucial services (IPCC, 2014).

Consumers play a central role in the high-stakes emissions scene. Public opinion records reveal that climate change is generally regarded as a significant challenge and even suggest that a majority of the global population identify it as a very serious problem (Stokes et al., 2015). Global GHG levels have however only continued to increase during the past three decades (International Energy Agency, 2019). There is a widespread understanding that stepping up to the challenge will require tough social, political, and individual decisions (Lorenzoni & Pidgeon, 2006). Members of the public have two primary and complementary

roles to play – firstly, as voters giving support to policy interventions pursuing GHG reductions and secondly, as consumers making lifestyle choices that cut down their carbon footprints (Rosentrater et al., 2013). Furthermore, consumers influence technological and economic development as well as emissions patterns through demand of products and services, thus holding potential to act as either drivers of decarbonization or enablers and accelerators of emissions generation (Dubois et al., 2019). By way of purchasing power consumers may demand suppliers to alter their production processes to alleviate pressure on the climate and the environment in general (Yu et al., 2017). For example, a study by Long et al. (2016) notes that consumers concerned with sustainable agro-food sourcing can act as a significant driving force for the implementation of climate-smart agriculture technology further up in the supply chain.

Research lends evidence to the magnitude of emissions linked with household-demand globally and in Finland. Analysis by Hertwich and Peters (2009) accounts 72%, and an environmental impact assessment by Ivanova et al. (2016) attributes over 60% of global GHG emissions to household consumption. The remainder was quoted as generated from investments and government consumption. Similar findings have been documented in Finland, as Seppälä et al. (2009) assessed Finnish households to be responsible for 68% of greenhouse gases emitted from final consumption in the country, and in 2015 the corresponding figure was 66% according to the Finnish Environment Institute (2020). Therefore unsurprisingly, climate-related consumer choices are said to be at the core of climate change (Gifford et al., 2011). Although on a global scale the contribution of an individual consumer is generally minor (Rosentrater et al., 2013), it holds momentous impact in the cumulative when numerous individuals act in a similar manner (Stern, 2000). Consequently, collective action to address climate change is called for from consumers, particularly from those in developed countries (Rosentrater et al., 2013). Globally, the average carbon footprint for a person is around 4 tons CO_2e (Scholes et al., 2015), while in Finland approximately 10.3 tons CO_2e (Mänty & Hietaniemi, 2019). Although smaller than for example that of an American or Australian, the carbon footprint of a Finnish consumer is on the high end of Europe (Salo & Nissinen, 2017). According to the Finnish Climate Change Panel (2020), the carbon footprint of Finnish households needs to be reduced by 70% in order to reach the national emissions reduction target of 2030 and to be on track for limiting global warming to the goal of 1.5 degrees set in the Paris Agreement.

Consumers can reduce their carbon footprint through behavior and product choices (Liu & Hao, 2020), which include altering the amount of consumption and changing consumption patterns (Dubois et al., 2019). Certain consumption choices such as avoiding meat and refraining from air travel present the opportunity for immense GHG savings (Cafaro, 2011). Indeed, research by Dubois et al. (2019) indicates that carbon footprints of (Northern and Western) European households are mainly dominated by car and plane travel, dairy and meat consumption, and heating. Climate-conscious food choices in general posit significant potential for GHG emissions reductions (Camilleri et al., 2018).

Enhanced communication strategies are needed to engender meaningful action. Although there seems to be a growing awareness among consumers that effective management of climate change requires lifestyle changes (von Borgstede et al., 2013), consumption patterns need to be led to a more climate-friendly direction as the necessary integral changes in consumer behavior are still mostly missing (Thaller et al., 2020; Yu et al., 2017). While not sufficient on its own, voluntary mitigation by consumers adopting climate-friendly lifestyle choices presents a prospect for immediate and substantial GHG savings – given that consumers are acceptive and responsive to messages encouraging these behavior-changes (Semenza et al., 2008). Evidence however indicates that the prevailing ways of communicating climate change and relevant actions to the public have in fact not been effective and research is needed to improve climate communications in different cultural contexts (Stoknes, 2014).

1.2 Justification and aims of the study

The present study is part of a project led by Climate Communications Studio Oy. Climate Communications Studio Oy, operating in the sector of research and experimental development on social sciences and humanities, was established in Jyväskylä in 2020 (Finnish Business Information System, n.d.) as a response to a need for enhanced climate change communications recognized by the founder. The company initiated a climate communications thesis project, commissioning three master's theses to examine the topic of climate change communications from slightly differing angels of the students' choosing. Motivated by the background reviewed above and developed based on research gaps identified through preliminary literature review, the research aims and research objectives of the present study are next described.

Communicating climate messages more effectively requires a foundation of valid empirical research. One key direction is to advance theoretical knowledge about people's barriers to engaging with climate action. Due to the central role households and consumers at the individual level hold for climate change mitigation, there is a crucial need to better understand the factors that influence climate-related consumption choices. In response to this need, the primary research aim (A1) of this thesis is to further the understanding of various barriers to consumers' climate action. The secondary research aim (A2) is to explore the general climate awareness and consumption-related climate action of Finnish university students. This potentially allows for detection of subject areas that call for targeted climate communication efforts and answers the request for more insight on the individual actions specific segments of the population (are able to) take. Throughout this thesis the term climate action is used to refer to the consumption-related actions and behavioral changes consumers adopt to mitigate climate change. The choice of barriers to climate action that are in the focus of this study – risk perception, knowledge, and perceived powerlessness – were

carefully selected based on gaps identified in scientific literature and their relevance to climate change communications. The primary research aim is further divided into three specific research objectives that revolve around these concepts and are introduced next.

The first research objective concerns the interplay between three elements: perceived risk, knowledge, and climate action. The reasons for this are threefold. Firstly, existing literature points to the need for further investigation of the role of climate change risk perception as a barrier to climate action. In particular, although measures of risk perception have been found to affect consumers' intentions for behavioral change, more efforts are needed to capture information on actual mitigation decisions. Secondly, a number of studies have sought to clarify the relationship between consumers' knowledge and climate action, with largely ambivalent results. Due to the diverging findings the need to consider different types of climate knowledge has been suggested. The current study proposes a novel approach of distinguishing five dimensions of knowledge when examining consumers' climate action. Thirdly, the research field refers to the need for further examination of the relationship between different forms of knowledge and climate change risk perception, as understanding these links is valuable for climate communicators attempting to raise necessary awareness and concern for the climate. Therefore, based on these paucities in literature, the first research objective (RO1) is to examine the relations between different types of self-reported knowledge, perceived risk, and self-reported climate action.

The second objective seeks to broaden understanding of the connection between consumers' knowledge and feelings of powerlessness in the context of climate change. How climate change is communicated to the public has a critical role in influencing not only the level of concern for the issue but also individuals' perceived power to make a difference. Feelings of powerlessness have been identified as a barrier to consumers' climate action, but more insight is needed as to how these perceptions could be avoided or reduced. As there is initial evidence suggesting that different types of climate change knowledge may impact views of powerlessness differently, the second research objective (RO2) is to examine the relation between different types of self-reported knowledge and the perception of powerlessness as a barrier to consumers' climate action.

The third research objective is formed to take a comparative look at different impediments to climate-friendly consumption behavior. Existing research has identified a multitude of potential barriers, but less data exists regarding which of them are felt the strongest in general or which stand out in specific population segments. Therefore, the third and final research objective (RO3) is to examine how perceived powerlessness compares to other barriers to consumers' climate action. In summary, the research aims and objectives of the study are the following.

A1: to further the understanding of various barriers to consumers' climate action through three main objectives:

- *RO1: to examine the relations between different types of self-reported knowledge, perceived risk, and self-reported climate action;*

- *RO2: to examine the relation between different types of self-reported knowledge and the perception of powerlessness as a barrier to consumers' climate action; and*

- *RO3: to examine how perceived powerlessness compares to other barriers to consumers' climate action.*

A2: to explore the general climate awareness and consumption-related climate action of Finnish university students.

1.3 Structure of the thesis

The master's thesis is comprised of five sections and is structured as follows. After this introductory chapter, the second section covers theory and existing research on barriers to climate-friendly consumer behavior, based on which the hypotheses of the current study are developed. In addition to risk perception, knowledge, and powerlessness, the literature review gives focus to the commons dilemma barrier due to previous research indicating that although conceptually distinct, powerlessness and the commons dilemma tend to overlap in consumers' thinking. The third section of the thesis presents the applied methodology of the study: a quantitative approach utilizing the survey research method and an online questionnaire. The chosen quantitative methods of data collection and analysis are explained, and key ethical considerations are reviewed prior to the next section, in which the results of the study are presented. The fifth and final section discusses the main findings and contributions of the study, and considers the implications the results hold for improved climate change communications. In addition, the soundness of the study is evaluated and directions for further research are proposed in the closing chapter. Supplementary material include the survey items at the end of the thesis.

2 BARRIERS TO CONSUMERS' CLIMATE ACTION

Through a literature review, this chapter takes under examination potential barriers between consumers and climate-friendly consumption behavior. After a brief overview of the multitude of barriers identified in research literature, focus is shifted to the particular impediments central to the present study, beginning with risk perception. The following sub-chapter on knowledge and climate action proposes the importance of considering five dimensions of knowledge, each of which is introduced in relevance with existing research findings. In addition, the relation between knowledge and risk perception is explored in this sub-chapter. Next perceived powerlessness, central to the second and third research objective, is introduced. The related concept of the commons dilemma is covered in the final sub-chapter of this section. In addition, the four hypotheses of the study are formulated and introduced following the reviewed literature in this second section of the thesis.

2.1 An overview of barriers identified in literature

In an attempt to understand the public's limited engagement with climate change mitigation, research investigating barriers to action has emerged in increasing volumes during the past two decades. Skepticism – doubting the existence or severity of the problem – inherently restricts the will to participate in alleviative climate action and has been documented as a key impediment (Lorenzoni et al., 2007; Semenza et al., 2008). However, even when consumers acknowledge the threat of climate change, there are various factors that may act as barriers for voluntary mitigative action. Recent years have seen a bulk of research dedicated to identifying these impediments. Table 1 displays a variety of such barriers revealed through literature review and grouped into categories according to themes that emerged: cognitive factors, losses and limitations, and social elements. As it is not viable or conducive to examine all of them in more detail, the present study focuses on the cognitive barriers of risk perception, knowledge, and powerlessness due to the research gaps introduced earlier in the thesis and their centrality to climate change communications. The social element of the commons dilemma is also included to better understand its relationship with perceived powerlessness; enhanced understanding of such barriers to involvement is needed for targeted communication strategies addressing these obstacles (Jones et al., 2017; Lacroix & Gifford, 2017). Next the significance of perceived risk is taken under examination by review of existing research.

TABLE 1 Summary of barriers to climate action identified in literature

Category	Barrier	Sources

Cognitive factors	Feelings of hopelessness	Lorenzoni et al. (2007); Quimby & Angelique (2011); Semenza et al. (2008)
	Feelings of powerlessness	Aitken et al. (2011); González-Hernández et al. (2019); Lorenzoni et al. (2007); Quimby & Angelique (2011); Stoll-Kleemann et al. (2001)
	(Lack of) knowledge	Aitken et al. (2011); González-Hernández et al. (2019); Lorenzoni et al. (2007); Semenza et al. (2008); Shi et al. (2015)
	Perception of intangibility	Lorenzoni et al. (2007); Stoll-Kleemann et al. (2001); Whitmarsh (2008)
	Personality traits	Brick & Lewis (2016)
	Personal values	Corner et al. (2014); Gifford et al. (2011)
	Risk perception	Aitken et al. (2011); González-Hernández et al. (2019); Kellstedt et al. (2008)
	Worldviews	Shi et al. (2015)
Losses and limitations	Financial constraints	González-Hernández et al. (2019); Mäkiniemi & Vainio (2014); Quimby & Angelique (2011); Saikku et al. (2017)
	Perceived costs	Mäkiniemi & Vainio (2014); Tobler et al. (2012)
	Perceived loss of comfort and freedom	Stoll-Kleemann et al. (2001)
	Structural deficits	González-Hernández et al. (2019); Lorenzoni et al. (2007); Quimby & Angelique (2011); Thaller et al. (2020)
	Time constraints	Quimby & Angelique (2011); Saikku et al. (2017)
	Unavailability of products	Mäkiniemi & Vainio (2014)
Social elements	Distrust in information sources	Lorenzoni et al. (2007)
	Externalizing responsibility and blame	Lorenzoni et al. (2007); Stoll-Kleemann et al. (2001)
	Habits and routines	Lorenzoni et al. (2007)
	Lack of social capital	González-Hernández et al. (2019); Quimby & Angelique (2011); Saikku et al. (2017)
	Social norms	Lorenzoni et al. (2007)
	Socio-demographic characteristics	González-Hernández et al. (2019); Thaller et al. (2020)
	The commons dilemma	Aitken et al. (2011); Lorenzoni et al. (2007); Quimby & Angelique (2011); Stoll-Kleemann et al. (2001)

2.2 Risk perception

The impression individuals form of a particular hazard that may be harmful for human life or property is regarded as risk perception (Bradford et al., 2012). Slovic et al. (1986) describe these perceptions as the subtle and complex opinions people have about risk events, influenced by psychological, social, and institutional factors. Consequently, risk information is processed by people in different ways – e.g. accepted, feared, ignored, or amplified – depending on the environment and characteristics of the individual (Leiserowitz, 2006). There is thus a common detachment between the way scientists and the public perceive risks (Bradford et al., 2012), with the latter demonstrating subjective views in contrast to the generally objective scientific assessments (Kellstedt et al., 2008). Understanding risk perception is of paramount importance for risk management (Wu et al., 2020), as risk perceptions of the public have the ability to significantly encourage or inhibit economic, political, and social response to risks in question (Leiserowitz, 2006). Indeed, public concern has been recognized as a driving force of great potential to increase consumers' willingness to alter their behaviors and support policies (Shi et al., 2015).

Insight regarding laypeople's perceptions of risk is particularly relevant in the context of climate change. Studies examining public risk perception of climate change generally describe perceived risk as the belief that climate change will likely lead to adverse effects (Rosentrater et al., 2013). Concern about climate change is regarded as an important precondition for participating in climate action (Thaller et al., 2020) and risk perception plays a key role in individuals' choice of climate change mitigation strategies (Yuan et al., 2017). Furthermore, consumers' perceptions of the risks involved with climate change have an integral effect on whether climate policies such as taxes and regulations are greeted with resistance or support from the public (Leiserowitz, 2006). Consequently, the importance of understanding consumers' perceptions of climate change is evident (Shi et al., 2015).

Literature indicates that consumers tend to view climate change as an abstract and distant issue (Yu et al., 2017). An analysis from 2006 reviewing fifteen years of studies on public views of climate change concluded that despite widespread awareness and concern about the issue, climate change largely persists as a risk perceived psychologically distant both geographically and temporally (Lorenzoni & Pidgeon, 2006). More recent literature concurs that while climate change is vastly regarded as a serious problem among the publics of the world, personal concern tends to be considerably lower (Stokes et al., 2015; Tvinnereim et al., 2020; van der Linden, 2017). Research by Lee et al. (2015) spanning 119 countries reveals this to be the case predominantly in developed nations. For example, Austrian respondents in a recent study by Thaller et al. (2020) evaluated climate change as a greater threat for humanity in general as well as for plants and animals, in comparison to personal concern. Furthermore, despite Australia being vulnerable to, and already feeling many adverse effects of climate change

(Parise, 2018), a study by Perera and Hewege (2018) found that young Australian adults seem to perceive climate change as a distant, non-local problem unrelated to their everyday lives. Reasons identified for this were a lack of personal experience with climate change, a reluctance to engage, and a lack of awareness that local adverse impacts on the environment, when relevant, resulted from climate change. The respondents based their perception of climate change risk primarily on the negative consequences resulting from climate change in other nations. Similarly, Leiserowitz (2006) found that the climate change risk perceptions of the American public appear to predominantly derive from the perceived threat to geographically distant populations, places, and nature.

Perceiving climate change as a significant risk has been repeatedly identified to increase the likelihood or willingness of consumers to partake in alleviative climate action, whereas low risk perception can act as a barrier for behavioral change (Elrick-Barr et al., 2016; Hidalgo & Pisano, 2010; Hu & Chen, 2016; Krosnick et al., 2006; O'Connor, Robert et al., 1999; O'Connor, Robert E. et al., 2002; Williams, M. N. & Jaftha, 2020). For example, Bord et al. (2000) found that Americans who perceived higher societal risk of global warming were more likely to have behavioral intentions to act in its alleviation. A study by Aitken et al. (2011) identified perceived risk - as in the seriousness and urgency of the issue – to be the strongest predictor of New Zealanders taking action against climate change. Jakučionytė-Skodienė and Liobikienė (2021) recently analyzed the relation between consumers' concern about climate change and their climate-protective actions taken based on data from an EU-wide survey. The findings indicate that perceiving climate change as a serious threat significantly and positively predicts low-cost actions (but not high-cost ones). Brody et al. (2012) found that respondents evaluating greater personal risks from climate change showed more willingness to adopt climate-protective behaviors. In addition, findings from Smith and Mayer's (2018) study surveying 35 nations provide evidence that in general, people perceiving climate change as a threat to their country are more amenable toward climate-friendly behavior. To further validate the relationship between risk perception and consumers' climate action, the present study proposes its first hypothesis as the following:

- H1: Respondents demonstrating higher levels of climate change risk perception are likelier to report having changed their behavior to mitigate climate change.

2.3 Knowledge

2.3.1 The role of climate change knowledge and its dimensions

One reason for consumers' inaction in climate change mitigation may simply be a lack of sufficient knowledge (González-Hernández et al., 2019). The knowledge deficit model is an early ecological behavior model that assumes the public is

disengaged due to ignorance and that dissemination of information will progressively lead to ecological concern and action (Irwin, 1995). Many climate change communication approaches are based on this model (Aitken et al., 2011), although it has faced much criticism in later times (Gifford et al., 2011; Taddicken et al., 2018). Literature gives indication that receiving information about an ecological problem leads to a higher level of knowledge and a greater likelihood to act (Milfont, 2012). However, a better understanding does not necessarily translate to altered behavior (Milfont, 2012; Rosentrater et al., 2013).

The existing body of research is rather ambivalent regarding the relationship between laypeople's climate change knowledge and climate action. While some studies have found little to no relation between knowledge about climate change and climate-protective behavior (Brody et al., 2012; Whitmarsh & O'Neill, 2010), other findings suggest that knowledge increases the willingness to cut GHG emissions (O'Connor et al., 2002) or even identify it as the strongest predictor of voluntary mitigation action (Bord et al., 2000). Research by Lorenzoni et al. (2007) discovered a lack of climate change knowledge to be a key barrier for consumers to engage with climate action, and Aitken et al. (2011) identified a significant but weak correlation between how informed consumers felt about climate change and self-reported action to mitigate the issue. A more recent study by Thaller et al. (2020) found that participants with greater knowledge about climate change were more likely to participate in social climate-protective activity, while the same effect was not observed for climate citizenship or consumption-related conservation behavior. Despite the ambiguity of to what extent climate change knowledge influences mitigative action among consumers, there appears to be a vast understanding that knowledge is a necessary prerequisite, although insufficient motivator for climate-related behavior change (Gifford & Nilsson, 2014; Rosentrater et al., 2013; Tobler et al., 2012).

The concept of knowledge is not unidimensional and can be approached in more than one way. The varying research evidence concerning the link between climate change knowledge and climate action may be affected by the array of other potential barriers for action, depending on which factors were included in the study. Another explanation for differences may be found in the type of knowledge under scrutiny. How knowledge is measured varies, and few studies take into consideration different dimensions of climate change knowledge (Taddicken et al., 2018). However, different knowledge dimensions exist and understanding their differences and synergies is likely to be beneficial.

Literature discerns three types of environmental knowledge: system knowledge, action-related knowledge, and effectiveness knowledge (Frick et al., 2004; Kaiser & Fuhrer, 2003). These are based on the notion that in order for an individual to purposely act on an environmental issue, it is not enough to merely be aware of the problem, but also possess knowledge of the behavior choices available, and to know which of them would be most effective for addressing the particular concern (Hines et al., 1987). Consequently, the present study suggests that all three types of knowledge should be considered when examining climate change knowledge as a barrier for climate action. Furthermore, literature has distinguished three forms of system knowledge (Shi et al., 2015; Tobler et al., 2012).

As there is evidence that different types of system knowledge may influence climate-related attitudes and actions differently (Shi et al., 2015), this thesis further proposes that these three dimensions of system knowledge should be distinguished by side of action-related knowledge and effectiveness knowledge.

A review of relevant literature suggests that the approach at hand is a novel one. Research pertaining to voluntary climate change mitigation has most often examined either one or two types of system knowledge (Bord et al., 2000; Brody et al., 2012; O'Connor et al., 2002). Studies by Shi et al. (2015) and Tobler et al. (2012) included all three forms of system knowledge in addition to action-related knowledge but omitted separate effectiveness-knowledge. Although not directly concerning climate action, a recent study by Ratinen and Uusiautti (2020) examined young Finnish students' causal climate change knowledge and action-related "mitigation knowledge" in relation to their perceptions of hope. Also recently, Loy et al. (2020) investigated the relation between German consumers' informational self-efficacy and their climate-related knowledge and behavior. The authors examined system knowledge and behavioral knowledge. System knowledge included elements from all three dimensions, but they were not analyzed separately, and behavioral knowledge was intended to include elements of both action-related and effectiveness knowledge, but the latter items were excluded due to a programming mistake. In research concerning another environmental problem – water issues – Liefländer et al. (2015) assessed system knowledge, action-related knowledge, and effectiveness knowledge. However, the authors did not differentiate between types of system knowledge. In conclusion, the comprehensive incorporation and separate examination of knowledge dimensions suggested in the present study (Figure 1) appears to be a novel approach, particularly in the context of examining knowledge as a barrier to climate action.

FIGURE 1 Model of relevant climate change knowledge dimensions to be examined as argued by this thesis

2.3.2 Three dimensions of system knowledge

System knowledge – also known as declarative knowledge (Kaiser & Fuhrer, 2003) or factual knowledge (Tanner & Kast, 2003) – refers to basic scientific information, such as knowledge about ecosystem processes or ecological problems (Frick et al., 2004). Essentially, it addresses knowing *what* (Milfont, 2012). The

connection between greenhouse gases and climate change is a characteristic example of system knowledge (Frick et al., 2004). As this type of knowledge includes definitions, causes, and consequences of an environmental problem (Tanner & Kast, 2003) it can further be divided into the subcategories of physical knowledge, causal knowledge, and result-related knowledge (Shi et al., 2015). In the context of climate change, physical knowledge refers to knowledge about GHGs and the greenhouse effect, causal knowledge to understanding of the causes of climate change – such as the extent of human-induced and natural variances – and result-related knowledge to knowledge about consequences such as effects to the sea, precipitation patterns, and human health (Shi et al., 2015; Tobler et al., 2012).

Research findings relating to the different dimensions of system knowledge and climate action vary. Consumers tend to give less value to basic climate science than to how climate change will impact them and how it can be addressed (Somerville & Hassol, 2011). For example, Shi et al. (2015) found no relation between physical knowledge and respondents' willingness to alter behavior to alleviate climate change. The roles of causal and result-related knowledge remain somewhat unclear as former research has produced varying results. Hidalgo and Pisano (2010) studied the relation between knowledge about the causes of climate change and respondents' intentions to take mitigative action and did not find any significant correlation between the two. Earlier studies by Bord et al. (2000) and O'Connor et al. (2002) on the other hand identified causal climate change knowledge to be a strong predictor of behavioral intentions to reduce GHG emissions. In addition, according to research by Heath and Gifford (2006) among Canadian, and Vainio and Paloniemi (2013) among Finnish consumers, attributing climate change to man-made causes is a significant predictor of willingness to engage in climate action. Similarly, Aitken et al. (2011) and recently Williams and Jaftha (2020) found that consumers who perceived climate change to be caused by human influence were more likely to report having taken action.

A couple of studies have investigated the relation between both causes and results of climate change and climate action and have come to differing conclusions. O'Connor et al. (1999) discovered both knowledge dimensions to act as a significant independent predictor of intentions to mitigate climate change, whereas Brody et al. (2012) studying factors influencing the willingness of U.S. residents to adopt mitigation behaviors found no relation between knowledge about the causes and effects of climate change and motivation for behavioral change. Interestingly, the study by Shi et al. (2015) investigating four knowledge types – three system dimensions and action-related knowledge – identified a small but negative correlation between result-related knowledge and the willingness to alter behavior for the benefit of the climate. The authors suspect that high awareness of the negative consequences of climate change may lead to a feeling of powerlessness, which can diminish the will for action. The varying results of existing research indicate that further investigation is needed to understand the relations between different types of system knowledge and consumers' climate action.

2.3.3 Action-related knowledge

Action-related knowledge – also referred to as procedural knowledge (Kaiser & Fuhrer, 2003) – refers to knowing *how* to mitigate an (environmental) issue; understanding which courses of action are available to potentially alleviate the problem (Liefländer et al., 2015; Milfont, 2012). While in the lines of system knowledge consumers may be aware that carbon dioxide contributes to climate change, they may still lack knowledge of behavioral options that lessen these emissions (Frick et al., 2004). Such action-related knowledge can refer to both information that has direct pertinence to action – e.g. driving one's car less reduces CO_2 emissions – as well as information with indirect relevance that has the potential to affect consumer decisions – e.g. gray energy is energy spent in goods before they reach the end-consumer (Frick et al., 2004). Tobler et al. (2012) suggest that due to its proximity in everyday life, action-related knowledge is more concrete and easier for people to remember compared to factual knowledge. However, individuals must first acquire the information from somewhere. Birkenberg et al. (2021) note that unless consumers are made aware of the carbon intensity of goods such as coffee, they may assume them to be "natural products" that do not produce GHG emissions and thus will not consider opting for a low carbon alternative.

The significance of the relation between action-related knowledge and individuals' climate action has been recognized through several studies of empirical research. In an investigation by Semenza et al. (2008) a lack of knowledge of what actions could be taken was the most common reason quoted by respondents who had not changed their behavior to mitigate climate change. Rather similarly, participants of the study by Aitken et al. (2011) examining New Zealanders' perceived barriers to climate action evaluated uncertainty of options as the factor most influential for their (in)action. The related questionnaire items inquired about a lack of knowledge concerning potential mitigative actions one could take, and uncertainty about the best, most effective option to mitigate climate change, thus calling attention to the need for both action-related and effectiveness knowledge. Adding to previous research, the study by Shi et al. (2015) found that climate related action knowledge has a positive correlation with the willingness to alter behavior, implying that greater knowledge of climate-friendly actions translates to a higher likelihood of behavior change.

Action-related knowledge surfaces in more recent research as well. Lazzarini et al. (2018) found providing action-related guidelines to be more effective in motivating consumers to choose foods of smaller climate impact than exposing them to eco-labels. A study by Schmidt (2020) continued empirical research on action-related knowledge and climate friendly food choices. She found that when consumers were provided with simple rules for climate friendly food consumption, they were distinctly more proficient in indicating the option less taxing for the climate out of two alternatives – but only when one option was clearly more climate friendly. When faced with choices where both alternatives were climate friendly to some degree, action-related knowledge failed to increase the ability to choose the option contributing the least to climate change. These findings further

indicate that in addition to action-related knowledge, there is a need to equip consumers with knowledge about the comparative effectiveness of available choices.

2.3.4 Effectiveness knowledge

The fifth and final knowledge dimension under examination is effectiveness knowledge. Effectiveness knowledge is closely linked with action-related knowledge and refers to an understanding of the relative efficacy of different actions in realizing a particular objective (Frick et al., 2004; Kaiser & Fuhrer, 2003). In an environmental context, effectiveness knowledge thus refers to recognizing how to achieve the most environmental benefit from ecologically friendly behavior (Milfont, 2012). The importance of this knowledge dimension is emphasized when behavioral choices are evaluated weighing their costs against their benefits (Kaiser & Fuhrer, 2003). Following the will to act in a more climate-friendly manner, consumers are faced with a variety of behavioral options to choose from. Making a rational decision generally requires evaluating personal costs against the comparative conservation effectiveness of different behaviors – the latter information being less obvious and often lacking (Kaiser & Fuhrer, 2003). Knowledge about the varying effectiveness of behavior options may not easily be available or understood, for instance due to geographically ungeneralizable information or the complex nature of life-cycle analyses (Gifford, 2011).

Lack of effectiveness knowledge concerning available actions can work as a barrier for climate-friendly behavior (Gifford, 2011). Therefore, to effectively promote climate-friendly consumption choices, dissemination of action-related information should be accompanied by estimations of the relative variances between potential emissions savings of different options (Schmidt, 2020). Yet, effectiveness knowledge tends to be overlooked (Frick et al., 2004; Kaiser & Fuhrer, 2003). Recent research by Körfgen et al. (2019), based on expert interviews and a survey targeting climate change communicators, concludes that communication about climate actions should always include information about their efficacy. Effectiveness knowledge is regarded as having the most influence on participation in mitigation measures and the authors advise that climate change communications should place more emphasis on it.

2.3.5 The relation between knowledge and risk perception

Empirical research indicates that climate-related knowledge appears to be closely linked to how big of a threat climate change is perceived as. For example, findings by Aitken et al. (2011) infer that consumers who deem themselves more knowledgeable about climate change perceive the associated risks of climate change as greater, and Yu et al. (2020) found that higher levels of climate knowledge was a significant predictor of higher risk perceptions among undergraduate students. In the context of the greater public, Libarkin et al. (2018) found that a higher level of knowledge about climate change seems to indicate a slightly higher evaluation of risks, although environmental beliefs and cultural worldviews were identified

as considerably greater predictors of risk perception. In contrast, in a study targeting university students Aksit et al. (2018) observed that climate change knowledge had a significant influence on the participants' risk perception of the issue whereas worldviews and political stance did not have the same effect. In addition, Stevenson et al. (2014) identified a positive relationship between climate change knowledge and risk perception among middle school students. Consequently, it seems knowledge plays an integral role in climate change risk perception development particularly among younger generations.

Existing literature reveals that causal knowledge and result-related knowledge have been repeatedly associated with higher climate change risk perceptions. In studies by Hidalgo and Pisano (2010) and Shi et al. (2015) the respondents who exhibited more knowledge about the causes of climate change were more likely to view the issue as a threat. Merely acknowledging present-day climate change as anthropogenic seems to predict risk assessment, as Aitken et al. (2011) found that respondents who recognized climate change as human-caused also perceived the issue as a risk. Several studies have included both causal and result-related knowledge. Work by Sundblad et al. (2007) surveying Swedish, and work by Tobler et al. (2012) surveying Swiss consumers found that knowledge of causes and consequences of climate change predicted risk perceptions significantly. In the context of the U.K. population, van der Linden (2015) identified greater understanding of the causes, impacts, and responses to climate change to be related with higher risk perceptions. In addition, recent findings by Zobeidi et al. (2020) portray an indirect link between causal and result-related climate change knowledge and risk perception, mediated by environmental belief and attitude. Although a certain inclination appears to be formed in the literature, differing results have also been documented. Shi et al. (2015) did not find result-related knowledge – unlike causal knowledge – to have any notable impact on concerns about climate change, and Kellstedt et al. (2008) found members of the American public with more knowledge of the causes, impacts, and characteristics of climate change to exhibit lower levels of risk perception.

Other knowledge types have also been examined in relation to climate change risk perception. A study in the United States, this time by Kahan et al. (2012), investigated the relation between risk perceptions about climate change and general scientific literacy and found no significant correlation. The authors concluded that enhancing the public's understanding of scientific information will not lead to heightened climate change risk perception. It should however be noted that the study did not assess basic scientific information about climate change, but focused on numeracy, biology, and physics – for example, "Antibiotics kill viruses as well as bacteria [true/false]" was one of the questions included (Kahan et al., 2012, p. 735). Focusing on climate change knowledge, Tobler et al. (2012) found physical knowledge to be negatively correlated with concern for climate change while Shi et al. (2015) detected no relation between the two. Shi and colleagues reasoned that the lack of correlation is likely due to the difficulty for consumers to form a perception about the associated risks based on basic processes and components of climate change. Neither Tobler et al. (2012)

nor Shi et al. (2015) identified any predictive effect between action-related knowledge and risk perception, which was according to expectations.

Based on the extensive literature reviewed in this sub-chapter, the second hypotheses of the study is formulated as the following:

- H2: The relation between respondents' knowledge and climate action, and that of knowledge and risk perception, varies depending on the type of climate change knowledge examined.

2.4 Perceived powerlessness

This sub-chapter takes under scrutiny the psychological barrier of perceived powerlessness. The more people believe that certain circumstances can be changed, the more likely they are to take relevant action (Schmitt et al., 2019). Due to the global scope of the challenge of climate change, many consumers view that as individuals they lack power to address it (Gifford, 2011), which presents a considerable barrier for taking action (Barr et al., 2011). People may also easily use feelings of powerlessness as justification not to take action, as such rationalization alleviates the cognitive dissonance deriving from notable environmental consciousness and contradictive actions (Thaller et al., 2020). Van Herpen and de Hooge (2019) summarize cognitive dissonance as the state of psychological discomfort caused by discordant relations between cognitive elements such as views and behaviors.

Literature defines the concept of powerlessness in differing ways. Ajzen's (1991) Theory of Planned Behavior approaches powerlessness through perceived control of one's behavior – that is, the less resources and opportunities a person perceives to have to perform a behavior, the more powerless they feel. The value-belief-norm theory proposed by Stern (2000) considers the perceived efficacy of actions, and thus according to the model powerlessness is the held belief that one's actions will not have an impact on the outcome of an issue. Following Aitken et al. (2011), this thesis applies Stern's definition when considering powerlessness as a barrier to climate action. Consequently, powerlessness refers to the perception that one's consumer behavior cannot affect the event or extent of climate change (Aitken et al., 2011).

The effects of perceived powerlessness on climate-protective consumer behavior have been documented in empirical research several times over. The impression that one's actions would not make a difference on climate change was found to be a major reason for inaction among the respondents of a survey conducted by Semenza et al (2008). Participants in a study by Hares et al. (2010) argued that the actions of an individual are inconsequential in the global challenge of climate change and that altering one's travel behavior would have no effect on its outcome. The authors speculate that the strong response was a result of cognitive dissonance. Work by Aitken et al. (2011) in turn implies that consumers

feeling more powerless are less likely to take climate change into consideration as a relevant aspect when altering their behavior, and in a study by Quimby and Angelique (2011) a lack of efficacy was revealed to be the most salient impediment for pursuing climate-friendly actions. In addition, several studies targeting adolescents have identified a sense of powerlessness and the feeling that individual behavior choices do not have an impact in the face of climate change (Corner et al., 2015).

More recent research concurs with these earlier findings. From a reversed perspective, Hartmann et al. (2018) found evidence that consumers' belief that they are capable and can impact their environment is a significant motivator to engage in climate-friendly behavior. In addition, Thaller et al. (2020) found indication that perceptions of powerlessness have a negative influence on climate change mitigation behavior. Austrian consumers who felt that their conservation actions or the actions of others do not have a significant effect on the outcomes of climate change reported less climate-friendly behavior. Furthermore, since the beginning of the present study, Williams and Jaftha (2020) published a replication of the work by Aitken et al. (2011) with a larger sample and in the Australian context in place of New Zealand. The new study was able to reproduce all key findings including the relation between perceptions of powerlessness and consumers' self-reported climate action.

Literature points to the need to communicate about climate change in a manner that leaves consumers feeling empowered to take action (Moser, 2016). Preliminary research suggests that perceptions of powerlessness could be affected by dissemination of different types of climate change knowledge. Research by Tobler et al. (2012) found that higher levels of action-related knowledge seem to lessen the perception of powerlessness in alleviating climate change, while Shi et al. (2015) recommend that provision of result-related knowledge that elicits feelings of powerlessness should be avoided. To advance theoretical knowledge on the matter, the third hypothesis of this study is proposed:

- H3: The extent to which respondents perceive powerlessness as a barrier to climate action is related to their level of knowledge, depending on the type of climate change knowledge examined.

2.5 Commons dilemma

The final barrier to action reviewed is a social concept referred to as the commons dilemma. A commons dilemma – also known as a common resource dilemma – is a condition in which everyone in a group is better off adhering to a collective interest of resource conservation as opposed to everyone behaving selfishly, yet the individuals all have reasons not to conform (Weber et al., 2004). Oftentimes, the collective advantages are mainly situated in the future instead of the present (Van Lange et al., 2018). Thus, the commons dilemma paradigm sets personal

short-term benefits at conflict with collective long-term interest (Liu & Hao, 2020; Van Lange et al., 2013).

Due to the commons dilemma requiring collective engagement to be resolved, people have a tendency to consider the (in)action of others when deciding their own stance (Aitken et al., 2011). Consequently, a lack of cooperation can result for example from wanting to freeride at the expense of others' contribution (Aitken et al., 2011; Vasi & Macy, 2003) coupled with the attraction of immediate self-interest in choosing not to pay in money, time, or effort for a collective good (Van Lange et al., 2013). Furthermore, failing to cooperate can stem from the perception of injustice in paying the cost when others do not (Clark & Sefton, 2001), or the belief that the desired outcome simply cannot be reached due to a lack of contribution from others (Vasi & Macy, 2003).

A number of the greatest concerns the world presently faces take the form of a commons dilemma, many of which have to do with Earth's limited ecological resources (Van Lange et al., 2013). Climate change is a fitting example, as our planet's climate is a common good, shared by the global population and vulnerable to overexploitation with an individual's investment in its protection seemingly having a substantially greater cost than the direct advantage the single individual gains from their contribution (Pfeiffer & Nowak, 2006). Moreover, climate change is an especially acute example of the phenomenon owing to its long timeframe, broad scope, and number of people – billions – involved (Aitken et al., 2011). Due to these complex reasons, as well as the abstractness of climate change, Van Lange et al. (2018) propose that even people with high concern for the environment may be deterred from taking mitigative climate action in face of this particular commons dilemma.

Research results imply that the perception of the commons dilemma in climate change mitigation is indeed a key element influencing individuals' (in)action. This has been documented by Aitken et al. (2011), Quimby and Angelique (2011), and more recently by Williams and Jaftha (2020). Another example of the influence of the commons dilemma on consumers' climate action is found from a study by Dubois et al. (2019) examining household consumption behavior and preferences in Norway, Sweden, Germany, and France. Among many households, the authors identified a recurring attitude of willingness to act for the good of the climate only if everyone else took part in cohesion. By "everyone else", participants referred to the inclusion of all scopes of society from individuals to industry and governments, and a number of them underscored the need for collective action on a European or an even wider scale for mitigation efforts to have an effect. Some potential mitigation measures in particular, such as higher aviation taxes, were felt unjust and unacceptable unless they would affect "everyone". These findings concur with Gifford's (2011) notion that people tend to be uninclined to take action if they perceive inequity in others' inaction, and that it is common to cite other countries, economic sectors or public figures as not participating to justify one's own inaction. On the other hand, many consumers find it completely reasonable to continue with high-carbon behaviors while still sup-

porting policy measures that would make maintaining these consumption patterns more challenging for everyone (Climate Change Communication Advisory Group, 2010).

Advancing understanding of how consumers view and experience different barriers is needed to better engender climate action. Conceptually, the commons dilemma epitomizes a reluctance for behavioral change unless others do the same, whereas perceived powerlessness refers to the belief that one's actions do not bear influence to make a difference (Aitken et al., 2011). These notions have however been found to overlap in the public's mind (Aitken et al., 2011; Stoll-Kleemann et al., 2001; Williams & Jaftha, 2020). Aitken et al. (2011) propose that the two concepts conflate in consumers' thinking when it is thought that an individual's efforts in mitigating climate change are futile due to the lack of contribution from others. The authors identified a clear correlation between perceptions of the commons dilemma and powerlessness, as did Williams and Jaftha (2020) in their recent replication study. This relation is further tested with the final hypothesis of the current investigation:

- H4: Perceived powerlessness correlates positively with the commons dilemma.

3 METHODOLOGY

In this chapter the research approach of the study is first presented and justified. Next the data collection methods are described, in particular the design of the questionnaire. Methods of data analysis are also introduced, and a review of ethical considerations is given in this methodology chapter preceding the results of the study.

3.1 Research approach: a quantitative study

The research methodology in this study follows a quantitative approach, the choice of which was the sum of several factors considered. The selection of a research approach in a study – whether a qualitative, quantitative, or mixed methods approach – is formed on the basis of the employed philosophical assumptions of research, as well as the research problem, particular design, and research methods of the study (Creswell & Creswell, 2018). The selection of a quantitative approach in the present study is therefore explained through the choice of each of these elements beginning with the underlying philosophy.

The philosophical worldview proposed in this study is postpositivism. This worldview represents research in its traditional form and is also referred to as the scientific method or empirical science (Creswell & Creswell, 2018). According to Phillips and Burbules (2000), inherent to postpositivist assumptions is that data, evidence, and analytical examinations are used to construct conjectural knowledge – absolute truth cannot be obtained. Postpositivists thus acknowledge that when researching human behavior and actions, one cannot be absolutely positive regarding assertions of knowledge (Creswell & Creswell, 2018). In the scientific method theories are tested and either supported or refuted based on collected data (Creswell & Creswell, 2018). Knowledge and understanding of the world is consequently advanced by objectively refining claims or abandoning some for those more justified (Phillips & Burbules, 2000). Postpositivist assumptions resonate most with quantitative research as the reductionistic nature of postpositivism, which is exemplified by reducing ideas into variables that form hypotheses, requires the development of numeric measures (Creswell & Creswell, 2018). The aim is to advance the relationship between variables (Phillips & Burbules, 2000) and conceive meaning through objectivity revealed in the data collected (Williams, 2007).

The research problem at hand also gives weight to the appropriate choice of approach. According to Creswell and Creswell (2018) a quantitative research approach is the preferred option when testing a theory or explanation. Furthermore, as stated above, quantitative research is used to study relational queries between variables and to advance the formation of generalizations (Williams, 2007). As the current research project aims to contribute to further understanding

of the relations and inferences theorized between climate action and various barriers, a quantitative approach is supported.

A research design provides structure for the procedures of a study, particularly regarding data collection and analysis (Bryman & Bell, 2011). In a similar manner that the broader concept of research approach falls into the category of qualitative, quantitative, or mixed, research designs are forms of inquiry within these three options (Creswell & Creswell, 2018). The research design adopted in the present study is survey research. Survey research aims to produce statistical estimates about a target population (Fowler, 2014) and is thus quantitative by nature (Creswell & Creswell, 2018). It involves standardized procedures to methodically gather data from individuals (Stockemer, 2019). In a cross-sectional survey, as the one applied in this study, a body of numeric or quantifiable information pertaining to the variables under examination is collected at a single point in time (Bryman & Bell, 2011).

Research methods are the techniques applied for collecting and analyzing data in a research project (Walliman, 2011). Their choice depends on which type of data is to be collected and how it will be interpreted (Creswell & Creswell, 2018). To suit the purpose of the current study, the type of information gathered is pre-determined – as opposed to emergent – and in quantifiable form to be analyzed statistically. The data are collected from respondents via an online questionnaire consisting of instrument scales and analyzed by means of a variety of statistical techniques. The advantages of executing an online-based survey include its cost-effectiveness, potential for rapid speed of returns, and having responses immediately in machine-readable form (Fowler, 2014).

3.2 Data collection

3.2.1 Procedure and respondents

Data were collected in spring 2021 between March 18th and April 4th. Participants of the study were students enrolled in the University of Jyväskylä (JYU) in central Finland. The questionnaire-type survey used for data collection was executed via Webropol, which is a secure online tool for creating web-based surveys. An invitation and link to answer the voluntary survey was distributed to JYU students by email with the assistance of faculty communication specialists and a few student unions. The sampling method used in the study was thus volunteer sampling, which is a frequently used non-probabilistic technique for attaining study participants particularly in the fields of psychology and business research (Stockemer, 2019).

The survey yielded a sample of n = 245. The majority of the participants were female with a representation of 165, while 74 were male, 5 responded with "other", and one opted not to disclose their gender. Women were thus somewhat overrepresented as they accounted for 67% of the sample, whereas 59% of the JYU degree student body are registered as female, and 41% are male (University

of Jyväskylä, 2021). Responses were received from students in all six faculties of the university, in varying numbers. The frequency data are presented in the results chapter of this thesis. The majority of respondents were between the ages of 20 and 30 (80%), with the sample age ranging from 20 to 70. As age was measured by year of birth, respondents are of said age during the current year.

3.2.2 Questionnaire: variables and operationalization

The questionnaire was designed specifically for this study and made use of items and scales validated in existing research literature. It was formulated in Finnish and consisted predominantly of closed-response questions of varying format. These types of questions are effective in hypotheses testing as they are easy to calculate, analyze, and interpret (Stockemer, 2019); closed-response items ensure that respondents focus on the same predetermined issues and thus allow for statistical analysis (Johnson & Morgan, 2016). The questionnaire covered five thematic areas: socio-demographics, climate change risk perception, climate change knowledge, perceived barriers to climate action, and climate action. All questions were set as mandatory to answer. The online questionnaire was pretested twice with a total of nine test participants who were not included in the actual study. Some Finnish translations were slightly modified based on the feedback and the labels of one Likert-scale were supplemented for enhanced comprehensibility. The final version was cleared of any issues. Next, the measures and variables of the questionnaire are described by themes. The full list of survey items are available in English at the end of the thesis (see Appendix).

Socio-demographics. Three multiple choice questions asked about the background of the respondents: year of birth, gender, and study faculty. The questions of gender and study faculty were included in order to examine the representativeness of the data sample. Furthermore, the variables of age and gender have been linked to climate action in previous studies (e.g. Aitken et al., 2011; Thaller et al., 2020; Tobler et al., 2012). Also Sundblad et al. (2007) examined type of education in relation to climate change risk perception. Therefore, although these variables are not central to the hypotheses of this study, their inclusion may add knowledge to the field. While gender has generally been asked dichotomously in the past, it is now considered politically correct to add a third option (Stockemer, 2019). In this study the options "male", "female", "other" and "do not want to say" were given. For study faculty participants were asked to select their primary faculty if more than one applied. The options listed were the six faculties of University of Jyväskylä: Humanities and Social Sciences, Information Technology, JYU School of Business and Economics (JSBE), Education and Psychology, Sport and Health Sciences, and Mathematics and Science.

Climate change knowledge. Respondents' level of knowledge pertaining to each of the five climate change knowledge dimensions was measured through self-evaluation. Self-evaluation has been used to assess laypeople's climate change knowledge repeatedly in the field (e.g. Heath & Gifford, 2006; Milfont, 2012;

Vainio & Paloniemi, 2011). Single questions regarding causal, result-related, and action-related knowledge were derived from Vainio and Paloniemi (2013) and were supplemented with ones concerning physical and effectiveness knowledge. Thus, the respondents were asked to evaluate their level of knowledge regarding the greenhouse effect and greenhouse gases (physical knowledge), the different causes of climate change (causal knowledge), the different consequences of climate change (result-related knowledge), ways to mitigate climate change (action-related knowledge), and the effectiveness of different ways to mitigate climate change (effectiveness knowledge). The scale consisting of five levels of self-reported climate change knowledge was adopted from Heath and Gifford (2006), with the labels slightly modified to nonexistent, minor, moderate, good, and professional – the meanings of which translate better in Finnish.

Risk perception. To assess consumers' risk perception about climate change, the risk perception index developed by van der Linden (2015) – who took inspiration from earlier work by Bord et al. (2000) and Leiserowitz (2006) in its creation – was applied. It was selected to use this index of eight items as it offers a holistic approach covering both temporal and geographical dimensions as well as both societal and personal aspects of risk perception. The response scale, which was the same for all risk perception items, ranged from 1 to 7 anchored at "1 - Not concerned at all/Very unlikely/Not serious at all/Very rarely or never" and "7 - Very concerned/Very likely/Very serious/Very frequently". The original material had the anchor "Very rarely", but this was changed to "Very rarely or never" to give the answer option of never worrying about climate change. One additional detail was changed; due to the target population, the United Kingdom was replaced with Finland when asking to estimate how serious the impacts of climate change are for the respective country. Van der Linden (2015) reported a Cronbach alpha coefficient (α) of 0.96 for the scale of holistic risk perception. While there are no established interpretations of acceptable values, $\alpha > 0.9$ indicates excellent internal consistency (George & Mallery, 2020). In the current study the alpha was 0.9.

Barriers to action. In order to examine consumers' perceived barriers to climate action – including the variable perceived powerlessness – respondents were asked to rate how influential a range of factors have been in their decision making about consumer behavior that might affect climate change. The matrix-level question was derived from Aitken et al. (2011) as were the majority of the factors. The five-point Likert-scale was also adopted from Aitken et al., but instead of only naming the anchors 1 and 5, all scale options were labeled ("1 – Not influential at all; 2 – Slightly influential; 3 – Somewhat influential; 4 – Very influential; 5 – Extremely influential"). Verbally labelling all response categories of a scale is at times recommended in order to increase reliability and aid interpretation of the results (Johnson & Morgan, 2016).

The barrier factors borrowed from Aitken et al. (2011) included the limitation and inconvenience of options for change, the monetary costs of changing actions, fitting in changes with e.g. family, lack of knowledge about possible

changes that can be made, uncertainty about the most effective action that can be taken to mitigate climate change, uncertainty as to whether climate change is a significant problem, and looking foolish due to being the only one to take action. In addition, perception of the commons dilemma was measured through three items in accordance with the study by Aitken et al. (2011). Perceived powerlessness was measured through two items from Aitken and colleagues and supplemented with two items used to measure feelings of powerlessness in research by Tobler et al. (2012). To achieve a more comprehensive list of barriers, it was decided to also include various aspects of skepticism, which were measured with four items borrowed from Tobler et al. (2012). Therefore, the final list of factors for respondents to rate included 19 items. The measures used for skepticism (α = 0.89), perceived powerlessness (α = 0.88), and the commons dilemma (α = 0.85) all had very good internal consistency. Items included for each concept are displayed in Table 2. Due to its similarity, "uncertainty as to whether climate change is a significant problem" was included in the skepticism scale as it correlated with the other four items and slightly improved internal consistency.

TABLE 2 Composite variable items for barrier concepts

Barrier concept	**Item** A = Aitken et al., 2011; T = Tobler et al., 2012
Perceived powerlessness	The feeling that my actions will not affect the outcome of climate change. (A) The feeling that climate change is too big for my actions to have an impact. (A) With my behavior I cannot influence the climate as the task lies with industry. (T) Climate protective measures are determined by a few people in power; as a single individual, I have no effect. (T)
The commons dilemma	Other countries or people not taking equivalent action at the moment. (A) Feeling other individuals will not change their actions even if I do. (A) Unfairness associated with bearing the costs of change while others do not take responsibility. (A)
Skepticism	There are larger problems than climate change. (T) The impacts of climate change are unpredictable; thus my climate-friendly behavior is futile. (T) Climate change and its consequences are being exaggerated in the media. (T) I do not perceive climate change as a threat. (T) Uncertainty as to whether climate change is a significant problem. (A)

Climate action. While some surveys (e.g. Aitken et al., 2011) use a single yes-or-no question to document self-reported climate action, it was decided against this method as it arguably leaves too much room for the respondent's own interpre-

tation. Also existing scales of climate-related behavior were, after careful consideration, excluded from use as they relied on measures of willingness or intent (e.g. Shi et al., 2015; Tobler et al., 2012), tended to disregard motivation behind the behavior (e.g. Brick & Lewis, 2016; Thaller et al., 2020), or were deemed too limited for the purpose of this study (e.g. European Commission, 2019). Instead, in order to capture information on whether respondents have changed their consumption behavior to mitigate climate change, four yes-or-no questions related to GHG-intense areas of consumption were asked. These inquired whether or not the respondent had changed his or her eating habits, transportation habits, energy or water consumption, or general consumption or recycling behavior to mitigate climate change. These four selected sectors are in accordance with the main categories of consumption considered in the Finnish Environment Institute's report presenting ways in which Finnish consumers can decrease their personal carbon footprints (Salo & Nissinen, 2017). The wordings for the questions were derived from answer options presented in a survey commissioned by the Finnish Innovation Fund Sitra (Kantar TNS Oy, 2019).

While the four dichotomous questions can by themselves be considered sufficient to capture self-reported climate action, this study is also interested in the specific ways in which respondents have changed their consumption behavior. Therefore, respondents who confirmed they had taken climate action were presented with a sub-question asking to indicate which action/s they had undertaken from a list of behavioral change options relating to that area of consumption. For example, if a respondent answered that he has changed his eating habits to mitigate climate change, he was then asked to indicate which change/s he had made: eating less meat, reducing food waste, favoring seasonal food, etc. Checklists are a common means of gathering data about behaviors and can be developed by help of a literature review (Johnson & Morgan, 2016). Accordingly, the extensive, albeit not exhaustive, lists of behavioral options were composed based on research literature examining climate-relevant consumer behavior, and are presented in Table 3. An "other" open-response option was included for answers not considered in the predetermined choices. It is generally recommended to include this choice in order to collect unanticipated data and to avoid respondents feeling frustrated if they are not able to express their true responses (Fraenkel et al., 2012).

TABLE 3 Research-based climate actions included in the survey

Consumption area	**Climate-friendly behav. change**	**Source examples**
Eating habits	Reducing consumption of meat	Brick & Lewis (2016); Mäkiniemi & Vainio (2014); Shi et al. (2015); Thaller et al. (2020); Wynes & Nicholas (2017)
	Reducing consumption of dairy	Mäkiniemi & Vainio (2014); Salo & Nissinen (2017)
	Adopting a plant-based diet	Wynes & Nicholas (2017)

Consumption area	Climate-friendly behav. change	Source examples
(Eating habits)	Favoring local food	Brick & Lewis (2016); Mäkiniemi & Vainio (2014); Thaller et al. (2020); Wynes & Nicholas (2017)
	Favoring seasonal food	Mäkiniemi & Vainio (2014); Shi et al. (2015)
	Avoiding food waste	Mäkiniemi & Vainio (2014); Wynes & Nicholas (2017)
	Considering the carbon footprint of products when making purchase decisions	European Commission (2019); Mäkiniemi & Vainio (2014)
Transportation habits	Driving less by private car	Brick & Lewis (2016); Quimby & Angelique (2011); Shi et al. (2015); Vainio & Paloniemi (2013)
	Switching to a more fuel-efficient car	Wynes & Nicholas (2017)
	Adopting economic driving practices	Brick & Lewis (2016); Salo & Nissinen (2017); Shi et al. (2015)
	Buying a hybrid, natural gas, or electric car	European Commission (2019); Quimby & Angelique (2011); Yarime (2009)
	Deciding not to buy a car	Wynes & Nicholas (2017)
	Giving up private car	Wynes & Nicholas (2017)
	Avoiding plane travel	Brick & Lewis (2016); Thaller et al. (2020); Vainio & Paloniemi (2013); Wynes & Nicholas (2017)
	Favoring environmentally friendly modes of transport	European Commission, (2019); Wynes & Nicholas (2017)
Energy and water consumption	Setting temperature of heating at 20 °C or lower in wintertime	Shi et al. (2015)
	Installing solar panels	European Commission (2019); Wynes & Nicholas (2017)
	Using high-efficiency light bulbs	Brick & Lewis (2016)
	Emphasizing energy efficiency when purchasing a device	European Commission, (2019); Shi et al. (2015); Thaller et al. (2020); Wynes & Nicholas (2017)
	Using less electricity	Quimby & Angelique (2011); Vainio & Paloniemi (2013); Wynes & Nicholas (2017)
	Increasing share of renewable energy from energy supplier	European Commission (2019); Wynes & Nicholas, (2017)
	Forgoing oil heating	Ministry of the Environment (n.d.)

Consumption area	Climate-friendly behav. change	Source examples
(Energy and water consumption)	Conserving water e.g. when showering, washing dishes or laundry	Brick & Lewis (2016); Salo & Nissinen (2017); Shi et al. (2015); Wynes & Nicholas (2017)
General consumption and recycling behavior	Reducing consumption of disposable items	Brick & Lewis (2016); European Commission (2019)
	Reducing consumption	Quimby & Angelique (2011); Wynes & Nicholas (2017)
	Buying used instead of new	Salo & Nissinen (2017)
	Considering the carbon footprint of products when making purchasing decisions	Wynes & Nicholas (2017)
	Purchasing carbon offsets	Wynes & Nicholas (2017)
	Increasing recycling at home	Brick & Lewis (2016)
	Increasing recycling in public	Brick & Lewis (2016)
	Reducing waste	Wynes & Nicholas (2017)

3.3 Data analysis

3.3.1 Software and data preparation

The chosen tool for data analysis in the study was IBM SPSS Statistics version 26. SPSS (Statistical Product and Service Solutions) is a comprehensive statistics software package that allows for management and analysis of data as well as its graphic presentation (Stockemer, 2019). Prior to beginning analysis of quantitative data it is advised to check the data set for errors and missing values (Pallant, 2016). As the survey was conducted via the Webropol online platform with particular settings, it was by design not possible to have out-of-range or missing values in the data set. Nevertheless, the data were screened carefully to ensure the automatic export from Webropol to a format compatible with SPSS was successful and without error. Also at this point the variables, labels, and values were named coherently and the appropriate type and measure for each variable was set. As the final step of data preparation the relevant composite variables were created as new additional variables without making changes to the original data.

3.3.2 Methods of analysis

The reported statistics included frequency distribution, measures of central tendency, measures of variability, measures of internal consistency, and measures of association. Frequencies are mainly used to obtain descriptive statistics for categorical variables (Pallant, 2016) and they also show if respondents have used the full response scales available (Johnson & Morgan, 2016). Measures of central tendency are used regularly in research due to their ability to describe a set of data concisely; the median (*Mdn*) is the mid-point of a variable's distribution, and the

mean (*M*) is the average value of the distribution (Johnson & Morgan, 2016). While mean values are most appropriate for scale variables, it is commonplace in social sciences to also report mean values for variables of ordinal nature (Karjaluoto, 2007). Measures of variability are useful as they give indication to how different or similar a set of responses are (Johnson & Morgan, 2016). The most frequently reported measure of variability is the standard deviation (*SD*), which indicates the typical distance response values have from the mean (Karjaluoto, 2007). Internal consistency is a measure of scale reliability and its purpose is to indicate whether all items in the scale measure the same concept (George & Mallery, 2020). Cronbach's alpha (α) is commonly used to measure the internal consistency of Likert-type items (Johnson & Morgan, 2016) and was used in the present research. Finally, the applied measures of association are next reviewed in detail.

The main statistical technique used in the study was bivariate correlation. Non-experimental research designs – in which variables are not purposely controlled or manipulated – typically call for correlational methods of analysis (Pallant, 2016). Measures of association, or correlation, are used to ascertain whether there is a relationship between two variables by examining how their values covary (Johnson & Morgan, 2016). These relationships are quantified by correlation coefficients, which can take any value from -1 to +1, reflecting both the direction and strength of association (Johnson & Morgan, 2016). A positive value signifies that as one variable increases, the other increases as well, whereas a negative value indicates that as one increases, the other decreases (Pallant, 2016). A correlation coefficient of 1 – either positive or negative – shows a perfect correlation between the pair of variables, while zero indicates a complete lack of association – information on the values of one variable does not provide any indication of the other (Johnson & Morgan, 2016). The recommendations for the interpretation of the correlation coefficient effect size vary by author to some extent (Pallant, 2016). In this thesis the following widespread guidelines suggested by Cohen (1988) are used:

small	r = .10 to .29
medium	r = .30 to .49
large	r = .50 to 1.0

A significance, or probability (*p*), is calculated for correlations to determine how likely it is that they could arise by chance (George & Mallery, 2020), thus giving indication to how much confidence one should have in the obtained results (Pallant, 2016). The traditional level for statistical significance is $p < .05$ (Pallant, 2016), which indicates that the probability of the correlation happening by chance is less than 5% (George & Mallery, 2020) Values of $p < .01$ or $p < .001$ report an even greater level of significance and are thus marked where appropriate. There are options for testing one-tailed and two-tailed significance. The measure of two-tailed significance (2-tailed sig.) is generally used when there is little certainty concerning the anticipated direction of the relationships (George & Mallery, 2020).

The specific method for measure of association used in the study is Pearson product-moment correlation, or Pearson *r*, which is a parametric statistic (Pallant, 2016). Karjaluoto (2007) relates that if possible, it is commonly recommended to use parametric tests as they are more powerful than nonparametric ones. In social sciences it is generally accepted to use parametric tests when the data set includes at least ordinal variables and has a response number over 50 or 100 (Karjaluoto, 2007). Furthermore, particularly in business research it is common to run parametric tests even with considerably smaller data sets (Karjaluoto, 2007). While approximate normal distribution of the pair of variables is an assumption associated with Pearson *r*, with large enough samples the formula tends to work well even if normal distribution of values is not met (George & Mallery, 2020; Pallant, 2016). Karjaluoto (2007) notes that since attitude type variables with a value range between 1 and 7 very rarely exhibit normal distribution, it is left for the discretion of the researcher to determine whether analysis of normality is worthwhile. In this study normal distribution was not tested for as the sample size (n = 245) is considered large enough.

Another assumption related to Pearson *r* is linearity. Scatter plots help determine whether the examined variables are related in a linear or curvilinear manner, and it is hence often recommended to generate a scatter plot prior to analyzing Pearson correlations as only linear relationships are appropriate for these calculations (Pallant, 2016). A scatter plot resembling a somewhat straight line indicates a linear association between the two variables (George & Mallery, 2020). However, as emphasized by George and Mallery (2020), many times a significant correlation may exist even if visual analysis fails to detect one. Furthermore, scatter plots are not fitting for all kinds of information, such as nominal data. Yet Pearson *r* is also used in SPSS when one of the variables included in correlation analysis is binary, as Pearson *r* mathematically corresponds to a point-biserial correlation (George & Mallery, 2020). For such data, a box plot is the recommended method to display distribution information and give indication of the direction of association prior to correlation analysis (Statistics Solutions, n.d.).

A couple of additional statistical methods were needed for analyses relating to demographic data. A chi-square test of independence was required to examine association between nominal variables, and a Kruskal-Wallis test for the relation between a nominal variable with three or more categories – such as study faculty – and a continuous variable. The chi-square test is based on a crosstabulation table and "compares the observed frequencies or proportions of cases that occur in each of the categories, with the values that would be expected if there was no association between the two variables being measured" (Pallant, 2016, p. 218). When both examined variables only have two categories, the correction value Yate's Correction for Continuity should be used instead of the standard output of Pearson chi-square (Pallant, 2016). The chi-square value can be anything from zero to infinity – the larger the value, the stronger the association between the variables (Karjaluoto, 2007). However, comparing chi-square values can be misleading and therefore the standardized *phi* statistic taking values between 0 and 1 is also reported (George & Mallery, 2020). When one variable has

more than two categories, Cramer's V is reported in place of *phi* (George & Mallery, 2020; Pallant, 2016). The associated significance value needs to be .05 or smaller for the result to be regarded as significant (Pallant, 2016). The Kruskal-Wallis test examines if a continuous variable is different across groups of a categorical variable (George & Mallery, 2020). Data that need reporting are the chi-square value, degree of freedom, and significance level, which needs to be smaller than .05 to indicate a difference of statistical significance (Pallant, 2016).

3.4 Research ethics

The ethical issues that need to be considered in research are extensive and span the whole research process (Creswell & Creswell, 2018). The research procedures of this study adhere to the code of responsible conduct of research (RCR) issued by the Finnish National Board on Research Integrity, and to which the University of Jyväskylä is committed. Some of the main ethical aspects addressed in this study are next highlighted, beginning with those concerning the study participants.

Voluntary participation and informed consent are central to ethical conduct of research (Saunders et al., 2012; Walliman, 2011). The respondents' participation in the study was completely voluntary and this was addressed in the purpose statement presented in the invitation email and questionnaire form. Participants were made aware that by filling out and sending the questionnaire they gave their informed consent to take part in the study. Respondents were also advised of the anonymity, safekeeping, and eventual deletion of their data and given access to a data privacy statement prior to filling the questionnaire. Furthermore, it was disclosed that the study is part of a thesis project led by Climate Communications Studio Oy.

Several other ethical considerations serve to be declared. Presenting the work and ideas of others as one's own – plagiarism – is a severe offense against integrity and the scientific community (Creswell & Creswell, 2018; Walliman, 2011). Meticulous attention is given throughout this thesis to accurately paraphrase, cite, and reference the original sources to whom credit is owed. Moreover, prior to publication the thesis passed a plagiarism detection check by the Turnitin software. While research may never be fully exempt of bias (Walliman, 2011), scientific objectivity is also maintained to the highest level possible. Moreover, information is accounted for truthfully throughout the study process and none is falsified, ignored, or invented to accommodate any research or other objectives. Finally, accurate descriptions of the research process are documented in a fashion that allows for potential replication of the study. Williams and Jaftha (2020) underscore that particularly research endeavors concerning matters of high-stakes such as climate change need to be carried out in a transparent and replicable manner.

4 RESULTS

In this chapter relevant information of the collected data set are presented as are the results from data analysis. The primary aim of the research was to further the understanding of various barriers to consumers' climate action through three research objectives: RO1) to examine the relations between different types of self-reported knowledge, perceived risk, and self-reported climate action; RO2) to examine the relation between different types of self-reported knowledge and the perception of powerlessness as a barrier to consumers' climate action; and RO3) to examine how perceived powerlessness compares to other barriers to consumers' climate action. The secondary aim was to explore the general climate awareness and consumption-related climate action of Finnish university students. The chapter is divided into three main parts. First descriptive statistics are reviewed across the five thematic areas of the survey. The second part covers details from measures of association as the variables are examined in relation to one another. The chapter ends with a summary concluding whether the proposed hypotheses were supported.

4.1 Frequencies and response distributions

Socio-demographics. The survey yielded a total of 245 responses. Frequency statistics were first extracted for participants' gender (Table 4). Females (n = 165) accounted for the majority of the sample with more than twice the amount of males (n = 74). In addition, five participants answered gender with "other" and one opted not to disclose this information.

TABLE 4 Frequency statistics for gender

Gender	Frequency	Percent
Female	165	67.3
Male	74	30.2
Other	5	2.0
Do not want to say	1	0.4
Total	245	100.0

The second measured socio-demographic was age by year of birth. Figure 2 depicts the response distribution for participants' year of birth revealing an average age of around 27-28 based on the mean of 1993; answers varied between 1951 and 2001 (*Mdn* = 1996, *IQR*: 1992, 1998). The third and final requested socio-demographic was study faculty. All six study faculties of JYU were represented (Figure

3). Students from the faculty of Mathematics and Science were most active in responses representing 31% of survey answers received, followed by students of Sport and Health Sciences (23%), Humanities and Social Sciences (22%), and Business and Economics (JSBE) (20%). Responses from the faculties of Information Technology (3%) and Education and Psychology (1%) held the minority.

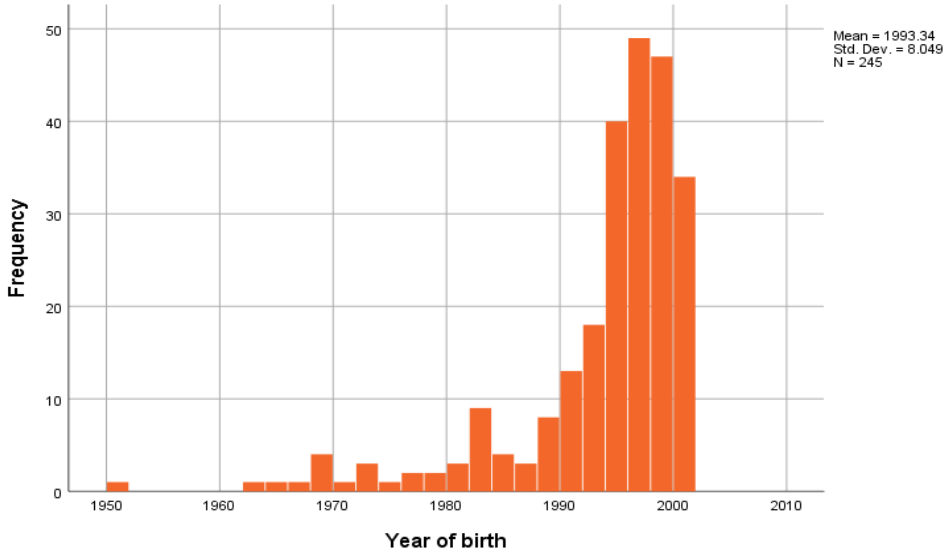

FIGURE 2 Histogram of frequency statistics for year of birth

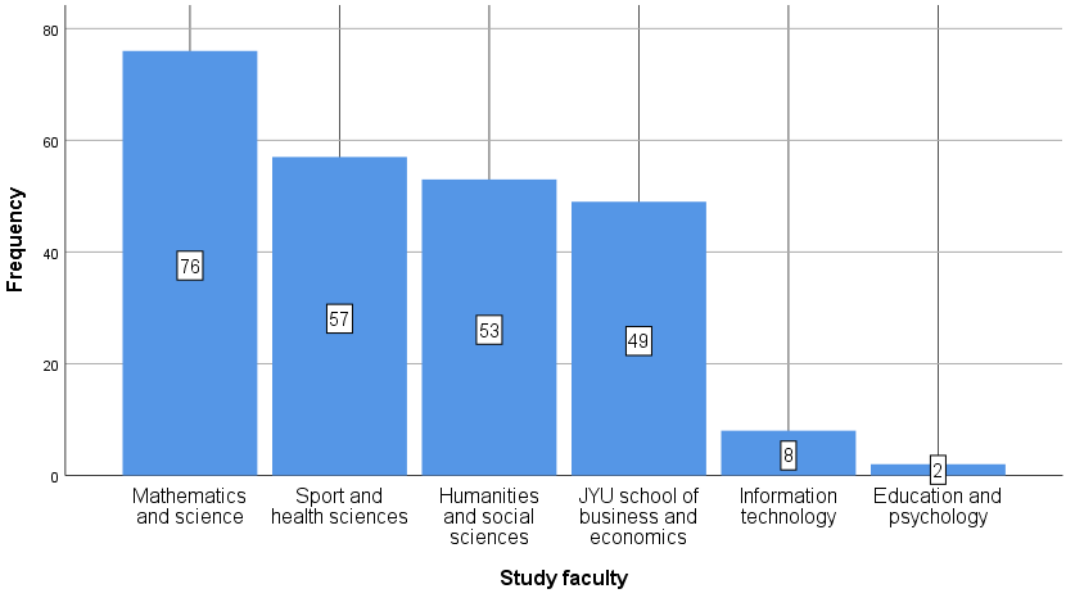

FIGURE 3 Bar chart of frequencies by study faculty

Climate change knowledge. Figure 4 presents the distribution of answers regarding the five types of climate-related knowledge measured. On the whole, respondents demonstrated high levels of perceived climate change knowledge. For the dimensions of result-related knowledge and action-related knowledge, more than 6 in 10 respondents, and for causal knowledge more than 7 in 10 respondents evaluated their level of knowledge as either good or professional. While physical knowledge was not as highly rated, still more than half of respondents considered to have good or professional knowledge of the greenhouse effect and GHGs. The knowledge dimension that stands out in responses is effectiveness knowledge, with moderate level receiving the bulk of the answers and minor and nonexistent levels of knowledge counting up higher than with other dimensions.

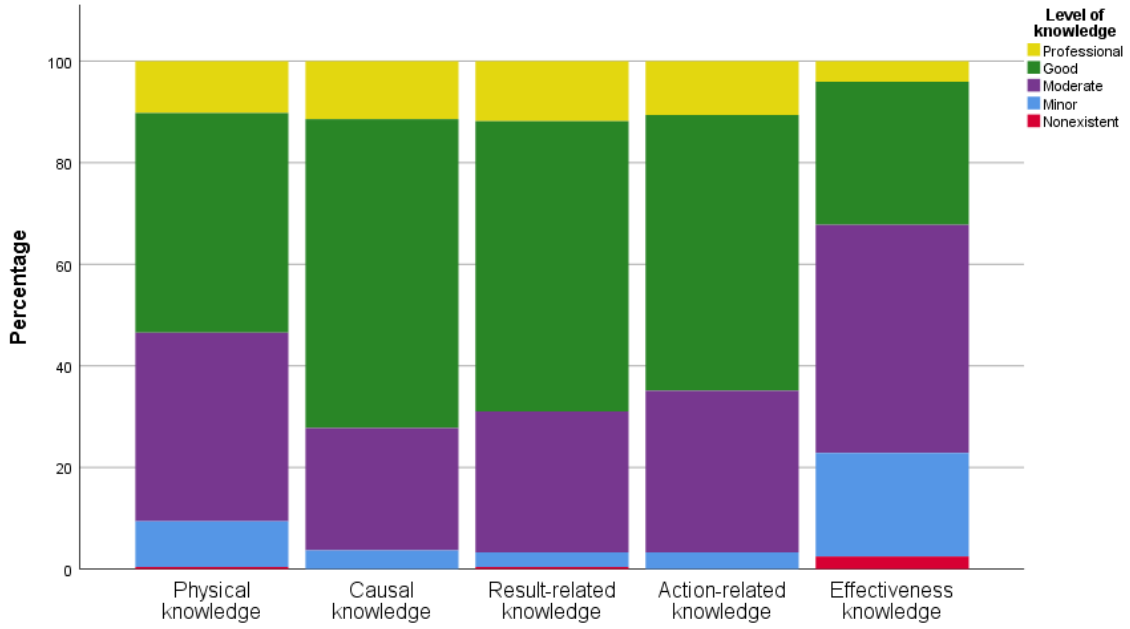

FIGURE 4 Response distribution for the five types of self-reported climate knowledge

Risk perception. A composite variable for risk perception was created from the eight items measuring respondents' perceptions relating to climate change risks ($\alpha = 0.90$). The statistics for the attained risk perception index show a high level of climate change risk perception among the participants, $M = 5.22$, $SD = 1.04$, on a scale from 1 to 7. Further information is available from the breakdown of the means for each individual item measuring risk perception presented in Table 5. Respondents used the full response scale of 1-7 for all items except for "How serious would you rate current impacts of climate change around the world?",

which received answers between 2 and 7. Altogether, respondents evaluated climate change as a bigger threat to nature and society in general than to them personally.

TABLE 5 Risk perception scale items with central tendency and variability

	Mean	Std. Deviation
How serious of a threat do you think that climate change is to nature?	6.41	1.10
In your judgment, how likely do you think it is that climate change will have very harmful, long-term impacts on our society?	6.16	1.18
How concerned are you about climate change?	5.77	1.22
How serious would you rate current impacts of climate change around the world?	5.67	1.25
How serious would you estimate the impacts of climate change for Finland?	4.80	1.31
How often do you worry about the potentially negative consequences of climate change?	4.44	1.56
In your judgment, how likely is it that you will sometime during your life experience serious threats to your health or overall well-being as a result of climate change?	4.36	1.57
How serious of a threat do you perceive climate change to be to you personally?	4.11	1.49

Barriers to action. Table 6 displays the means and standard deviations of the nineteen items used to measure barriers to consumers' climate action. Each factor received scores between 1 ("Not influential at all") and 5 ("Extremely influential") meaning the full response scale was used for all items. The obstacle felt strongest by respondents was the financial costs of changing their behavior (M = 3.58) followed by the inconvenience and limitation of options. The factors at the low end of the list were related to skepticism and looking foolish due to being the only one changing actions.

The means and standard deviations are again displayed in Table 7, this time by barrier concepts; composite variables are shown in italics. No further items were combined as their internal consistency measured by Cronbach's alpha was not high enough (e.g. inconvenience and limitation of options, $\alpha = 0.59$) and the concepts were thus deemed distinct. Feelings of powerlessness were found to be on average slightly influential (M = 2.32) and scored third last on the list of ten barrier factors; looking foolish and skepticism were close to not influential at all. Factors that fell between slightly influential and somewhat influential were the commons dilemma and questions relating to lack of knowledge.

TABLE 6 Barrier items with central tendency and variability

	Mean	**SD**
The monetary costs of changing my actions.	3.58	1.11
The inconvenience of options.	3.44	1.05
Limited options.	3.09	1.01
Uncertainty about the most effective option to mitigate climate change.	2.84	1.12
Other countries or people not taking equivalent action at the moment.	2.76	1.36
Feeling others will not change their behavior even if I do.	2.67	1.29
Unfairness associated with bearing the costs of change while others do not take responsibility.	2.64	1.27
The feeling that my actions will not affect the outcome of climate change.	2.62	1.30
The feeling that climate change is too big for my actions to have an impact.	2.57	1.26
Lack of knowledge about possible changes I can make.	2.45	1.07
Fitting changes in with e.g. family.	2.33	1.26
With my behavior I cannot influence the climate as the task lies with industry.	2.07	1.07
Climate protective measures are determined by a few people in power; as a single individual, I have no effect.	2.03	1.12
There are larger problems than climate change.	1.70	0.92
Looking foolish due to being the only one changing actions.	1.44	.078
Uncertainty as to whether climate change is a significant problem.	1.41	0.84
The impacts of climate change are unpredictable; thus my climate-friendly behavior is futile.	1.35	0.72
Climate change and its consequences are being exaggerated in the media.	1.34	.083
I do not perceive climate change as a threat.	1.30	0.70

TABLE 7 Barrier concepts with central tendency and variability

	Mean	**Std. Deviation**
Monetary costs	3.58	1.11
Inconvenience of options	3.44	1.05
Limited options	3.09	1.01
Uncertainty of most effective option	2.84	1.12
Commons dilemma	2.69	1.14
Lack of knowledge of options	2.45	1.07
Fitting changes in with family	2.33	1.26
Perceived powerlessness	2.32	1.02
Looking foolish	1.44	0.78
Skepticism	1.42	0.67

Climate action. To begin reviewing participants' climate action, Table 8 reveals the number of categories (0-4) respondents had changed their behavior in. Only 6.5% had not altered their consumer behavior in any area, meaning 93.5% of respondents had taken climate action in at least one area of consumption. 38% of participants had taken climate-protective measures in all four of the presented categories. These results were obtained by coding No = 0 and Yes = 1 and creating a composite variable "action category sum" that added up each respondent's answers for the four areas of consumption.

TABLE 8 Action category sum - total of consumption areas (0-4) respondents had taken climate action in

Areas of action	Frequency	Valid Percent	Cumulative Percent
0	16	6.5	6.5
1	26	10.6	17.1
2	38	15.5	32.7
3	72	29.4	62.0
4	93	38.0	100.0
Total	245	100.0	

Next focus was shifted to the response distribution for each area. Table 9 presents how many respondents had made changes to their consumption behavior in order to mitigate climate change for each of the four categories. All investigated areas of consumption received a majority of positive answers, with changes in general consumption and recycling behavior being the most popular – well over 8 in 10 respondents reported having taken climate action in this area.

TABLE 9 Distribution of responses answering "have you changed your consumer behavior to mitigate climate change" for each of four areas

Climate-related consumption area	Made change	*n* (245)	Percent
Eating habits	No	60	24.5
	Yes	185	75.5
Transportation habits	No	103	42.0
	Yes	142	58.0
Energy and water consumption	No	94	38.4
	Yes	151	61.6
General consumption and recycling behavior	No	33	13.5
	Yes	212	86.5

Moving from general consumption areas to examination of specific actions, respondents reported an average of 10 consumption-related climate actions each. To examine these in detail, frequencies were extracted for each action. These are next reviewed by climate-related consumption area, beginning with eating habits. Within the four categories, a few participants informed via open-responses that they had not taken steps to change their behavior due to climate-related reasons, but favored low-carbon consumption patterns (also) due to other motivational factors. These included ethical, economic, and health-related reasons.

Three quarters of respondents reported having changed their eating habits to mitigate climate change. Table 10 lists the frequencies of specific behavioral changes taken and their percentages relating to the whole sample size (n = 245). Avoiding food waste was the most common change made with approximately 63% of all respondents having done this. More than half (56.3%) had also reduced their consumption of meat. Favoring seasonal food and local food were popular choices as well. Regarding open responses, four respondents wrote that they had adopted a vegan diet; these were included in the action of adopting a plant-based diet. The term plant-based diet is not unequivocal and the response option was likely selected by respondents following a variety of vegetarian diets. These accounted for more than a quarter of all respondents. Other open responses were combined as seen in the table. Examples of self-sufficiency were cultivation and berry and mushroom picking.

TABLE 10 Frequencies of climate actions relating to eating habits

Eating habits	**Frequency**	**Percent of total (n = 245)**
Avoiding food waste	154	62.9
Reducing consumption of meat	138	56.3
Favoring seasonal food	107	43.7
Favoring local food	103	42.0
Reducing consumption of dairy	94	38.4
Adopting a plant-based diet	65	26.5
Considering carbon footprint of products	62	25.3
Other: ”measures of self-sufficiency”	4	1.6
Other: ”favoring organic food”	3	1.2
Other: ”favoring eco-labels/ecological food”	2	0.8
Other: “considering packaging amount/material”	2	0.8
Other: “considering water footprint of products”	1	0.4

Next in line for scrutiny were transportation habits. Over half of respondents (58%) informed having changed their behavior in this area to alleviate climate change, with favoring environmentally friendly modes of transport being the most common change made (Table 11). Avoiding plane travel and driving less by private car were both reported by roughly a quarter of respondents, while

more than 1 in 5 had made the decision not to buy a car for climate-related reasons. A respondent wrote as additional information that their decision not to buy a car depends on their life circumstances and would consider an electric car should they have children in the future. The respondent went on to say that climate change was precisely the reason for them to give serious thought to having children; "it would be quite selfish to bring more people in to the world, where there already are too many".

TABLE 11 Frequencies of climate actions relating to transportation habits

Transportation habits	**Frequency**	**Percent of total (*n* = 245)**
Favoring environmentally friendly modes of transport	132	53.9
Avoiding plane travel	62	25.3
Driving less by private car	59	24.1
Deciding not to buy a car	55	22.4
Adopting economic driving practices	32	13.1
Buying a hybrid, natural gas, or electric car	10	4.1
Buying a more fuel-efficient car	7	2.9
Giving up private car	6	2.4
Other: "avoiding travel by boat"	1	0.4

Around 6 in 10 respondents answered positively to having changed their energy and water consumption to mitigate climate change. Frequencies for actions in this category are listed in Table 12 and elaborated on below.

TABLE 12 Frequencies of climate actions relating to energy and water consumption

Energy and water consumption	**Frequency**	**Percent of total (*n* = 245)**
Conserving water	103	42.0
Using less electricity	85	34.7
Using high-efficiency lightbulbs	75	30.6
Increasing share of renewable energy from supplier	59	24.1
Emphasizing energy efficiency in device purchases	51	20.8
Setting temperature at max 20 degrees in winter	35	14.3
Forgoing oil heating	7	2.9
Installing solar panels	5	2.0
Other: "decision to live in a smaller space"	2	0.8
Other: "energy efficiency measures for heating"	2	0.8

Conserving water was the most popular option with 42% of all participants reporting to have taken this action, followed by using less electricity (34.7%) and using high-efficiency lightbulbs (30.6%). Close to one fourth of respondents had

increased the share of renewable energy from their energy supplier. Single open responses not presented in the table included "wood heating", "replacing electric heating with an air source pump", and "favoring geothermal energy in the housing market". The response "reducing use of clothes dryer" was included under using less electricity.

The climate protective measures respondents had taken in their general consumption and recycling behavior are presented in Table 13. Of all the climate actions measured in the study, increasing recycling at home (78.4%) and reducing consumption of disposable items (68.2%) were the most frequent. Reducing consumption (67.3%) and buying used instead of new (56.7%) were also climate-motivated behavioral changes that were accounted for by a majority of respondents. Regarding open responses, answers were combined according to theme except for "reducing consumption of individually wrapped products", which was added to the action of reducing waste. Also, a few comments were treated as additional insight: "not caring about fashion", "making more sustainable choices even if it costs more", and "especially as new, recycling plastic".

TABLE 13 Frequencies of climate actions relating to general consumption and recycling behavior

General consumption and recycling behavior	**Frequency**	**Percentage of total (n = 245)**
Increasing recycling at home	192	78.4
Reducing consumption of disposable items	167	68.2
Reducing consumption	165	67.3
Buying used instead of new	139	56.7
Reducing waste	109	44.5
Increasing recycling in public	104	42.4
Considering carbon footprint of products	54	22.0
Purchasing carbon offsets	31	12.7
Other: "ecolabels/ecological/climate-friendly products"	3	1.2
Other: "investment in sustainability/longevity of products"	3	1.2
Other: "borrowing instead of buying"	2	0.8
Other: "avoiding products containing palm oil"	1	0.4

4.2 Correlation analyses

Risk perception and knowledge. The first research objective relating to barriers to action called for examination of the relations between knowledge, risk perception, and climate action. This was approached by first investigating the relationship between risk perception (RP) and the five types of climate change knowledge. Before Pearson correlation coefficients were calculated for the variables, preliminary analyses of linearity were performed. The subsequent results of correlation are presented in Table 14. A statistically significant positive relation was found between risk perception and each of the five knowledge dimensions. The strongest correlation of medium effect size (r = .32, n = 245, p < .001) was observed between RP and causal knowledge (CK), and RP and result-related knowledge (RK). Physical knowledge (PK), action-related knowledge (AK), and effectiveness knowledge (EK) each had a positive correlation of small effect size with RP. In addition, the knowledge variables had strong positive correlations with each other, particularly in the cases of CK and RK (r = .64, p < .001), and AK and EK (r = .63, p < .001).

TABLE 14 Pearson correlations between measures of risk perception and types of climate change knowledge

Variable	1	2	3	4	5	6
1. Risk perception	-					
2. Physical knowledge	.22**	-				
3. Causal knowledge	.32**	.60**	-			
4. Result-related knowledge	.32**	.56**	.64**	-		
5. Action-related knowledge	.29**	.48**	.59**	.60**	-	
6. Effectiveness knowledge	.27**	.54**	.61**	.50**	.63**	-

** p < .001 (2-tailed).

Risk perception and climate action. Next the relation between risk perception and climate action was examined from three perspectives. As only 16 respondents out of 245 had not taken climate action in any consumption area, correlation analysis would not have been appropriate with a binary variable of "has or has not taken action"; there should not be a large disparity between the number of respondents for the two options. Instead the relationship between risk perception and binary climate action was approached through a box plot (Figure 5). The graph indicated that respondents who had not changed their consumption behavior to mitigate climate change tended to have lower risk perception. This was supported by the results from calculating a risk perception mean for those who

had not taken climate action (M = 4.29, n = 16) and those who had taken action in at least one of four areas (M = 5.28, n = 229).

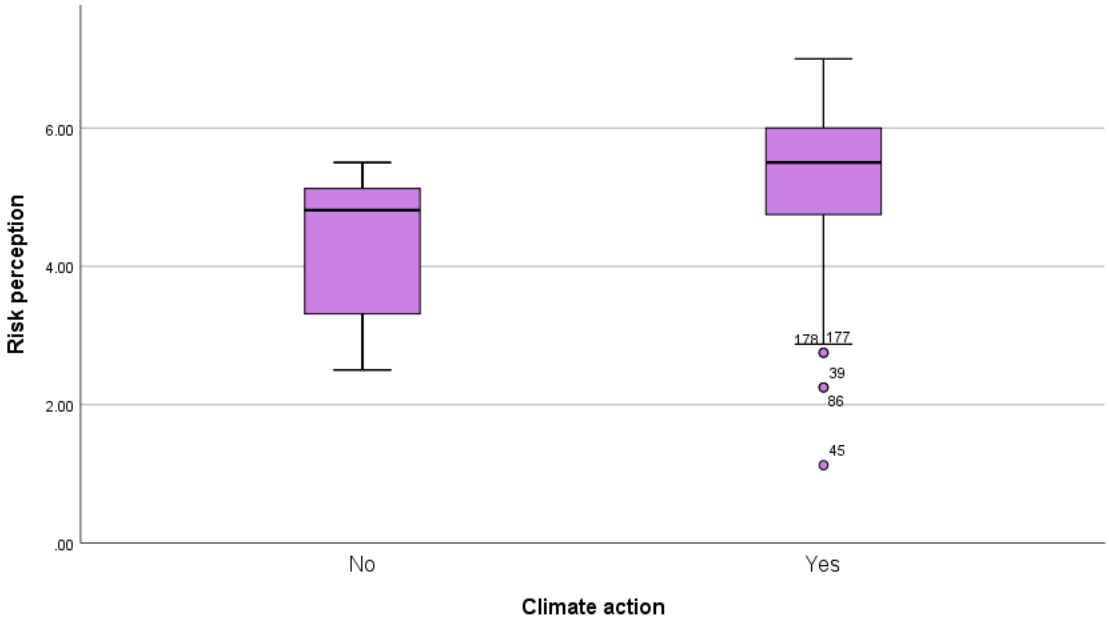

FIGURE 5 Box plot of relation between risk perception and climate action

Secondly, the relationship between risk perception and climate action was examined by calculating the Pearson correlation coefficient for RP and action category sum (ACS). As introduced in the previous sub-chapter, the composite variable ACS measured how many areas of consumption had respondents changed their behavior in (0-4). A preliminary analysis of linearity was performed through a scatter plot. There was a positive correlation of medium effect size between the two variables, r = .45, n = 245, p = < .001 (2-tailed sig.) with higher levels of risk perception associated with climate action in more areas of consumption.

Thirdly, the relation between risk perception and action was investigated for each of the four consumption areas to identify any differences between the categories. As the climate actions / changes in consumer behavior were measured dichotomously – by answers of yes or no – this was begun by creating simple box plots for initial analysis of direction and strength of correlation. Visual inspection indicated that the strongest association was between risk perception and taking action by change of eating habits (EH). This was confirmed in the point-biserial correlation analysis performed by means of Pearson r. The results are presented in Table 15. Respondents who reported having changed their eating habits to mitigate climate change tended to have higher risk perception (r = .41, p < .001). A positive correlation of medium effect size was also found for transportation habits (TH) and general consumption and recycling behavior (GCR). For risk perception and energy and water consumption (EWC) there was a small but significant positive correlation.

TABLE 15 Pearson correlations between risk perception and climate action in four consumption areas

Variable	Risk perception
Eating habits	.41**
Transportation habits	.32**
Energy and water consumption	.21**
General consumption and recycling behavior	.33**

** p < .01 (2-tailed).

Knowledge and climate action. Similar to the relationship between risk perception and climate action, the relationship between knowledge and climate action was approached from more than one angle. Pearson *r* was first used to examine the correlation between action category sum (ACS) and each of the five knowledge dimensions (Table 16). This revealed no significant correlation between physical knowledge and the number of consumption areas (0-4) respondents had taken climate action in. A small but significant positive relation was found for all of the other dimensions, the strongest of which was between ACS and RK, and weakest between ACS and AK.

TABLE 16 Pearson correlations between types of climate knowledge and number of consumption areas respondents had taken climate action in

Variable	Action category sum (0–4)
Physical knowledge	(.12)
Causal knowledge	.19**
Result-related knowledge	.23**
Action-related knowledge	.15*
Effectiveness knowledge	.21**

** p < .01 (2-tailed), * p < .05 (2-tailed).

Next the relationship between climate knowledge and action was investigated by examining each area of consumption separately. Box plots were extracted for preliminary analysis. The results for calculation of Pearson *r* as point-biserial correlation are presented in Table 17 and reveal an association between higher levels of climate knowledge – with the exception of physical knowledge – and changing eating habits to mitigate climate change. In particular respondents reporting higher levels of RK were more likely to have changed their eating habits ($r = .27$, $p < .01$). On the other hand, there was no correlation of significance between knowledge and changes in energy and water consumption.

TABLE 17 Pearson correlations between types of climate knowledge and climate action by consumption area

Variable	EH	TH	EWC	GCR
Physical knowledge	(.12)	(.08)	(.08)	(.07)
Causal knowledge	.22**	.16*	(.02)	.13*
Result-related knowledge	.27**	.14*	(.10)	.14*
Action-related knowledge	.20**	(.11)	(.02)	(.08)
Effectiveness knowledge	.23**	.14*	(.10)	(.12)

** p < .01 (2-tailed), * p < .05 (2-tailed).

Note to Table 17
EH = eating habits; TH = transportation habits; EWC = energy and water consumption; GCR = general consumption and recycling behavior

Knowledge, powerlessness, and the commons dilemma. To pursue the second research objective, preliminary scatter plots and Pearson *r* were again used to examine the relationship between perceived powerlessness (PP) and different dimensions of climate change knowledge. Also the composite variables of the commons dilemma (CD) and skepticism (SKP) were included in the analysis, the results of which are presented in Table 18. To increase clarity the inter-relations of the knowledge variables are omitted from the correlation matrix as they were previously shown in Table 14. A small negative correlation was observed between PP and AK, as well as PP and EK, indicating a weak but significant association between higher levels of action-related and effectiveness knowledge and lower perceptions of powerlessness as a barrier to climate action.

The correlation analysis revealed a strong positive relation between the barrier factors PP and CD ($r = .66$, $p < .01$). In addition, there was a moderate and positive correlation between SKP and both PP and CD. Furthermore, skepticism was found to have a small negative correlation with all types of climate knowledge, in particular causal knowledge, which bordered medium effect size ($r = .29$, $p < .01$). In addition, a weak correlation was identified between higher levels of physical knowledge and considering aspects of the commons dilemma as less of a barrier.

TABLE 18 Pearson correlations between composite barriers and types of climate knowledge

Variable	PP	CD	SKP
Commons dilemma	.66**	-	
Skepticism	.39**	.33**	-
Physical knowledge	(-.07)	-.14*	-.14*
Causal knowledge	(-.11)	(-.04)	-.29**
Result-related knowledge	(-.06)	(-.08)	-.21**
Action-related knowledge	-.15*	(-.08)	-.18**
Effectiveness knowledge	-.14*	(-.07)	-.14*

** p < .01 (2-tailed), * p < .05 (2-tailed).

While not central to the research objectives, the three composite barriers were also examined against risk perception and action category sum with significant correlations revealed (Table 19). Pearson *r* indicated a weak negative correlation between RP and both PP and CD, and a strong negative correlation between RP and SKP inferring the more skepticism is felt as a barrier, the lower one's risk perception tends to be. As for climate action, a negative relation of small effect size was recorded between ACS and CD, and a moderate negative correlation between ACS and both PP and SKP. This inferred a tendency that the less these concepts were felt as a barrier, the more likely a respondent was to engage in more areas of consumption-related climate action.

TABLE 19 Pearson correlations between composite barriers and risk perception and ACS

Variable	Risk perception	Action category sum
Perceived powerlessness	-.23**	-.38**
Commons dilemma	-.17**	-.15*
Skepticism	-.61**	-.36**

** p < .01 (2-tailed), * p < .05 (2-tailed).

Socio-demographics. Pearson *r* and preliminary box plot / scatter plot analyses were used to test for associations between gender and age – measured by year of birth – and composite variables central to the study. The correlation coefficients are displayed in Table 20. Analyses performed for gender included males and females (n = 239), while those performed for age included the whole sample (n = 245). Year of birth was found to correlate negatively with skepticism (r = -.24, n = 245, p < .001) indicating a somewhat weak but statistically significant relation

between older age and higher levels of skepticism. Regarding respondents' age and climate action, no significant association was found – neither for ACS nor by examining each consumption area separately. Similarly, no relation was found between year of birth and risk perception.

TABLE 20 Pearson correlations between composite variables and birth year and gender

Variable	**Birth year**	**Gender**
Perceived powerlessness	(.08)	-.16*
Commons dilemma	(<.01)	(-.05)
Skepticism	-.24**	-.25**
Risk perception	(.08)	.28**
Action category sum (0-4)	(.01)	.27**

** p < .001 (2-tailed), * p < .05 (2-tailed).

Moving on to gender, an initial box plot assessment indicated that women tended to report higher levels of perceived risk. Pearson *r* then revealed an association of small effect size between gender and risk perception. Regarding composite barriers, males were more likely to rate perceptions of powerlessness and skepticism higher, while no meaningful gender-related association was detected for the commons dilemma. Women tended to take climate action in a greater number of consumption areas. Examination was then continued for gender and each consumption area through chi-square tests for independence (with Yate's Correction for Continuity), having first confirmed that the assumptions of minimum expected cell frequency were not violated. A significant association of medium effect size was found between gender and changing eating habits ($X^2(1, n = 239) = 24.43$, $p < .001$, $phi = .31$), and small associations for energy and water consumption ($X^2(1, n = 239) = 4.89$, $p = .03$, $phi = .15$), and general consumption and recycling behavior ($X^2(1, n = 239) = 6.49$, $p = .01$, $phi = .18$). No significant association was indicated for gender and changing transportation habits to mitigate climate change (X^2 (1, $n = 239$) = 3.11, $p = .08$, $phi = .12$).

The third and final type of demographic data examined was study faculty. Education and Psychology was omitted from the analyses due to its low response rate (n =2). A Kruskal-Wallis test revealed a statistically significant difference in risk perception levels across the five remaining study faculties (Mathematics and Science, n = 76, Sport and Health Sciences, n = 57, Humanities and Social Sciences, n = 53, JSBE, n = 49, Information Technology, n = 8), $\chi 2$ (4, n = 243) = 11.86, p = .018. Information Technology recorded the lowest median value (Mdn = 4.69), followed by Sport and Health Sciences and Mathematics and Science (Mdn = 5.25). The highest median score was shared by Humanities and Social Sciences and JSBE (Mdn = 5.63).

Next study faculty and climate action were examined together. A Kruskal-Wallis test did not show a difference of significance in how many areas of consumption respondents had taken climate action in across study faculties, $\chi 2$ (4, n = 243) = 6.54, p = .163. A chi-square test for independence was then used to investigate whether there was an association between study faculty and climate action in each of the four consumption areas. It was first confirmed that the assumptions of minimum expected cell frequency were not violated. No significant association was found between faculty and transportation habits (X^2(4, n = 243) = 4.30, p = .37, *phi* = .13), energy and water consumption (X^2(4, n = 243) = 5.56, p = .24, *phi* = .15), nor general consumption and recycling behavior (X^2(4, n = 243) = 7.12, p = .13, *phi* = .17). There was however a significant association of small effect size indicated between study faculty and change in eating habits (X^2(4, n = 243) = 13.37, p = .01, *phi* = .24).

4.3 Summary

To conclude this chapter and summarize the findings, the main results of the study are considered against the proposed hypotheses that concerned the primary research aim. Table 21 reviews the four hypotheses and summarizes the outcomes of whether or not the theory-based assumptions were supported.

TABLE 21 Summary of hypotheses

	Hypothesis	**Supported or not**
H1	Respondents demonstrating higher levels of climate change risk perception are likelier to report having changed their behavior to mitigate climate change.	Supported
H2	The relation between respondents' knowledge and climate action, and that of knowledge and risk perception, varies depending on the type of climate change knowledge examined.	Partly supported
H3	The extent to which respondents perceive powerlessness as a barrier to climate action is related to their level of knowledge, depending on the type of climate change knowledge examined.	Supported
H4	Perceived powerlessness correlates positively with the commons dilemma.	Supported

H1 was supported by all three pieces of information revealed: Firstly, the risk perception mean for respondents who had not taken any climate action was lower than for those who had taken action in at least one of four areas. Secondly, higher levels of risk perception were associated with climate action in more areas of consumption. And thirdly, when examining each area separately higher risk

perception reflected on a higher likelihood of having taken action for each of the four categories.

H2 was partly supported. There was little variance across the associations between risk perception and different types of climate change knowledge – however, the correlations ranged from small to medium effect size. The hypothesis was supported in that unlike with the other knowledge dimensions, no statistically significant correlation was found between physical knowledge and climate action. Thus, the relation between knowledge and climate action varied depending on the type of climate change knowledge examined.

The results relating to H3 supported the hypothesis as a negative relation was identified between perceived powerlessness and action-related and effectiveness knowledge, but no association of significance was found for perceived powerlessness and the other knowledge types. Finally, H4 was supported as a strong positive correlation was revealed between perceived powerlessness and the commons dilemma.

5 DISCUSSION AND CONCLUSIONS

This final chapter of the thesis consists of four main parts. First, the central findings of the study are reflected on in relation to existing literature, considering each research aim and objective in turn. Next, the contributions of the study are recognized, and the implications the research findings offer for improved climate change communications are presented. In the third sub-chapter, limitations of the study are acknowledged and assessed. Finally, the thesis concludes with relevant recommendations for further research.

5.1 Addressing the research aims and key findings

5.1.1 Relations of knowledge, risk perception and climate action

The primary research aim of furthering the understanding of various barriers to consumers' climate action was divided into three objectives. Motivated by gaps in the literature field, the first research objective was to examine the relations between different types of self-reported knowledge, perceived risk, and self-reported climate action. Beginning with the association of perceived risk and knowledge, the key findings were twofold. Risk perception was positively correlated will all five types of climate change knowledge, and out these the strongest relations of medium effect size were for causal knowledge and result-related knowledge. The overall finding supports the theory that climate knowledge is closely linked to how serious of a threat climate change is perceived as, but that knowledge by itself is by no means enough to explain the variances in risk perception. However, this study did not examine causal relations and as such cannot assume that knowledge preceded perceptions of risk, even if this might be the intuitive expectation. The positive associations identified for risk perception and knowledge related to the causes and effects of climate change were in accordance with several previous studies (Hidalgo & Pisano, 2010; Sundblad et al., 2007; Tobler et al., 2012; van der Linden, 2015), while contradicting to more solitary findings by Kellstedt et al. (2008) that implied more information to be related with less concern, and by Shi et al. (2015) who, interestingly, did not find knowledge about the effects of climate change to be related with concern for the issue. The knowledge dimensions of physical and action-related knowledge – and particularly that of effectiveness knowledge – have been less researched. The present results of weak positive correlations are at variance with initial research by Tobler et al. (2012) who found physical knowledge to be negatively correlated with concern for climate change, and Shi et al. (2015) who detected no relation between the two. Furthermore, the pair of studies did not find predictive effect between action-related knowledge and risk perception. The present study however focused on correlation analysis and did not apply methods of prediction.

Next the relationship between perceived risk and climate action was scrutinized. Three main findings supporting a positive relation between the concepts surfaced from the results. Firstly, respondents who had not changed their consumption behavior to mitigate climate change in any of the four presented areas – eating habits, transportation habits, energy and water consumption, or general consumption and recycling behavior – tended to have lower risk perception than those who had taken climate action in at least one area. Secondly, higher levels of risk perception were correlated with climate action in more areas of consumption. Thirdly, greater risk perception was related to climate action in each of the four areas, the strongest association of which was identified for changes in eating habits. As altering the food behaviors of consumers – both for the sake of the climate and public health in general – is a widely recognized challenge, it is regarded as valuable to understand the motivators which can prompt food-related behavioral change (Sanchez-Sabate & Sabaté, 2019). The clear implication between higher levels of perceived climate change risk and changing one's eating habits is therefore of particular importance. All in all the findings add to the bulk of literature indicating that greater awareness and concern does seem to increase the likelihood of voluntary behavioral change (e.g. Aitken et al., 2011; Hu & Chen, 2016; Williams & Jaftha, 2020), although this connection is not always found (Thaller et al., 2020).

The final aspect of the first research objective called for examination of the relation between different types of climate change knowledge and climate action. Several points of interest were found. The lack of association between physical knowledge and climate action is in line with the work of Shi et al. (2015) and supports the theory that basic climate science tends to hold less importance for consumers (Somerville & Hassol, 2011). The other four dimensions of knowledge were all positively associated with climate action to some extent. Since the existing body of literature is so ambivalent regarding the relation between knowledge and voluntary mitigation, these findings support some studies (e.g. Bord et al., 2000; O'Connor et al., 1999) while inevitably contradicting others (e.g. Brody et al., 2012; Hidalgo & Pisano, 2010; Thaller et al., 2020). Result-related knowledge had the strongest association – albeit still of small effect size – with climate action, whereas Shi et al. (2015) identified a negative correlation between this type of climate knowledge and the willingness to alter behavior for the benefit of the climate. The authors hypothesized that greater knowledge about the consequences of climate change resulted in feelings of powerlessness, which in turn diminished the willingness to act. The present results suggest the opposite – better understanding of the impacts of climate change is related to more behavioral change aimed at its mitigation. Both studies however noted a positive correlation for action-related knowledge and climate action. Since the current study differentiated between action-related and effectiveness knowledge, it was able to detect that the association for the latter appeared to be slightly stronger.

Some further points of interest were discovered when examining climate knowledge and action separately for each of the four consumption areas. A significant variance was observed between the categories: all types of climate-related knowledge – excluding physical knowledge – were correlated with changes

in eating habits, whereas climate action in energy and water consumption was not related to any of the climate knowledge dimensions. This raises the question of why does climate change knowledge appear to be related to changes in eating habits, but not changes in energy and water consumption? Perhaps energy and water consumption is closely linked to another variable, such as environmental values, which was not examined in this study. The environmental benefits of energy and water conservation tend to be known and therefore engaging in these for the sake of climate protection would not require higher levels of climate-specific knowledge. Furthermore, saving electricity and water may offer a financial incentive and demand little personal sacrifice. In contrast, eating habits are not only a deeply personal matter but they are also ingrained culturally in a complex sense. For example, meat consumption was until the recent implementation of factory farming associated with wealth, luxury, and status. The ready availability of meat products – which is now the case for developed countries – does not alter millennia of socially learned behavior and association. This is to say, the reduction or renunciation of animal products represents a much bigger investment than for instance saving water or electricity. Therefore, it seems reasonable that those who have changed their eating habits to mitigate climate change are likely to be knowledgeable about the causes and consequences of climate change, as well as different mitigative actions and their effectiveness. Conversely, those less informed are less likely to have altered their eating habits or diet, which is regarded as a very personal matter.

5.1.2 The relation between knowledge and powerlessness

The second research objective was to examine the relation between different types of self-reported knowledge and the perception of powerlessness as a barrier to consumers' climate action. Although the identified correlations were weak in strength, the findings point to higher levels of action-related knowledge and effectiveness knowledge to be linked with a lesser likelihood of viewing feelings of powerlessness as a barrier to climate action. Tobler et al. (2012) reached a similar conclusion, although the authors did not distinguish effectiveness knowledge as separate but included some of its elements under evaluation of action-related climate change knowledge. No further correlations were detected for perceived powerlessness and the knowledge dimensions studied. For example, result-related knowledge was not related to higher perceptions of powerlessness, thus contradicting theorization by Shi et al. (2015). Also causal knowledge was not associated with less feelings of powerlessness, therein diverging from the findings by Tobler et al. (2012). The notion that understanding the anthropogenic causes of climate change may increase people's perceived power to make a difference however certainly seems plausible. Focusing on the evidence presented by the present study, the implications seem even more straightforward: consumers equipped with knowledge about different measures and their relative effectiveness to mitigate climate change do not feel as powerless in face of the challenge as those lacking this information. The reason why the correlation was not stronger may have to do with the perceived limited impact of a single individual.

Although an individual consumer may know what climate actions they can take, the actions may not be felt particularly impactful unless produced in the cumulative by a number of people. This relation between perceived powerlessness and the commons dilemma will be discussed among the findings relating to the third research objective.

5.1.3 Perceived powerlessness and other barriers to action

The third research objective was to examine how perceived powerlessness compares to other barriers to consumers' climate action. The low mean ranking on the list of ten barrier factors speaks that among the participants various other impediments were deemed more relevant than perceptions of powerlessness. The most influential of these were monetary costs, followed by inconvenience of options, and limitation of options. These were also the three most influential barriers rated by Australians in the recent study by Williams and Jaftha (2020), albeit in different order. The similarities also extended to the impediments felt the least, which were related to skepticism and looking foolish due to being the only one to change behavior. Uncertainty of the most effective option, perceptions of the commons dilemma, and lack of knowledge about possible changes that could be made were all on average more influential than perceived powerlessness. Fitting changes in with e.g. family was nearly levelled with powerlessness, which ranked third last in influence of the ten barrier concepts measured.

While perceptions of the commons dilemma appeared to be a more significant barrier than perceptions of powerlessness, the difference was not particularly substantial. Following the findings by Aitken et al. (2011) and William and Jaftha (2020) a strong positive correlation was identified between the two factors. It is worth noting that the scale for the commons dilemma was the same for all three studies, but for perceived powerlessness the current study replaced one of the original three items with two new ones. Yet, a similar correlation effect was obtained. The finding thus offers support to the theory that a substantial part of the powerlessness consumers feel regarding the effects of their actions is related to a (perceived) lack of contribution from others – be it other individuals, countries, industries, or persons in power. With climate communication efforts that are often designed in a manner that targets individuals as single consumers within a larger social system (Climate Change Communication Advisory Group, 2010), these perceptions may be exacerbated and the challenges felt overwhelming. Another challenge relating to perceived powerlessness and the commons dilemma that climate communicators face is referred to as the mobilizer's dilemma. This predicament arises when communication strategies that aim at raising action through urgency involuntarily leave the audience feeling powerless in face of the forthcoming catastrophe – whereas efforts advocating action and empowerment by showcasing the commitment of others may undermine urgency and provoke freeriding through a feeling of complacency (Vasi & Macy, 2003).

5.1.4 General climate awareness

The second research aim of the thesis was to explore the general climate awareness and consumption-related climate action of Finnish university students. The survey produced interesting data on the perceptions of climate-related risks and knowledge held by students as well as their responses to tackle climate change through altered consumption behavior. The key findings are next reviewed for those related to climate knowledge and perceived risk, while the next sub-chapter takes climate action into focus.

Overall, participants tended to view themselves knowledgeable about climate change. They appeared to feel informed particularly about the causes and consequences of climate change as well as means of mitigation. While the greenhouse effect and greenhouse gases – relating to physical knowledge – were not as familiar, still more than half considered to have at least a good understanding of them. However, respondents were found to report considerably lower proficiencies of effectiveness knowledge compared to the other four knowledge dimensions. This is in line with the reviewed literature suggesting that despite its significance, consumers tend to lack understanding of the comparative effectiveness of available mitigative measures (Gifford, 2011; Kaiser & Fuhrer, 2003). The finding is particularly salient considering that after monetary and structural barriers, "uncertainty of most effective option to mitigate climate change" was rated as the most influential factor in one's decision making about consumption behavior that might affect climate change. This offers a consumer perspective to research by Körfgen et al. (2019) who, having interviewed experts and surveyed climate change communicators, regarded effectiveness knowledge as a key driver for engagement in climate action.

In addition to high levels of reported knowledge, the low overall ratings of barriers relating to skepticism speak of high climate awareness among the respondents. Items measuring skepticism included for instance "uncertainty as to whether climate change is a significant problem" and "climate change and its consequences are being exaggerated in the media". Examining climate change knowledge and skepticism together revealed a negative correlation: respondents evaluating their levels of climate knowledge as low were more likely to rate elements related to skepticism as relevant barriers to climate action. A similar outcome was obtained by Yu et al. (2020). The findings of the present study suggest that a lesser understanding of particularly the causes of climate change is linked with more doubts about the nature and scope of the issue. While the respondents' assessment of knowledge may already reflect a wariness toward climate science, the findings together with those by Tobler et al. (2012) involving measured knowledge give reason to believe that skepticism about climate change could be lessened through dissemination of causal knowledge. As skepticism was also correlated with older age, it may be that older participants had not received the same climate education as younger ones, since climate change education in schools is relatively new (Ratinen & Uusiautti, 2020). Then again, evidence suggests that adults in later stages of life are more influenced by cultural worldviews and political stance than younger people, and their perceptions of climate change

are less affected by factors such as climate change knowledge (Aksit et al., 2018; Libarkin et al., 2018). Therefore merely informing about the science-based causes of climate change may not change these perceptions, and the importance of the source and framing of the issue is instead highlighted in these instances.

The dataset generated a high overall rating for climate change risk perception, reflecting participants' concern for the issue. Similar to findings by Thaller et al. (2020), respondents evaluated climate change as a bigger threat to nature and society in general than to them personally. The estimated impacts for Finland were also rated comparatively low. These outcomes are of particular interest as research indicates that those perceiving climate change as a greater risk to their person (Brody et al., 2012), country (Smith & Mayer, 2018), or local area (Scannell & Gifford, 2013) are more likely to take relevant action. The findings raise question as to whether lower perceived risk concerning oneself and Finland is due to a lack of awareness about the current, expected, and potential local impacts – and as such, presents a prospective pathway for enhanced climate communications. However, the greater adaptive capacities of developed countries give justified reason – to some extent – to the common effect of spatial optimism, which is the tendency to view climate change as less of a risk to oneself than to geographically distant people (Tvinnereim et al., 2020).

5.1.5 Consumption-related climate action

The results revealed a particularly high rate of participation in climate change mitigation among the respondents, with more than nine in ten reporting having taken climate action. Furthermore, more than one third (38%) had changed their behavior in all four of the climate-related consumption areas: eating habits, transportation habits, energy and water consumption, and general consumption and recycling behavior. These findings suggest that university students are more engaged in climate protection than the greater population, although information regarding consumers' climate action in Finland conveys varying levels. Vainio and Paloniemi (2013) relate that despite multisectoral promotion of climate-friendly behavior, only a minority of Finnish consumers take action to protect the climate. More recent evidence however displays a more positive trend. In a survey commissioned by the Finnish Innovation Fund Sitra inquiring whether respondents have taken action in their daily lives to mitigate climate change, nearly half (46%) answered positively (Kantar TNS Oy, 2019). In the same year of 2019 also considerably higher rates of engagement were documented. According to the latest Eurobarometer on climate change (European Commission, 2019), more than eight in ten respondents (82%) in Finland said they had personally taken action to tackle climate change during the past six months. The report highlights that the figure had increased significantly, by 17 percentage points, from the previous survey only two years prior. In that survey of 2017 the percentage of Finns stating having taken action to fight climate change was the same as in 2011, 65% (European Commission, 2011).

Reviewing respondents' climate action by category revealed general consumption and recycling behavior to be the most common area for climate-related

behavioral change (87% positive responses). Changes in transportation habits was the least reported, although still more than half (58%) informed having done this. Changes in eating habits (76%) and energy and water consumption (62%) fell in between. The lower rate in change of transportation habits may simply reflect respondents' living situations – in compact cities such as Jyväskylä it is commonplace for students to walk, cycle, or move by bus and owning a car is by no means necessary. However, research has shown that climate-driven voluntary change of mobility behavior among Europeans is rather rare and difficult to motivate (Dubois et al., 2019; Jakučionytė-Skodienė & Liobikienė, 2021) and that Finns tend to consider their personal car use to be at an appropriate level (Salonen et al., 2018). That being said, the sample is from a very specific segment and appears to diverge considerably from the greater public in at least some of their actions. For example, three quarters of the study participants stated having changed their eating habits to mitigate climate change, whereas only 17% of European respondents in the latest Eurobarometer on climate change reported having considered the carbon footprint of their food purchases and had at times adapted their shopping accordingly (European Commission, 2019). Student restaurants offer and promote vegetarian and vegan options (e.g. Semma, n.d.) and thus make it possible for students to eat affordable climate-conscious meals with little effort. This may in part explain the high rate of climate action in this area of consumption, particularly in the case of reducing one's consumption of meat. The specific means of consumption-related climate action participants had engaged in are next discussed highlighting the main findings.

Of all the climate actions measured in the study, increasing recycling at home, and reducing consumption of disposable items were the most frequent. These findings concur with the latest climate change themed Eurobarometer, which reports that the two most common climate measures among Finns are reducing and separating waste, and cutting down consumption of disposable items (European Commission, 2019). Recycling waste tends to be an automated act of sustainability for Finns (Salonen et al., 2018). The result of nearly eight in ten respondents having increased their recycling at home for the sake of climate change mitigation is likely partly related to the fairly short history of plastic recycling in Finland – the collection of consumer plastic packaging began in 2016 (Rasmussen, 2017). In fact, a participant volunteered the information that they had in particular started recycling plastic. In general, respondents were rather conscious of their consumption behavior as the climate actions of reducing consumption and buying used instead of new were reported by more than half of the participants. Examining the most popular actions spanning all four categories, more than half also stated having started favoring environmentally friendly modes of transport and avoiding food waste. Furthermore, over half had reduced their consumption of meat, which was even more common than favoring seasonal or local food. This is a particularly positive discovery in light of previous research where consumers were found to be more willing to buy local and seasonal food than to eat less meat, despite the latter option being exceedingly superior in emissions mitigation (de Boer et al., 2016).

Within energy and water consumption, actions of conservation were highlighted. Students' living situations may restrict the means available and there may also be other prior, for instance economic motivations to save water and energy. It is noteworthy however that several respondents had undertaken means of greater investment such as installing solar panels and forgoing oil heating. Some high impact actions – as categorized by Wynes & Nicholas (2017) – were also present within changes in transportation habits: a quarter of respondents avoided plane travel and around the same number had either decided not to buy a car or had given it up, while several had opted for a more climate-friendly car. All in all, the pool of consumers were commendably engaged in climate change mitigation. While the most frequent actions tended to be of low or medium impact, such as recycling and reducing consumption and waste, high impact ones were, arguably, represented fairly well. In addition to those mentioned above, these included eating a plant-based diet and purchasing green energy – both climate-motivated changes that were adopted by a quarter of respondents. Moreover, participants reported an average of ten consumption-related climate actions each. This is positive as it suggests a lack of single-action bias, which refers to people's tendency to take only one step of action in face of a threat and is regarded as a central barrier for meaningful climate action (Weber, 2010).

Despite the study being quantitative in nature, the few open-response items allowed for the collection of some additional qualitative data. This gave a glimpse of how profoundly climate change can be present in the minds of students, such as in family planning. Comments also strengthened the notion that climate action tends to go hand in hand with personal values and health benefits, and often with economic savings as well. Statements about borrowing a lot and not caring about fashion, in addition to two thirds of respondents reporting having cut down on their consumption, hints at a will to break from the culture of consumerism that is arguably largely behind climate change (e.g. Atkin, 2019).

5.1.6 Socio-demographic factors

Socio-demographic information was collected to assess whether the sample could be regarded as representative of the Jyväskylä University student body – which it could not be due to slight overrepresentation of females and disproportional faculty representation. However, as literature points to a need for further data on the relations between demographic factors and climate-related concern and behavior (e.g. Lacroix & Gifford, 2017), these associations were also included in the study. Next the findings concerning age, gender, and study faculty are reviewed, beginning with the former. Younger people have at times been linked with more climate-friendly behavior (Semenza et al., 2008; Shi et al., 2015), although more often climate action has been seen to increase with age (Bruderer Enzler & Diekmann, 2019; González-Hernández et al., 2019; Thaller et al., 2020; Tobler et al., 2012). Among the university students no such relation was found – neither for the number of areas climate action had been taken in nor by examining each consumption area separately. Similarly, no relation was found between year

of birth and risk perception, while previous research has linked low climate-related risk perception with young individuals (Perera & Hewege, 2018). The lack of significant correlation may be due to the specific segment of this study that resulted in a data set with skewed age distribution.

The study adds to existing literature on variances in climate-related concern and behavior between genders. There is a bulk of research demonstrating that women tend to report more pro-environmental attitudes and concern than men (e.g. Feygina et al., 2009; Gifford et al., 1982; Hunter et al., 2004) and evidence is beginning to show a similar trend for climate-specific concern (Scannell & Gifford, 2013; Shi et al., 2015; Sundblad et al., 2007). The current results add to this notion. They also support the findings by Thaller et al. (2020) indicating that women are more likely to take part in consumption-related climate conservation behavior. The present study found a gender dependency particularly in the action of changing one's eating habits to mitigate climate change. Literature has speculated the reasons behind the differences in climate-related consumer behavior between genders. For example, the personality trait of agreeableness and the social disposition of being other-oriented – both of which are more prominent among females – have been suggested as explanations for sustainable consumer behavior (Gifford & Nilsson, 2014). The present results indicated that compared to women men were more likely to rate perceptions of powerlessness and skepticism as relevant barriers for action. A long line of research indicates that women are more risk averse particularly in matters of health and safety - presumably due to evolutionary factors and biological profiles – which may manifest itself in a more future risk oriented disposition (e.g. Harris et al., 2006).

It should be noted however that while this thesis focused on climate action in various forms of consumption-related behavior, in the areas of climate citizenship (Thaller et al., 2020) and willingness to support GHG-restrictive government policies (O'Connor et al., 1999) it has been the male segment that has been documented to show more engagement. As related by Verba et al. (1997), literature theorizes that men's greater engagement in political pressure stems from gender-based personality differences such as aggressiveness and an inclination for conflict. Furthermore, with research linking men's reluctance to engage in sustainable consumption to a fear of being perceived as feminine (Brough et al., 2016), at least a partial picture is painted of why the generalized male segment may be more active in driving climate politics than taking individual climate action. Most certainly both voluntary individual and regulatory societal changes are necessary to mitigate the course of climate change (e.g. Lacroix & Gifford, 2017). If men are less inclined to adopt climate-friendly lifestyle choices for the sake of climate protection, perhaps desirable behavioral change could be better pursued through other pathways such as health-related, social, or economic motivators.

The research also contributed by revealing a difference in risk perception levels across study faculties. This may have to do with the subjects taught, but student disciplines have also been linked to value orientations (e.g. Myyry & Helkama, 2001). Students of Information Technology appeared to be the least concerned about climate change. While the faculty was represented by only eight

respondents, previous research studies have documented students of technology to exhibit less environmental concern than students of other disciplines (McKnight, 1991; Tikka et al., 2000). Regarding climate action, study faculty was not related to how many areas of consumption respondents had taken action in, but there was an association indicated between study faculty and change in eating habits.

5.2 Contributions and implications of the study

Within the greater topic of engaging consumers with climate change mitigation, this thesis embarked on the mission of producing pertinent information concerning barriers that may stand in the way of meaningful action – and how climate communications might alleviate them. Several different angles were applied and data were also gathered to form a picture of the segment's general climate engagement – consequently, the findings and contributions were manifold. This sub-chapter will first review the central inputs the study presented. The findings will then be considered based on their implications for enhanced climate change communications. The section ends in a summary encapsulating these key implications.

Firstly, the thesis has supplemented the work of Shi et al. (2015) and Tobler et al. (2012) by adding evidence to the relevance of treating climate change knowledge as multidimensional and differentiating between three types of system knowledge. More significantly, it has introduced the importance of separating climate-related effectiveness knowledge from action-related knowledge when examining consumers' levels of climate change knowledge and considering the implications for climate communications. In accordance with its primary aim, the study has furthered the understanding of various barriers to consumers' climate action. It has, for instance, added to initial research examining the relation between different types of climate-related knowledge and perceptions of powerlessness as a barrier to climate change. The research also presented further evidence of the positive correlation between perceived powerlessness and perceptions of the commons dilemma, thus contributing to a clearer understanding of the two impediments and their interrelation. Furthermore, the study contributed to the field by considering the demographic factors of age, gender, and study faculty in relation with climate action and risk perception. The findings added particularly to the building notion that similar to general environmental concern and behavior, females appear to display higher climate-related perceived risk and engagement in consumption-based action.

Through its secondary aim, this thesis provided insight on the general climate awareness of Finnish university students with some interesting outcomes. These findings regarding perceived risk and knowledge will soon be reviewed in relation to their implications for climate communications. Another aspect of the secondary aim was to explore the consumption-related climate action of the study sample. By collecting data on not only whether or not participants had

taken climate action, but also in which areas of consumption they had changed their behavior in, a better picture could be painted of students' climate engagement. Moreover, the study dug even deeper by gathering information on the numerous specific measures respondents had undertaken, revealing many points of interest that may be useful for future studies as well. For example, the open responses produced some information on actions that are less discussed in literature.

Considering climate awareness, the study revealed a high level of perceived climate change risk among the students. Risks were on average rated notably higher for nature and society as a whole than for Finland and respondents themselves. This suggests that climate change is still perceived as a relatively distant threat that will not, at least very adversely, impact the lives of Northern nationals. Climate communicators could seek to make the related risks more salient by focusing on framing climate change in relation to local geography and specific communities, and by applying a shorter timeline than the commonly referred end of the century. Moreover, it could be beneficial to emphasize the adverse impacts already happening as well as elaborate on how they are expected to exacerbate.

Arguably the most significant findings of the study concerned effectiveness knowledge. Firstly, while the sample tended to demonstrate high levels of perceived climate change knowledge, distinctly lower proficiencies of climate-related effectiveness knowledge were reported in comparison to the other knowledge dimensions. As people with higher levels of education tend to be more knowledgeable about environmental topics (e.g. Santhakumar et al., n.d.) there is reason to assume that the finding is relevant also for other segments of the population. Secondly, lack of knowledge about the most effective way in which to mitigate climate change was found to be one of the most influential barriers to action. The implications for enhanced climate communications are clear: efforts should be employed to communicate not only what measures consumers can engage in but also the relative effectiveness of different climate actions. Furthermore, focus should be on high-impact actions spanning different areas of consumption since consumers' circumstances greatly affect which means are available for them. The importance of effectiveness knowledge is even more pronounced when taking into account that action-related and effectiveness knowledge appear to be related with less perceived powerlessness, and that low perceptions of powerlessness were linked to climate action in more areas of consumption.

Some further contributions were achieved through efforts of responding to research gaps concerning perceived risk, knowledge, and climate action. Within a field of some ambivalence, the results sided with climate change knowledge – particularly that of the causes and effects of the issue – to be related with greater perceived risk. Climate change knowledge, excluding the dimension of physical knowledge, was also found to be associated with climate action. In turn, the findings supported that those perceiving the risks of climate change as greater were more likely to have had changed their consumption behavior in its

mitigation. Furthermore, by examining climate action separately for four consumption-related areas, the study revealed some notable differences between them. In particular, risk perception and climate change knowledge were most distinctly associated with changes in eating habits. What do these findings imply for practical climate communications? Firstly, while greater knowledge does not necessarily mean more action nor higher perceived risk, the apparent connections give reason to particularly convey messages about the present and expected consequences of climate change – whereas scientific information about the greenhouse effect and GHGs is less relevant. The importance of causal knowledge should also be noted; all knowledge types, but particularly causal knowledge was negatively correlated with skepticism. The results thus suggest that especially communicating the causes behind climate change could alleviate perceived uncertainties associated with the issue and raise necessary concern. Another related means could be stressing the consensus behind the science. The significance of climate awareness is highlighted in the findings linking both greater knowledge and risk perception with a greater likelihood of having changed eating habits. This is salient not only because dietary changes are notoriously difficult to engender, but also due to the large emissions saving potential this consumption area holds. Thus, it is important for communicators to convey climate risks in a relatable manner and give focus to result-related and effectiveness knowledge – the two types that were most notably associated with changes in eating habits.

The study also answered to a paucity in literature concerning which barriers to action consumers perceive most influential. The most salient barriers relating to losses and limitations alludes to a compelling need for structural changes that engender affordable and convenient zero or low-emissions alternatives. However, uncertainty of the most effective option to mitigate climate change was also identified as one of the more significant barriers and is one that offers promising potential to be alleviated with targeted climate change communications, as stated before. Furthermore, perceptions of the commons dilemma and the related concept of perceived powerlessness were by no means negligible barriers and thus also warrant consideration of how these psychological barriers could be alleviated through carefully designed communication strategies. Some potential pathways for this are next envisioned based on notions from experts in the field.

To lessen the powerlessness individuals perceive due to others' inaction, communication efforts are recommended to give focus to success stories of people collectively making a difference (Hartmann et al., 2018; Milfont, 2012). While there is the fear that shining light on others' willingness to act may counteractively encourage freeriding (Vasi & Macy, 2003), this might be reduced if a sense of social inclusion and empowerment can be connected to taking similar action – especially if it was associated with a group one can relate to. Arguably success stories are also needed from other countries to emphasize the global efforts invested in the challenge and so as not to isolate the endeavors of a small, yet GHG-intense, country such as Finland. Messages of positive measures adopted by oth-

ers are in any case needed, particularly due to people's natural tendency for social comparison of the actions of others (Festinger, 1954). In contrast, communication about the inaction or climate-detrimental behavior of others should be avoided, as this may unintendedly send a message about the prevailing social norm – and since people have a tendency to "follow the norm" (Festinger, 1954), the message could become counterproductive.

Relating to observing the actions of other individuals, an aspect of the commons dilemma is the feeling of unfairness in making sacrifices whilst others do not – a prominent barrier also among the respondents in this study. Another way to avoid or alleviate this feeling is by framing climate actions based on the benefits they can offer to the individual and/or their family and community, thus shifting focus from potential personal losses to tangible gains (van der Linden et al., 2015). As also surfaced from the data collected in this study, a climate-friendly lifestyle can be closely linked to e.g. health benefits, living in accordance with one's ethics, social ties – for instance, a borrowing/lending culture among friends – and in many cases, financial savings as well. However, intrinsic motivators – incentives related to e.g. personal growth, one's community, or benefit of family and friends – have been found to better engender meaningful and long-term climate-friendly behavior than extrinsic motivators, such as financial incentives (Climate Change Communication Advisory Group, 2010; van der Linden et al., 2015).

To sum, the key implications the study holds for enhanced climate change communications are the following. Firstly, communication relating the comparative effectiveness of different climate actions is needed, with a focus on high impact measures within different consumption areas. Furthermore, it is recommended to transmit the collective effectiveness of individual actions. Secondly, conveying information about the impacts of climate change is important, particularly framed in relation to local communities, events, and geography as well as the present time and near future. Thirdly, to reduce perceptions of powerlessness and the commons dilemma, it is beneficial to share success stories of mitigative action from close to home as well as international achievements. In contrast, negative examples should be avoided even when backed with good intentions. Finally, whenever possible, climate actions should be framed around intrinsic motivators that highlight tangible benefits for the individual and their community. Overall, while the most significant barriers – as perceived both by respondents in this and previous research – emphasize the need for systematic societal changes that make climate-protective measures more accessible for consumers, the study has added to literature establishing that dedicated climate communications is not only needed, but offers potential to alleviate other relevant barriers through targeted strategies based on empirical research.

5.3 Evaluation and limitations of the study

As inherent to research, there are several limitations associated with this study that should be acknowledged when considering its results. These mainly relate to generalizability, sample and response bias, the nature and context of the study, as well as the measures used. Each will be considered separately, beginning with generalizability.

In particular, generalization of the findings is restricted due to the study targeting Finnish university students. As such the sample is unrepresentative of the general population of Finland. While there are arguments in favor of the appropriateness of student samples for generalization (Kardes, 1996; Lucas, 2003), highly educated individuals have been shown to display more pro-environmental attitudes (e.g. Gifford & Nilsson, 2014; Haller & Hadler, 2008). The student sample therefore may well have had a more climate-friendly disposition compared to the general public. Furthermore, life circumstances can affect the barriers individuals experience for climate-protective behavior (Mäkiniemi & Vainio, 2014). For example, Finnish students tend to have limited financial resources (Statistics Finland, 2021) and the barrier felt strongest among the sample was the monetary costs of changing one's behavior. Nevertheless, the results shed some light to the specific segment of university students as intended and allow for cautious comparisons against previous and future studies across various populations.

Further caution is however required concerning the study sample. Firstly, due to limitations characteristic to the scope of the study – a master's thesis – the sampling was non-random and unrepresentative. To some extent the sample was also likely subject to the common effect of self-selection bias. This occurs when some people are more likely than others to participate in a voluntary survey – the bias most often stemming from the topic of the survey (Stockemer, 2019). For example, almost one third of the participants studied in the faculty of Mathematics and Science, which hosts the department of Biological and Environmental Science, among others. These and other participants may have had a particular interest in climate issues or sustainable consumption. The invitation to the survey was however worded in a manner that aimed to present an opportunity for those that do not find these issues relevant to express their views and opinions as well. This was also meant to reduce social desirability bias. Social desirability bias is the most frequent form of response bias, which occurs when participants respond to questions untruthfully or misleadingly in an attempt to follow social norms (Stockemer, 2019). The bias can be reduced by means of assuring that responses are anonymous and using a self-administered tool such as an online survey (Johnson & Morgan, 2016) – both means that were purposefully applied in this study. To further reduce the possibility of social desirability bias, climate actions were approached by asking a simple yes or no question. Only after a positive response were respondents shown a list of actions to choose from to indicate the changes they had made for climate change mitigation. Based on the deviation of

answers throughout the survey, there is no reason to assume that they reflected social desirability.

Next the research design and context of data collection require consideration. The cross-sectional nature of the study inherently means conclusions cannot be drawn regarding dynamic causal relationships between the variables or the effects of unconsidered third variables. On the other hand, it has allowed for insightful examination of relationships between a number of variables at a single point in time. Research conducted at a single point in time may however subject it to contextual factors. Contextual elements have been found to influence variables related to climate change. For example, Milfont (2012) notes that risk perceptions may be affected by other perceived risks prevalent during the period of data collection. It is possible that in the light of the ongoing Covid-19 pandemic some respondents perceived climate change as a lesser or more distant threat. On the other hand others may have been more concerned since widespread infectious diseases are expected to become more prolific as the effects of climate change proceed (e.g. Anwar et al., 2019). According to an Ipsos poll (2020) seven in ten members of the global public view that in the long term, the crisis of climate change is as serious as Covid-19. What can be said for the present survey is that the barrier item "there are larger problems than climate change" produced a low average score on the list of factors influencing decision making about consumer behavior that might affect climate change. Of the five items measuring skepticism it was however the most influential.

Another matter that warrants attention are the measures used. The survey questions and items were derived from existing studies and in accordance, did not include a "do not know" or "no opinion" option. The need for these choices is debated, but arguments in their favor warn that respondents in doubt may choose the mid-scale option thus affecting the validity of responses (Johnson & Morgan, 2016). Including these types of answer options was considered, but as the survey items were not deemed obscure or requiring any specific knowledge, it was decided to follow the original sources' example on the matter. Nevertheless, the potential limitations need to be acknowledged. So is the case with measures of knowledge. Self-reported proficiency was used to measure the five types of climate change knowledge examined in the study. While this type of perceived awareness is commonly employed in the research field to assess laypersons' levels of climate knowledge (e.g. Heath & Gifford, 2006; Milfont, 2012; Vainio & Paloniemi, 2011), the method is not without potential issues. Respondents' confidence in their knowledge may not reliably correspond to their actual levels of understanding. Objective assessment might therefore produce some different results. For example, Stoutenborough and Vedlitz (2014) found that people with more perceived climate change knowledge have a tendency to report less concern for the issue, whereas those with greater assessed knowledge tend to disclose more concern. Furthermore, Milfont (2012) suggests that particularly those most dismissive of climate change might state greater comprehension of the issue than their actual level of knowledge would reveal. However, the low overall ratings for items related to skepticism suggest that this would not have been an issue of great consequence. All in all, despite the potential limitations of

self-reported measures, the respondents' self-assessed levels of climate knowledge can be regarded as sufficient indicators for the purpose of this study and allowed for a number of interesting inferences.

Finally, typical to quantitative studies and social sciences, self-reports were also used to assess climate action, as opposed to observed behavior. This may therefore limit the accuracy to some extent. However, the action-related questions were designed to measure specifically climate-motivated behavioral change that respondents had consciously undertaken, instead of mere willingness or intent to act. Furthermore, the four categories of consumption were carefully selected to be both specific and comprehensive enough. There are of course limitations to what information could be captured. For example, some respondents may have already engaged in climate-friendly consumption behavior for other reasons – e.g. economic, ethical, or health-related – and therefore answered not having changed their conduct to mitigate climate change in a particular area, even if climate change had later become an additional motivator for such behavior. Nevertheless, even considering such limitations the applied method can be deemed more than adequate in capturing data on climate action – in fact, it can be considered rather innovative compared to existing research in the field.

5.4 Directions for further research

The study points to several intriguing paths for future research endeavors. First of all, the study can be replicated in other universities and countries to test and expand the cultural validity of the results. There is also reason to consider additional variables such as personal values and climate-related political activity. Moreover, as this study applied self-reported knowledge, an angle for further research would be to examine whether assessed proficiency produces similar results. As the university students appeared to be particularly informed and engaged in climate change mitigation, it would be useful to compare results with other segments, especially those of lower education degree. Furthermore, additional prospects emerged from the quantitative study that could be approached through qualitative research. For example, in-depth research investigating the drivers and supporting factors behind Finnish consumers' climate action – in particular, those of high impact actions – is warranted and could benefit local climate communicators. Similarly, it is recommended to pursue further understanding of how to foster social norms that alleviate perceptions of the commons dilemma and promote consumers' feelings of empowerment in climate change mitigation.

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APPENDIX

Survey items

1. Year of birth

2. Gender
   - Male
   - Female
   - Other
   - Do not want to say

3. Which faculty do you study in? (If more than one applies, choose the primary one)
   - Humanities and Social Sciences
   - Information Technology
   - Jyväskylä University School of Business and Economics
   - Education and Psychology
   - Sport and Health Sciences
   - Mathematics and Science

What level would you rate your knowledge to be regarding…

4. …the greenhouse effect and greenhouse gases?
   - Nonexistent
   - Minor
   - Moderate
   - Good
   - Professional

5. …the different causes of climate change?
   - Nonexistent
   - Minor
   - Moderate
   - Good
   - Professional

6. …the different consequences of climate change?
   - Nonexistent
   - Minor
   - Moderate
   - Good
   - Professional

7. …ways to mitigate climate change?
   - Nonexistent
   - Minor
   - Moderate
   - Good
   - Professional

8. …the effectiveness of different ways to mitigate climate change?
   - Nonexistent
   - Minor
   - Moderate
   - Good
   - Professional

9. How concerned are you about climate change?

1 – Not concerned at all … 7 – Very concerned

10. In your judgement, how likely is it that you will sometime during your life experience serious threats to your health or overall well-being as a result of climate change?

1 – Very unlikely … 7 – Very likely

11. In your judgement, how likely do you think it is that climate change will have very harmful, long-term impacts on our society?

1 – Very unlikely … 7 – Very likely

12. How serious of a threat do you think that climate change is to nature?

1 – Not serious at all … 7 – Very serious

13. How serious would you rate current impacts of climate change around the world?

1 – Not serious at all … 7 – Very serious

14. How serious of a threat do you perceive climate change to be to you personally?

1 – Not serious at all … 7 – Very serious

15. How serious would you estimate the impacts of climate change for Finland?

1 – Not serious at all … 7 – Very serious

16. How often do you worry about the potentially negative consequences of climate change?

1 – Very rarely or never … 7 – Very frequently

17. How influential have the following factors and views been in your decision making about consumer behavior that might affect climate change?

1 – Not influential at all; 2 – Slightly influential; 3 – Somewhat influential; 4 – Very influential; 5 – Extremely influential

1. Limited options.
2. The inconvenience of options.
3. The monetary costs of changing my actions.
4. Fitting changes in with e.g. family.
5. Lack of knowledge about possible changes I can make.
6. Uncertainty about the most effective option to mitigate climate change.
7. Uncertainty as to whether climate change is a significant problem.
8. The feeling that climate change is too big for my actions to have an impact.
9. The feeling that my actions will not affect the outcome of climate change.
10. Feeling that others will not change their actions even if I do.
11. Unfairness associated with bearing the costs of change while others do not take responsibility.
12. Other countries or people not taking equivalent action at the moment.
13. Looking foolish due to being the only one to change actions.
14. With my behavior I cannot influence the climate as the task lies with industry.
15. Climate protective measures are determined by a few people in power; as a single individual, I have no effect.
16. Climate change and its consequences are being exaggerated in the media.
17. There are larger problems than climate change.
18. The impacts of climate change are unpredictable; thus my climate-friendly behavior is futile.
19. I do not perceive climate change as a threat.

18. Have you changed your **eating habits** to mitigate climate change?

- ☐ No
- ☐ Yes

Which change have you made? Choose more than one if necessary.

- Reducing consumption of dairy
- Reducing consumption of meat
- Adopting a plant-based diet
- Favoring local food
- Favoring seasonal food
- Avoiding food waste
- Considering the carbon footprint of products when making purchase decisions
- Other (what?)

19. Have you changed your **transportation habits** to mitigate climate change?

- No
- Yes

Which change have you made? Choose more than one if necessary.

- Driving less by private car
- Adopting economic driving practices
- Switching to a more fuel-efficient car
- Giving up private car
- Deciding not to buy a car
- Buying a hybrid, natural gas, or electric car
- Avoiding plane travel
- Favoring environmentally friendly modes of transport (e.g. public transport, walking, cycling)
- Other (what?)

20. Have you changed your **energy or water consumption** to mitigate climate change?

- No
- Yes

Which change have you made? Choose more than one if necessary.

- Using high-efficiency light bulbs
- Emphasizing energy efficiency when purchasing a device
- Using less electricity
- Setting temperature of heating at 20 °C or lower in wintertime
- Increasing share of renewable energy from energy supplier
- Installing solar panels
- Forgoing oil heating
- Conserving water e.g. when showering, washing dishes or laundry
- Other (what?)

21. Have you changed your **general consumption or recycling behavior** to mitigate climate change?

- ☐ No
- ☐ Yes

Which change have you made? Choose more than one if necessary.

- ☐ Reducing consumption of disposable items
- ☐ Reducing consumption
- ☐ Buying used instead of new
- ☐ Considering the carbon footprint of products when making purchasing decisions
- ☐ Purchasing carbon offsets
- ☐ Increasing recycling at home
- ☐ Increasing recycling in public
- ☐ Reducing waste
- ☐ Other (what?)