Examining the Role of Cultural Values and Climate Change Risk Perception on Barriers to Pro-Environmental Behaviour

by

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B.A., University of Ottawa, 2009

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Supervisory Committee

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Abstract

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This study examined the perception of barriers to pro-environmental behaviour for different population segments in British Columbia. Cultural cognition scales were used to assign cultural values to participants (i.e., hierarchy-egalitarianism scale and individualism-communitarianism scale). Psychological and socio-cultural barriers were assessed using the list of *dragons of inaction*. Data on cultural values, perception of climate change risk, perception of barriers, frequency of pro-environmental behaviour, climate change knowledge and socio-demographic variables were collected using online surveys. Egalitarian values were correlated with greater climate change risk perception and with weaker perception of barriers to pro-environmental behaviour. Greater climate change risk perception was also associated with more pro-environmental behaviour. The effect of cultural values on barrier perception was partly mediated by climate change risk perception. These findings suggest that future research should focus on lessening the discrepancy between scientific climate change risk perception and public climate change risk perception, which can, in turn, increase the frequency of pro-environmental behaviour.

Table of Contents

List of Tables

List of Figures

Acknowledgments

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Dedication

I dedicate this thesis to *mon p'tit rayon de soleil*, my nephew Éliott. You are my biggest inspiration. I wish you a lifetime of happiness filled with love, curiosity, and an open-mind.

Chapter 1: Introduction

Anthropogenic greenhouse gas (GHG) emissions have resulted in a 40% increase in atmospheric GHG concentrations since pre-industrial times and are modifying climate patterns on a global scale (International Panel on Climate Change, 2013). An estimated 75% of the hot extremes and 18% of precipitation extremes worldwide are currently attributable to climate change (Fischer & Knutti, 2015). Global temperature rises will intensify climate-related extremes such as heat waves, droughts and floods (International Panel on Climate Change, 2014). These changes in climate pose physical, psychological and economic risks to humans through mortality and morbidity in periods of extreme heat, food insecurity due to changes in precipitation patterns, disrupted livelihoods in coastal zones, reductions in fisheries and many other ecological shifts (International Panel on Climate Change, 2014).

An increase of 0.85°C in average global temperature occurred from 1880 to 2012 (International Panel on Climate Change, 2013). A recent report by the International Panel on Climate Change predicts a continuing increase followed by a stabilization at 1.5°C for low-emissions scenarios and up to 2.5°C by year 2050 for high-emissions scenarios with a continual increase of up to 4.5°C by year 2100 (International Panel on Climate Change, 2014). The severity of the predicted human risks associated with climate change varies depending on the degree of additional warming.

Consequently, the overall gravity of climate change impacts can be substantially reduced by limiting the magnitude of GHG emissions (International Panel on Climate Change, 2014). Households are responsible for 46% of Canada's GHG production through emissions from motor fuel, residential fuel, and the production of goods and

services consumed (Government of Canada, 2008). Home energy use and transportation at the individual and household level in the United States account for 38% of carbon emissions, and that figure rises if indirect energy uses such as household food choices and purchases of consumer goods and services are taken into account (Gardner & Stern, 2008).

As major emitters of GHGs, households have significant potential for immediate reductions. However, pro-environmental behaviours that would help reduce these emissions are not widely adopted. Many argue that barriers to pro-environmental behaviours can explain the discrepancy between a growing concern for the environment and limited pro-environmental behaviour (Blake, 1999; Gifford, 2011; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Patchen, 2010; Stoll-Kleemann, O'Riordan, & Jaeger, 2001; Takacs-Santa, 2007).

1.1 Present study

The existing literature provides many variables known to contribute to pro-environmental behaviour, more specifically through the theory of planned behaviour (TPB) and the value-belief-norm (VBN) models. However, a relatively large proportion of variance remains unexplained using these models (see Chapter 2), and scholars posit barriers as an explanation (e.g., Gifford, 2011; Lorenzoni et al., 2007). Removing structural barriers, such as increasing access to public transportation, is necessary but it is not enough; the public has to demand and make use of these changes for climate change mitigation to be successful (e.g., Gifford, 2011; Lorenzoni et al., 2007; Patchen, 2010). Therefore, many efforts have been dedicated to increasing knowledge about the social and psychological barriers that hinder the public's willingness to adopt more pro-

environmental behaviour (Blake, 1999; Gifford, 2011; Lorenzoni et al., 2007; Patchen, 2010; Stoll-Kleemann et al., 2001; Takacs-Santa, 2007). However, knowledge about how different individuals experience these non-structural barriers is missing in the literature. Also, the relation between non-structural barriers and frequency of pro-environmental behaviour has not been demonstrated in the literature. The objective of the current study is to gain a better understanding of the perception of social and psychological barriers (i.e., non-structural) and how they affect pro-environmental behaviour frequency. Climate change information needs to be personally relevant and linked to individual concern and perceived barriers in order to increase public acceptance of, and demand for, climate policies and programs (Gifford, 2011; Lorenzoni et al., 2007).

The existing literature also shows that values and attitudes are important predictors of pro-environmental behaviour in the TPB and VBN models (e.g., Abrahamse & Steg, 2011; Abrahamse, Steg, Gifford, & Vlek, 2009; Armitage & Conner, 2001; Steg, Dreijerink, & Abrahamse, 2005; Stern, Dietz, Abel, Guagnano, & Kalof, 1999; Tikir & Lehmann, 2011). Cultural theory and its associated values are conceptually similar to central variables in these models (Overdevest & Christiansen, 2013; Poortinga, Steg, & Vlek, 2002; Tikir & Lehmann, 2011). Furthermore, cultural values have been linked to an individual's preferences for environmental management strategies (Poortinga et al., 2002; Steg & Sievers, 2000). Building from the similarities with established pro-environmental behaviour models and considering its past use in studying environmental policy preferences, cultural theory was an appropriate starting point for studying group differences in barrier perception. However, cultural theory presented measurement problems (Kahn & Morris, 2009; Rippl, 2002; Steg & Sievers, 2000) and, thus, cultural

cognition was used instead (Xue, Hine, Loi, Thorsteinsson, & Phillips, 2014). Cultural cognition theorizes that an individual perceives risks based on whether or not an idea (e.g., regulation, technology, etc.) threatens his or her worldviews. The existing literature demonstrates that perception of climate change risk varies according to worldviews (e.g., Kahan, Jenkins- Smith, & Braman, 2011). This relation has not been studied in a Canadian sample. Additionally, cultural cognition has not been used to study perception of barriers to pro-environmental behaviour. The present study examined barrier perception for different cultural groups in Canada using cultural cognition.

The end goal of this research is to contribute to reducing GHG emissions by increasing the frequency of pro-environmental behaviour. This goal will be achieved by gaining a better understanding of the perception of barriers, which will then inform climate change mitigation efforts. Accumulating knowledge on the relations between cultural values, concerns and barrier perception will allow for more tailored interventions. This study also complements the existing literature. It contributes to the advancement of the *dragons of inaction* measurement items. Also, it increases conceptual knowledge about psychological barriers to pro-environmental behaviour. More specifically, it examines the relation between the *dragons of inaction* and climate change risk perception. Furthermore, this study verifies the relation between perceived barriers and pro-environmental behaviour. These perceived barrier variables might add power to existing models of pro-environmental behaviour in future studies. Finally, this study further validates the use of cultural cognition to study pro-environmental behaviour and climate change mitigation efforts more generally.

Chapter 2: Critical context

2.1 Pro-environmental behaviour

Environmentally significant behaviour is behaviour that "changes the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere itself" (Stern, 2000, p. 408). Hence, pro-environmental behaviour is behaviour that has a positive environmental impact (de Groot & Steg, 2010; Kazdin, 2009).

Pro-environmental behaviour can generally be divided into five or six domains; energy and/or water conservation, personal transportation, food, waste disposal and eco-friendly shopping (Department for Environment Food and Rural Affairs, 2008; Gifford, 2014; Kaiser & Keller, 2001; Whitmarsh, 2009). Behaviour types can also be divided between efficiency and curtailment. Curtailment behaviours are those that require repetitive actions to reduce consumption (e.g., shorter showers) while efficiency behaviours entail the purchase of new equipment to reduce consumption (e.g., low-flow shower head) (Gifford, 2014). Most experts agree that efficiency behaviours have greater potential for environmental impact reduction (Dietz, Stern, & Weber, 2013; Gardner & Stern, 2008). Furthermore, environmentally significant behaviour can also be distinguished based on its impact level; for example, increasing recycling or using less water has a lower impact on GHG emission reduction than flying less (Department for Environment Food and Rural Affairs, 2008). Researchers should target behaviours that have a larger potential for environmental impact (Stern, 2000).

The theories most frequently used to explain the causality of pro-environmental behaviour, also referred to in the literature as environmentally supportive behaviour, are

the theory of planned behaviour (TPB) and the value-belief-norm theory (VBN) (Gifford, 2014). TPB (see Figure 1) explores attitudes, subjective norms and perceived behavioural control as predictors of behavioural intention (Ajzen, 1991). A meta-analysis examining the predictive power of TPB found that on average it explained 39% of variance in intentions and 27% of variance in behaviour (Armitage & Conner, 2001). TPB explained between 36% and 53% of the variance in recycling intentions (Chan, 1998; Greaves, Zibarras, & Stride, 2013; Tonglet, Phillips, & Bates, 2004), 52% of the variance in car use (Abrahamse et al., 2009), 70% of the variance in intentions to take public transportation (Heath & Gifford, 2002; Tikir & Lehmann, 2011), and between 18% and 70% of intentions to reduce energy consumption (Abrahamse & Steg, 2011; Greaves et al., 2013; Scott, Jones, & Webb, 2014).

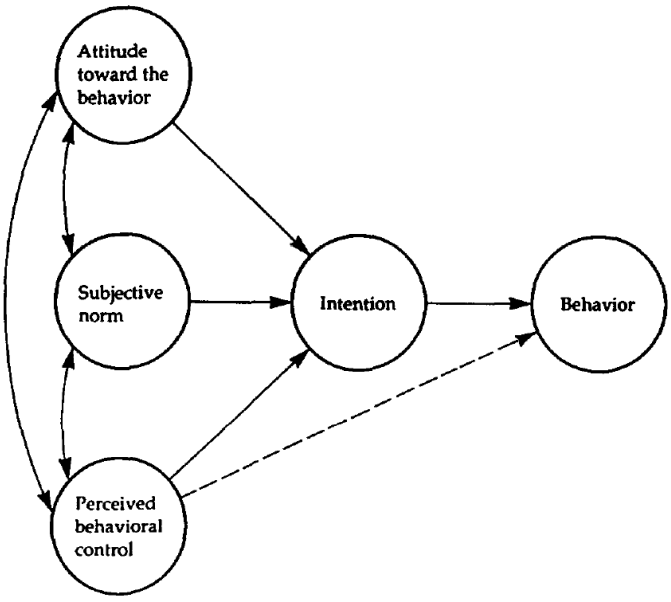

Figure 1. **Theory of planned behaviour (Ajzen, 1991) .**

The value-belief-norm theory (Figure 2), which extends the familiar norm-activation theory specifically to pro-environmental behaviour (Lindenberg & Steg, 2007),

includes worldviews, awareness of consequences, ascription of responsibility and personal norms as predictors of pro-environmental behaviour (Stern et al., 1999). VBN explained 19% of variance in private-sphere behaviours (e.g., buying organic), 35% of variance in environmental policy support, and 30% of variance in environmental citizenship (e.g., signing a petition or giving money to environmental group) (Stern et al., 1999). VBN also explained 32% of the variance in acceptance of policies aimed at reducing GHG emissions (Steg et al., 2005) and 15% of the variance in energy use (Abrahamse & Steg, 2011)

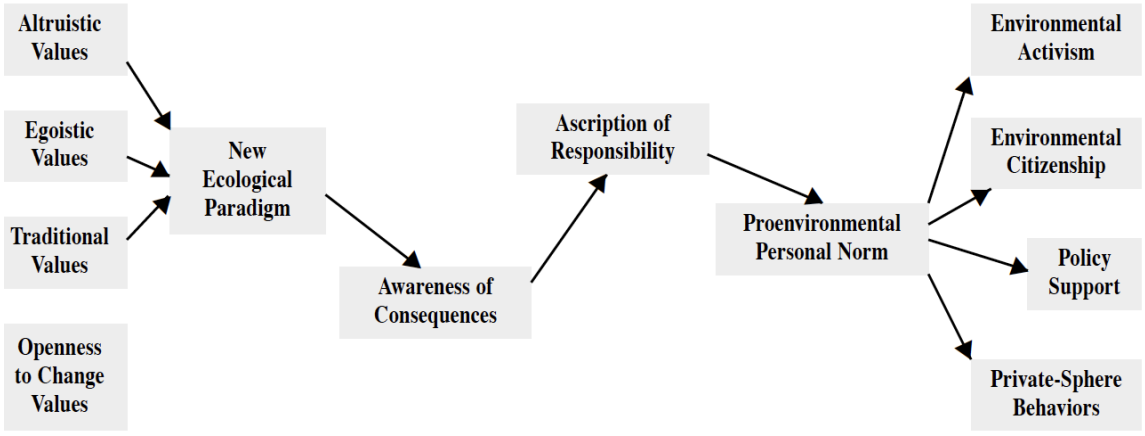

Figure 2. **Value-belief-norm theory (Stern et al., 1999).**

Although TPB and VBN hint at potential barriers to pro-environmental behaviour, such as the lack of *perceived behavioural control* (Figure 1) or *awareness of consequences* (Figure 2), they do not directly factor in the effect of social and psychological barriers on environmental concern, intent or behaviour.

2.2 Perception of barriers to pro-environmental behaviour

Public opinion polls and past studies indicate a sizable level of concern for climate change; 76% of Americans view it as a serious problem (Leiserowitz, 2006) and

60% of Canadians believe that science is conclusive that climate change is happening and caused by human activity (Environics Institute, 2013). However, individuals are still engaging in greenhouse gas-emitting behaviours. This discrepancy between environmental concern and behaviour is often referred to as the value-action gap or the attitude-behaviour gap (Lorenzoni et al., 2007). In fact, 87% of environmentally concerned Canadians report a gap between their environmental intentions and their behaviour (Huddart Kennedy, Beckley, & Nadeau, 2009).

This gap is partly attributed to structural deficits, such as the limited access to public transport in rural areas, which are outside of an individual's immediate control (Gifford, 2011). However, even when these structural deficits are not present and individuals are able to make choices that limit emissions, these behaviours are not extensively adopted (Gifford, 2011). Beyond structural barriers, most if not all of the research aimed at gathering information on the barriers to climate-relevant behaviour recognize the effect of both psychological and socio-cultural factors in determining pro-environmental behaviour (Lorenzoni et al., 2007; Patchen, 2010; Takacs-Santa, 2007).

Research in the United Kingdom found that perceived barriers can be classified into three categories: individuality (i.e., attitude and cognition), responsibility (i.e., evaluation of consequences), and practicality (i.e., lack of time, money, information, etc.) (Blake, 1999). A Swiss study reported four justifications for climate inaction: comfort (i.e., unwillingness to give up consumption), tragedy-of-the-commons (i.e., great cost to individual freedom), managerial-fix (i.e., technological solutions), and governance-distrust (Stoll-Kleemann et al., 2001). The authors argued that individuals resort to internal justifications when they perceive a struggle (i.e., a dissonance) between what

they feel they should be doing (i.e., an attitude) and their preference for a certain lifestyle. They hypothesize that individuals deny that a particular behavior change is justifiable in order to resolve this dissonance: "… individuals experiencing dissonance seek to resolve it, deny it, or displace it" (Stoll-Kleemann et al., 2001, p. 111).

Three studies in the United Kingdom examined the perception of barriers to engage with climate change and uncovered 15 barriers, which were classified into two categories: individual (e.g., lack of knowledge, distrust in information sources, etc.) and social (e.g., social norms and expectations, lack of political action, etc.) (Lorenzoni et al., 2007). The authors pointed out that the barriers overlap and potentially accumulate to worsen the total effect and that distinct groups experience the barriers differently.

Most recently, Gifford (2011) described 30 psychological barriers (i.e., dragons of inaction) in seven categories: limited cognition, ideologies, comparison with others, sunk costs, discredence, perceived risks and limited behavior. These barriers, along with a description, are found in Table 1. The barrier groups do not occur in isolation; they constantly interact with each other. Some might be closely linked or overlap while others might need to be further teased apart or are missing entirely. Therefore, Gifford (2011) called for more research on the interactions between psychological barriers.

Chen and Gifford (2015) developed a barrier scale for the 30 *dragons of inaction* and used this scale to study justifications for low-cooperation levels (i.e., barriers to cooperation) in a simulated fisheries "microworld". They found that 24 of those barriers were significantly correlated with cooperation levels. In addition, using principal component analysis, the barriers were clustered in three themes; resource (e.g.,

uncertainty), self-interest (e.g., financial benefits), and interpersonal (e.g., perceived injustice).

Another version of the barrier scale was tested in a pilot study on the psychological factors that influence the acceptance of plug-in hybrid electric vehicles (Kormos, Gifford, & Crawford, 2011). The barriers were also tested in a study exploring environmental concern in which the author found that as biospheric concern increased, the perception of barriers decreased (McIntyre, unpublished). However no relation was found between the level of egoistic concern, and the perception of barriers. The barrier scale was most recently used to test the relations between climate change engagement and pro-environmental food choices (Gifford & Chen, in preparation). The authors found that the barriers formed four major themes; denial, conflicting goals, tokenism, and interpersonal influences. For three of these themes (i.e. denial, conflicting goals, tokenism), they found that stronger perceived barriers were correlated with low levels of climate change concern and low levels of pro-environmental food choices.

Table 1.

Psychological Barriers to Climate Positive Behaviour (Gifford, 2011)

Barrier groups	**Barriers**	**Description**
Limited cognition	Ancient brain	The human brain is more adapt at perceiving immediate danger, as opposed to the physically and temporally distant risks associated with climate change.
	Ignorance	Individuals do not know that a problem exists, or they are aware that a problem exists but they do not know the causes or the solutions.
	Environmental numbness	Hearing about climate change too often can make people numb to the message.
	Uncertainty	Perceived uncertainty can lead individuals to underestimate risk or wait for more conclusive evidence.
	Judgmental discounting	Individuals undervalue risks that are far and in the future.
	Optimism bias	Individuals are more optimistic about climate change in their geographical location than in other places.
	Perceived behavioural control and self-efficacy	Individuals do not feel like they have any control over the outcome of the situation nor that their actions have an impact.
Ideologies	Worldviews	Individuals do not act because they believe that free market capitalism holds the answers to climate change.
	Suprahuman powers	Individuals believe that a religious deity or Mother Nature will solve the problems associated with climate change.
	Technosalvation	Individuals believe that human ingenuity in the form of technological innovation will solve the problems associated with climate change.
	System justification	Individuals are more comfortable with the societal status quo and do not want to change.
Comparison with others	Social comparison	Individuals observe others to determine the proper course of action.
	Social norms and networks	When climate harming behaviour is the norm, individuals have been known to adjust their behaviour to “fit the norm”.

	Perceived inequity	Individuals feel that they will be at a disadvantage if they act pro-environmentally but others do not.
Sunk costs	Financial investments	Individuals that have a financial stake in something (e.g., fossil fuel industry) or have invested money in something (e.g., a car) find it difficult change.
	Behavioural momentum	Many climate harmful behaviours are habitual and thus difficult to change.
	Conflicting values, goals, and aspirations	An individual's values, goals, and aspirations are not always compatible with climate change action.
	(Lack of) place attachment	Individuals that do not feel connected to their environment might feel less need to protect it.
Discredence	Mistrust	Individual do not trust the motives of scientists or government officials.
	Perceived program inadequacy	Individuals may feel that climate change programs are inadequate and choose not to participate.
	Denial	Individuals do not believe that climate change is occurring or that humans caused it.
	Reactance	Individuals sometimes distrust a message simply because it comes from scientists or government officials.
Perceived risk	Functional risk	Individuals are worried that more efficient technology will not work.
	Physical risk	Individuals are worried that changing their behaviour will put them at risk (e.g., riding their bike).
	Financial risk	Individuals do not see the financial benefits of more efficient technology because of its initial costs.
	Social risk	Individuals fear judgment from others or social repercussions.
	Psychological risk	Social repercussions might lead to self-esteem damage.
	Temporal risk	Climate positive behaviour can necessitate lots of time invested in research and preparation.
Limited behaviour	Tokenism	Easier behaviours are usually targeted first but have a small positive environmental impact, which results in disconnect between pro-environmental intentions and impact.
	The rebound effect	Efforts in increasing efficiency are offset by the impacts of an individual's behaviours (e.g., increased use of car after purchasing a hybrid vehicle).

2.3 Cultural cognition

Cultural theory has its roots in grid-group typology and has taken different forms over the years, one of the most recent forms being cultural cognition. To understand the theory behind cultural cognition, we must first turn to grid-group typology, followed by cultural theory, as well as the problems of measurement associated with cultural theory.

2.3.1 Grid-group typology

The point of departure for the cultural theory of risk is the grid-group analysis theory or grid-group typology (Douglas, 1978, 1982; Mamadouh, 1999). Grid-group typology is used as a heuristic device because it "captures the wisdom of a hundred years of sociology, anthropology and psychology" (Tansey, 2004, p. 25). This typology came about through work searching for regularities in the social construction of meaning. According to Douglas, clusters of socially constructed beliefs can help predict the construction of meaning (Thompson, Ellis, & Wildavsky, 1990).

Based on the patterns that were found in social relations, Douglas (1982) presented a parsimonious account of cultural diversity in which there are two dimensions of sociality: grid and group. The group dimension, also called social contact, is based on whether an individual is group-oriented or individual-oriented (i.e., the level of group determination involved in individual choice). The grid dimension, also called social regulation, is based on a belief (or disbelief) that social rules are necessary to govern behaviour (i.e., externally imposed prescriptions). These two dimensions yield a typology with four categories and associated values, often referred to in the literature as ways of life, worldviews, or orienting dispositions. These include: strong group-low grid (i.e.,

factionalism), strong group-strong grid (i.e., ascribed hierarchy), low group-low grid (i.e., individualism), and low group-strong grid (i.e., atomized subordination) (Douglas, 1982).

2.3.2 Cultural theory of risk

Following this grid-group typology, Thompson et al. (1990) developed the Cultural Theory of Risk. This theory presupposes that worldviews, beliefs about society and values affect risk perception (Dake, 1991). It also presumes that technologies or policies are perceived in a social and political context (Dake, 1991).

Cultural theory proposes four main patterned interpretations of the social, political and cultural world that guide individual responses to situations. These patterned interpretations of how people make sense of the world, also called 'ways of life' or 'idealized form of social ordering', are a combination of cultural bias (i.e., shared values and beliefs) and social relations (i.e., patterns of interpersonal relations) (Thompson et al., 1990). Along the same lines as the grid-group typology, cultural theory posits that there are only five possible ways of life in all societies (the fifth way of life, the hermit, is characterized by deliberate withdrawal from social transactions and is therefore usually not included in studies). The four main worldviews are: egalitarian (i.e., originally known as factionalism), hierarchical (i.e., originally known as ascribed hierarchy), individualistic, and fatalistic (i.e., originally known as atomized subordination).

According to cultural theory, each way of life has an associated view on particular aspects of human life, such as the natural world, use of natural resources, how to make ends meet, environmental risk perception and preferences for solutions to manage these risks (Steg & Sievers, 2000). Based on patterned worldviews, cultural theory has been

applied to the study of blame, envy, apathy, growth, scarcity and risk perception (Thompson et al., 1990).

The interpretation of risk varies based on the individual's worldview and its associated rationality (Leiserowitz, 2006). The four typologies have different rationalities, preferences and interpretations of risk based on the desire for each individual to maintain their ways of life: "… risks are socially constructed; namely, people choose what to fear and how to fear it to sustain their preferred pattern of social relations" (Steg & Sievers, 2000, p. 251).

In the early 1990s, Dake and Wildavsky developed questionnaire item measures for hierarchy, individualism and egalitarianism (Dake, 1991). The fatalist items were added later (Dake, 1992). Cultural bias helps explain the divergence in opinion about climate change, as well as policy preferences (Jones, 2011; Leiserowitz, 2006). Cultural biases explained between 26% and 34% of the variance in global warming risk perception, policy preferences, and tax policy support (Leiserowitz, 2006). Egalitarians and hierarchs are positively correlated with a belief in human-caused climate change while individualists are negatively correlated and tend to deny it (Jones, 2011).

Similar research was also conducted using myths of nature scales instead of Dake's original cultural bias scales (Poortinga et al., 2002; Steg & Sievers, 2000). The myths of nature are rooted in these cultural biases and express beliefs about the vulnerability of nature. Using the myths of nature, researchers can infer predictions about the preferences for environmental management strategies. The myths of nature are commonly illustrated with a ball in a landscape that summarizes the view on nature and the preferred management strategy (Figure 3).

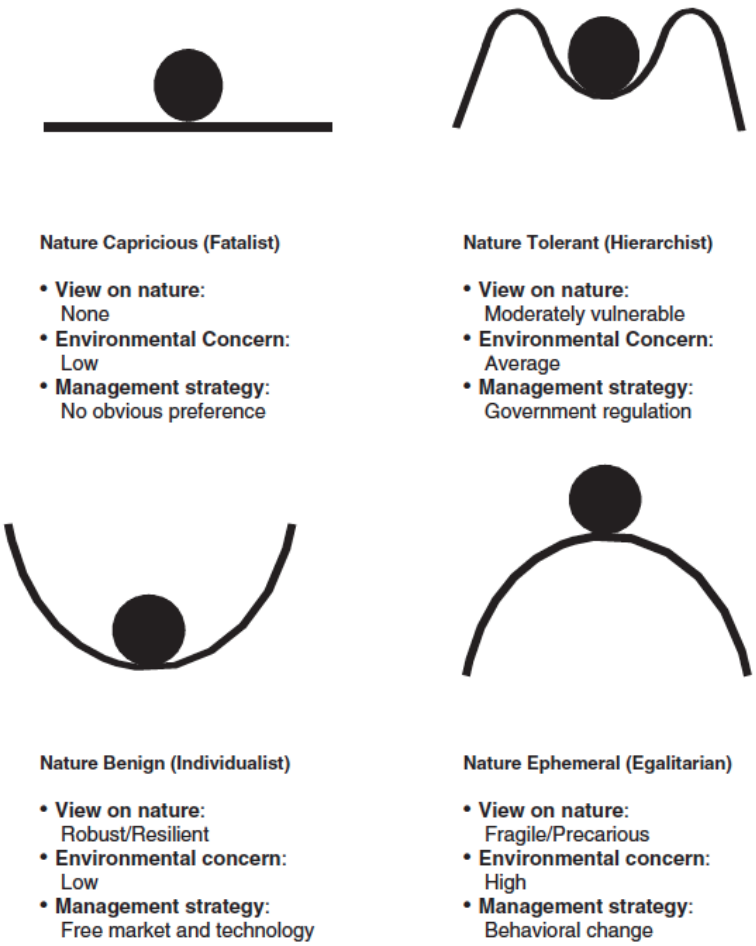

Figure 3. **Myths of nature (Poortinga et al., 2002, adapted from Thompson et al., 1990).**

The myths of nature, environmental beliefs, risk perception and preferences for behavioural and management strategies are related (Poortinga et al., 2002; Steg & Sievers, 2000). More specifically, the nature ephemeral group (i.e., egalitarian) scored the highest and the nature benign group (i.e., individualist) scored the lowest on their evaluations of car use problem awareness levels, sense of responsibility for car use, the belief in the need to reduce car use, and policy measures aimed at reducing car use (Steg & Sievers, 2000). Furthermore, myths of nature groups differed in levels of environmental concern, with nature ephemeral being the most concerned and nature benign the lowest (Poortinga et al., 2002). Nature ephemeral also was most in favour of

government regulation for energy reduction while nature benign preferred it the least (Poortinga et al., 2002). The authors also recognize that barriers likely exist preventing environmental beliefs from translating into behaviour, such as situational constraints (Steg & Sievers, 2000).

2.3.3 Challenges to the cultural theory measurements

Many scholars point to problems with measures of cultural theory (Steg & Sievers, 2000). Researchers have faced problems when attempting to assign individuals to only one cultural type using the questionnaire items designed by Dake (1991, 1992). For example, in one study only 32% of respondents belonged unequivocally to one cultural type while almost 60% belonged to more than one cultural bias and 5% belonged to none at all (Marris, Langford, & O'Riordan, 1998). In another study, although the myths of nature and associated cultural bias correlated significantly, each myth of nature was not exclusive to one bias (Steg & Sievers, 2000), again supporting the problem of belonging to more than one cultural type.

The reliability of the cultural theory scale has also been critiqued. The Cronbach's alphas for the original cultural bias scale (Dake, 1991, 1992) were not reported (Kahan, 2012) and in subsequent studies when they were reported, were not always satisfactory. For example, a study using items from Dake's index reported Cronbach's alphas between .36 and .67 (Stern et al., 1999). In a more recent study only two cultural biases achieved satisfactory Cronbach's alphas (Leiserowitz, 2006), and another study using Dake's and other authors' modified cultural bias items reported Cronbach's alphas between .54 and .70 (Lima & Castro, 2005).

In addition, possibly the most important criticism of Dake's scale has to do with construct validity. Based on the rationale behind cultural theory, the cultural biases that have reverse grid and group dimensions (i.e., individualism and hierarchy, fatalism and egalitarianism) should also have significant negative correlations (Rippl, 2002). However, many studies report strong positive correlations between individualism and hierarchy (Rippl, 2002). Cultural cognition attempts to address these concerns using continuous scales to measure the grid-group dimensions.

2.3.4 Cultural cognition

Recognizing the problems with Dake's measurements, Kahan proposed cultural cognition of risk as another approach designed to measure cultural theory (e.g., Kahan, 2012). A recent meta-analysis reveals that the cultural cognition scale has greater reliability and construct validity than the cultural theory scale (Xue et al., 2014).

Cultural cognition is: "… the psychological disposition of persons to conform their factual beliefs about the instrumental efficacy (or perversity) of law to their cultural evaluations of the activities subject to regulation" (Kahan & Braman, 2006, p. 152). This interdisciplinary model combines anthropological efforts, based on the grid-group work described earlier (Douglas, 1982) with a social psychological approach (Slovic, 2000). More specifically, cultural cognition uses mechanisms from social psychology to explain the effect of ideologically (*i.e.*, cultural worldviews) motivated cognition, such as cognitive dissonance, biased assimilation and group polarization, identity protection and group membership, cultural credibility, and cultural availability (Kahan, 2012; Kahan & Braman, 2006; Kahan, Braman, Gastil, Slovic, & Mertz, 2007; Kahan, Braman, Slovic, Gastil, & Cohen, 2007).

Being presented with two opposing ideas creates psychological tension, known as cognitive dissonance. Individuals often attempt to avoid or resolve this dissonance through biased assimilation (i.e., rejecting information given by individuals from opposing views or adversaries) or confirmation bias (i.e., searching for information that fits or confirms their current worldview) (Brownlee, Powell, & Hallo, 2013). Furthermore, given that not everyone is an expert on climatology, individuals have to rely on others to determine how risky climate change is. In group/out group dynamics explains the tendency to refer to trustworthy and likeminded individuals to determine the level of risk associated with climate change (Kahan & Braman, 2006). The availability heuristic posits that salient information is easier to recall and is thus believed to be more common (Myers, Spencer, & Jordan, 2009). The level of salience attached to judgments of risky situations varies according to cultural worldviews (Kahan, 2012).

Instead of having four cultural types or quadrants, cultural cognition classifies the four cultural biases on opposite ends of two crosscutting scales: the hierarchical-egalitarian (i.e., grid) scale and the individualism-communitarianism (i.e., group) scale (see Figure 4). These scales map onto the original grid-group typology (Kahan, 2012). Individuals can also be classified as Hierarchical individualism, Hierarchical communitarianism, Egalitarian individualism or Egalitarian communitarianism based on where they fit on these two scales. The strongest negative relation is expected between Hierarchical individualism and Egalitarian communitarianism.

The communitarianism worldview (formerly called the solidarism worldview – see Kahan & Braman, 2006) is new to cultural cognition but is believed to be logically opposed to individualism in the group typology and therefore implicit in the previous

cultural theory framework (Kahan & Braman, 2003). In addition, these new scales ignore fatalism, which was previously assigned to the weak group-high grid. Weak group-high grid still exists in cultural cognition, but equates more to Hierarchical communitarianism instead of a fatalistic worldview (Kahan, 2012).

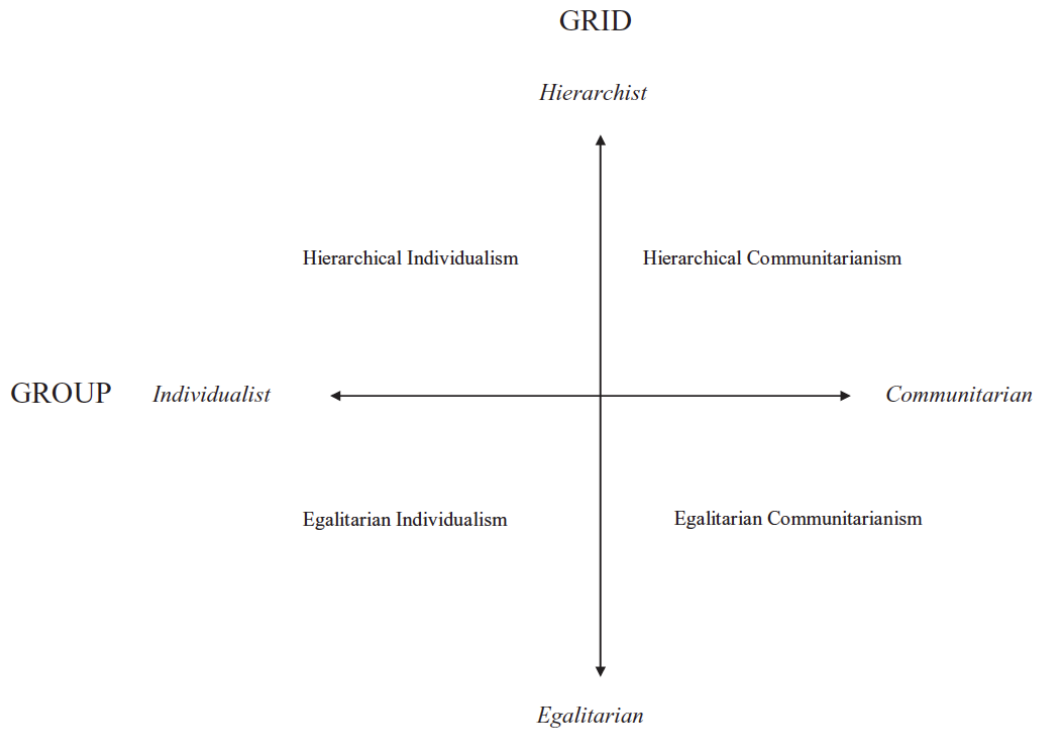

Figure 4. **Cultural cognition and grid-group theory (Kahan, Braman, Gastil, et al., 2007).**

Along the individualism-communitarianism scale a weak group correlates to the individualistic culture and a strong group to the communitarian culture. Individualistic cultures are highly competitive and believe that each individual should be responsible for his or her own well-being without resorting to collective assistance. They are usually dismissive of environmental and technological risk because they want to avoid restrictions on commerce and industry (Kahan, 2012). These individuals perceive low risk associated with climate change and believe that most scientific experts disagree on the occurrence or the cause of global warming (Kahan et al., 2011). In contrast,

communitarians favour high levels of social interaction, social assistance and solidarity over competitiveness. They perceive environmental and technological risks as real because they dislike commerce and other self-seeking behaviours (Kahan, 2012). They perceive high risk and expert agreement on climate change (Kahan et al., 2011).

Along the hierarchy-egalitarianism scale, a high grid correlates to the hierarchical culture and a low grid to the egalitarian culture. Hierarchical culture favours stratified social roles and social classifications based on characteristics such as gender, age, ethnicity and status. They are dismissive of environmental and technological risks (i.e., climate change) because this type of risk perception threatens the authority or competence of those in power (i.e., the social and governmental elite) (Kahan, 2012). In contrast, an egalitarian culture favours equal consideration for people of all gender, age, ethnicity or status. They perceive strong environmental (i.e., climate change) and technological risks because they dislike unjust social disparities (Kahan, 2012).

Cultural worldviews can predict global warming scepticism: it is more likely for hierarchs and individualists (Kahan et al., 2011). The majority of hierarchical-individualists believe that scientists are either divided or disagree that climate change is happening (Kahan et al., 2011). Similarly, perception of risks associated with climate change decreases as people are more hierarchic and more individualist (Kahan, Braman, Slovic, et al., 2007). Hierarchical-individualists are least concerned about environmental risks and egalitarian-communitarians are most concerned.

Cultural worldviews explain global warming beliefs three times better than political ideology and 10 times better than gender (Kahan et al., 2011). Furthermore, the cultural identity of the climate policy advocate and their proposed solutions are known to

affect the participants differently according to how their values align with the advocate or the message (Kahan et al., 2011). For example, only 23% of hierarchical-individualists believed an advocate to be an expert on climate change when this advocate presented a high-risk scenario (i.e., beyond doubt that humans are causing climate change), compared to 86% for the low-risk scenario (i.e., it is premature to conclude that humans are causing climate change) (Kahan et al., 2011). Therefore, worldviews function as a mental filter and explains an individual's beliefs and preferences for social or environmental practices (Kahan & Braman, 2003).

2.4 Cultural cognition and pro-environmental behaviour

As mentioned earlier, the theory of planned behaviour and the value-belief-norm theory are said to be the most widely used theories of pro-environmental behaviour (Gifford, 2007). Cultural Theory, the myths of nature, and cultural cognition have been linked to crucial components of both of these theories.

As mentioned previously (Figure 1), attitudes and norms are two central components of the theory of planned behaviour. Attitudes and norms were the most important predictors of intentions to use public transport (Tikir & Lehmann, 2011). The authors also conclude that attitudes (R^2 = .24) and norms (R^2 = .14) are explained by cultural values as measured with cultural theory. In addition, they conclude that attitudes and norms completely mediate the relation between cultural values (i.e., measured by cultural theory) and the intention to use public transport, meaning that the relation between cultural values and intentions disappears when attitudes and norms are included in the analysis. This suggests that cultural values have an indirect effect on intentions through their relation with attitudes and norms. This finding supports previous research;

individualists have a negative relation with attitudes, norms, and intentions while egalitarians have a positive relation (Tikir & Lehmann, 2011).

As illustrated earlier in Figure 2, environmental beliefs measured by the new ecological paradigm (NEP) are early pro-environmental behaviour predictors in the value-belief-norm theory (Stern et al., 1999). The myths of nature and the NEP measures are related; nature ephemeral respondents had the highest level of environmental concern as measured by NEP scale while nature benign respondents had the lowest (Poortinga et al., 2002). Furthermore, the hierarchy-egalitarianism scale used in cultural cognition theory predicted more than 31% of the variance in NEP (Overdevest & Christiansen, 2013).

2.5 Climate change risk perception

As part of cultural cognition theory, risk perception explains behavior based on the desire to avoid situations that threaten worldviews. Physical vulnerability to climate change, political party affiliation, belief in climate change, and knowledge also affect climate change risk perception.

Vulnerability to climate change and risk perception are not always related. For example, actual physical climate change risk, as measured using spatial data, explained only 4% of the variance in risk perception (Brody, Zahran, Vedlitz, & Grover, 2008). However, when control variables were added to the regression, 42% of the variance in risk perception was explained and perceived efficacy (which included one item on the belief in human-caused climate change) and worldviews (measured by new ecological paradigm (NEP)) were by far the most important predictor variables. Vulnerability and climate change risk perception were not correlated for segments of the population that are

economically vulnerable to climate change – ranchers and farmers (Safi, Smith Jr., & Liu, 2012). Instead, and consistent with other studies (Gifford et al., 2009; Leiserowitz, 2005; Lima & Castro, 2005; Lorenzoni & Pidgeon, 2006), the authors found comparative optimism; individuals rated the climate change risks to themselves as lower than the risks to others elsewhere around the world.

In addition, belief in anthropogenic climate change correlates with risk perception (e.g., Safi et al., 2012). This belief is in turn predicted by worldviews (i.e., NEP), political (Whitmarsh, 2011) and economic orientation (Lewandowsky, Gignac, & Vaughan, 2013). Furthermore, perceived scientific consensus on anthropogenic climate change also predicts belief in climate change (Lewandowsky et al., 2013; McCright, Dunlap, & Xiao, 2013). Individuals often underestimate the scientific agreement on anthropogenic climate change, which varied from 55% to 73% perceived agreement compared to 97% actual agreement (Downing & Ballantyne, 2007; Lewandowsky et al., 2013; Schuldt, Roh, & Schwarz, 2015). Presenting participants with information on the scientific consensus attenuates the effect of economic worldviews on belief in climate change (Lewandowsky et al., 2013).

Knowledge specifically about the causes and consequences of climate change, predicts risk perception (Sundblad, Biel, & Gärling, 2007). Self-reported climate change knowledge is correlated with concern (measured as seriousness of the problem), although this was only true for those who trust in scientists or were not Republican (Malka, Krosnick, & Langer, 2009). Political party affiliation moderates the relation between climate change knowledge and risk perception, which is weaker for center-right parties

(Milfont, 2012). However, sometimes being more informed about climate change correlates with lower levels of risk perception (Kellstedt, Zahran, & Vedlitz, 2008).

Research on climate change knowledge, beliefs in climate change and pro-environmental behavior, is also inconclusive. Understanding the causes to climate change correlates with climate policy support, buying green, and driving less (O'Connor, Bord, Yarnal, & Wiefek, 2002; Zahran, Brody, Grover, & Vedlitz, 2006) and knowledge correlates with beliefs in climate change (Jones, 2011). However, the Jones study found no link between knowledge and climate policy preferences. Furthermore, others report no relation between knowledge and pro-environmental behavior (S. Brody, Grover, & Vedlitz, 2012) or climate change skepticism (Whitmarsh, 2011).

Chapter 3: Objectives, Hypotheses, and Design

3.1 Objectives

To the best of my knowledge, cultural cognition has never been used to study the perception of barriers to pro-environmental behaviour. Past studies of cultural theory and cultural cognition demonstrated their usefulness in predicting environmental policy preferences and in making suggestions for value-based message framing. Therefore, I concluded that cultural cognition would provide some useful insight to the study of pro-environmental behaviour and barrier perception. The main objective (1) of the present study was to explore how different segments of the population perceive barriers to pro-environmental behaviour, using cultural cognition as the basis for forming groups. Additionally, this study explored the following objectives:

(2) The present study verified the presumed relations between the perception of barriers and the frequency of pro-environmental behaviour.

(3) The present study further explored the relations between cultural cognition and climate change risk perception.

This study also included the following exploratory analyses:

(4) This study provided additional insight on the relations between climate change knowledge and pro-environmental behaviour, which remained unclear in the literature.

(5) This study explored the processes leading to high barrier perception and pro-environmental behaviour frequency through moderation and mediation analyses.

(6) This study compared the level of perceived barriers for efficiency and curtailment behaviours.

(7) This study included exploratory analyses to empirically verify the proposed list of psychological barriers to pro-environmental behaviour (i.e., *dragons of inaction*) and (8) to conduct a critical analysis of cultural cognition theory.

3.2 Hypotheses

I formed the following hypotheses based on the findings from my literature review. The hypotheses are grouped by outcome variable; barrier perception, pro-environmental behaviour frequency, and climate change risk perception. A variable can be both a predictor variable and an outcome variable depending on the analysis (e.g., climate change risk perception as predicted by cultural cognition or risk as a predictor of pro-environmental behaviour frequency).

3.2.1 Barriers to pro-environmental behaviour

Hypothesis 1: Cultural cognition will significantly explain barrier perception. Overall, hierarchs and individualists will report more barriers.

Hypothesis 2: Cultural cognition will significantly explain climate change scepticism. Scepticism will be stronger for hierarchs and individualists.

Exploratory analysis: Multiple regression analyses of all predictor variables on barrier perception to determine the relative importance of each.

3.2.2 Pro-environmental behaviour frequency

Hypothesis 3: Stronger barrier perceptions will be significantly correlated with less behaviour.

Hypothesis 4: Cultural cognition will explain behaviour frequency. Hierarchs and individualists will be correlated with less behaviour.

Exploratory analysis: Multiple regression analyses of all predictor variables on behaviour frequency to determine the relative importance of each.

3.2.3 Climate change risk perception

Hypothesis 5: Cultural cognition will significantly explain climate change risk perception. Perception of risks associated with climate change will decrease as people are more hierarchical and more individualist.

Hypothesis 6: Participants will perceive more risk to others than to themselves.

Exploratory analysis: Multiple regression analyses of all predictor variables on risk perception to determine the relative importance of each.

3.3 Exploratory analyses

After review, some areas did not have sufficient empirical findings to form the basis for hypotheses. I conducted exploratory analyses to address these gaps in the literature. The role of climate change knowledge in barrier perception, behaviour frequency and climate change risk perception was explored. The perceived barriers to pro-environmental behaviour were analyzed to compare my findings to the proposed list of *dragons of inaction*. The cultural cognition approach and its scales were critically evaluated to determine if this approach successfully addressed some of the aforementioned challenges to cultural theory measurements (i.e., non-exclusive cultural types, reliability, construct validity).

3.4 Design

A correlational design was used. Participants reported their cultural values, perception of climate change risk, perception of barriers, frequency of pro-environmental behaviour, climate change knowledge and socio-demographic variables in a close-ended survey. Participants were given the opportunity to elaborate on their perception of barriers to pro-environmental behaviour in one open-ended survey question. Survey sections were randomized to avoid order effects. Hypotheses were tested using correlational and regression analyses. In addition, exploratory analyses included *T*-tests, moderation, mediation, and principal component analysis.

3.5 Conceptual model

Although my study design does not allow testing for causality, I generally believe that the major flow of causation is as follows; cultural values, climate change risk perception, pro-environmental barriers, and pro-environmental behaviour (Figure 5).

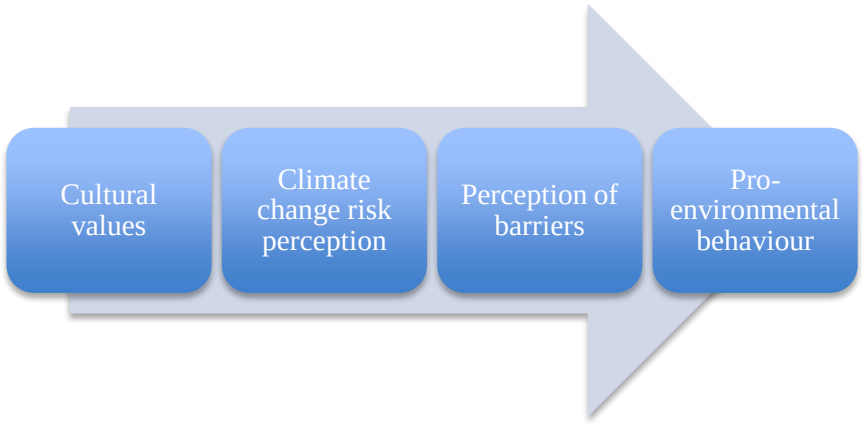

***Figure 5*. Conceptual model.**

Chapter 4: Method

4.1 Measures

4.1.1 Barrier scale

My research focused on the perception of barriers that are compatible with cultural cognition theory. In other words, I focused on the barriers for which I could make predictions using the cultural patterns stipulated by the theory (e.g., technosalvation will be correlated with individualism). Respondents were asked to think about behaviour that they engaged in less often (chosen from a list of behaviours, see 4.1.4) when evaluating their perception of barriers.

To measure participant perception of barriers, I used a scale consisting of three to four items per barrier (see Appendix 1). The barrier scale was originally developed for use in other studies. New items were created and re-tested in a pilot study to replace the ones that were unsatisfactory in previous studies (i.e., low Cronbach's alpha).

Respondents were asked to rate their level of agreement to each barrier item on a 7-point Likert scale from strongly disagree to strongly agree. If the scale was reliable in my sample, a score was assigned to each respondent based on his or her average for the scale. A higher score on a barrier scale indicated that barrier perception was stronger.

Additionally, a measure of scepticism was required to test for hypothesis 2. The cultural cognition literature defines scepticism as a belief that the experts disagree on the occurrence and the cause of climate change (see Kahan, Jenkins- Smith, & Braman, 2011). To account for both the perception of expert disagreement and the belief in

climate change, scepticism was measured with a combination of denial and mistrust items from the barrier scale.

4.1.2 Cultural cognition scale

As detailed in Appendix 2, I used a short form of the cultural cognition scale consisting of six items per scale. These items were slightly modified for a Canadian sample. In my surveys, respondents were presented with the items in a random order and asked to rate their agreement on a 6-point Likert scale, from strongly disagree to strongly agree. If both scales were reliable in my sample, a score was assigned to each respondent based on his or her average for each scale. A high score on individualism-communitarianism scale indicated a more individualist orientation, whereas a high score on hierarchy-egalitarianism scale indicated a more hierarchical orientation.

For most hypotheses, I used these continuous scores. For analyses comparing cultural types, respondents were also classified into Hierarchical individualists, Hierarchical communitarians, Egalitarian individualists or Egalitarian communitarians according to where they fell in relation to the median scores of both scales.

4.1.3 Climate change risk perception scale

A climate change risk perception index, selected from a previous study (Leiserowitz, 2006), was used to measure the perception of risk. Participants were asked to rate a series of nine questions on a scale of 1 (i.e., not concerned, not serious, not likely) to 4 (i.e., very concerned, very serious, very likely) (Appendix 3). If the scale was reliable in my sample, participants were assigned a risk perception score based on the average of the nine items. A higher score indicated stronger climate change risk

perception. In addition, personal risk items (i.e., items 7, 8, 9) and worldwide risk items (i.e., items 4, 5, 6) were used to assign a personal and worldwide risk score.

4.1.4 Reported pro-environmental behaviour

Individuals often are more motivated to select pro-environmental behaviours that have lower impact on GHG emission reduction (Department for Environment Food and Rural Affairs, 2008; Gifford, 2011). The preference for lower impact behaviour is probably because of ease; perceived ease of behaviour has a positive relation with the intention to do that behaviour (Fujii, 2006). This suggests that behaviours that have more GHG emission reduction potential (e.g., driving less) are associated with more social and psychological barriers and are thus perceived as being harder to accomplish (Department for Environment Food and Rural Affairs, 2008; O'Connor et al., 2002). These higher impact behaviours are precisely the ones that researchers should focus on (Stern, 2000).

For the purpose of this study, I focused on behaviours that are perceived as being medium in difficulty (i.e., not too easy and not too difficult) given that the high number of barriers presumably associated with the most difficult behaviours would make it harder to distinguish between the different population segments (i.e., all population segments would perceive a high number of barriers). Alternatively, I presume the opposite would also be true for behaviours that are very easy to achieve. That being said, I have chosen to focus on a behavioural domain that has a medium level of difficulty perception and medium to high GHG emission reduction potential: reducing residential energy use (Department for Environment Food and Rural Affairs, 2008).

I gathered a list of energy reduction behaviours from multiple sources (Department for Environment Food and Rural Affairs, 2008; Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009; Gronhoj & Thogersen, 2012; Kaiser & Keller, 2001; Mirosa, Lawson, & Gnoth, 2011) . The list included curtailment and efficiency behaviours. For curtailment behaviours, respondents were asked to rate how often they engaged in the behaviours on a 5-point Likert scale from never (1) to always (5) (see Appendix 4). Participants were given a N/A option as well, which was included primarily to account for participants who were not homeowners and thus had less control over certain behaviours (i.e., installing a low-flow showerhead). For efficiency behaviours, respondents were asked if they had engaged in the behaviours (i.e., yes = 1, no = 2, N/A = 3).

If the scale was reliable in my sample, participants were assigned a pro-environmental behaviour frequency score based on the average. A higher score indicated more pro-environmental behaviour frequency.

4.1.5 Climate change knowledge

I asked the respondents 11 multiple choice climate change knowledge questions (see Appendix 5). This suite of questions focused on objective knowledge of the causes and processes related to climate change. Participants were assigned a score based on the number of correct answers.

4.1.6 Socio-demographic variables

As a part of my survey I also collected data on the socio-demographics of the participants (Appendix 6) to measure the effect these had on the perception of barriers and other variables. This measure was not central to my hypotheses but was included to

increase empirical understanding in this area and also to serve as a comparison for explanatory power of my predictor variables (e.g., is cultural cognition a better predictor than socio-demographic variables).

Other than age (respondents had to be 18 years or older to participate), answers to the socio-demographic questions were optional. Gender and education were measured through multiple-choice questions. A score of one was assigned to males and a score of two assigned to females. Education level was measured using seven categories; a higher score indicated a higher education level (adapted from Bradburn, Sudman, & Wansink, 2004). Participants were also asked to provide their age and income. These two variables formed a continuous scale.

4.2 Procedure

4.2.1 Pilot testing

In past studies, some of the barriers in the multiple item scale did not achieve satisfactory Cronbach's alpha (Kormos et al., 2011). Specifically, items for ignorance, social norms, mistrust and inequity barriers needed to be improved and pre-tested using a university student sample before the survey was administered to the community sample. Additionally, any new scales (e.g., knowledge questions) were pilot tested for quality control.

4.2.2 Recruitment

An online panel recruitment agency (i.e., Qualtrics) was used to recruit 200 British Columbia participants. Recruitment took place during the first two weeks of

December 2014. Participants were invited to take part in a 20-minute survey and were compensated by the panel recruitment agency.

4.3 Pre-analysis variable recoding

The collected data had to be modified prior to analyses. First, the scores on six reverse scored items in the cultural cognition scale and two items in the barrier scale were reversed. Second, income and knowledge data had to be recoded. The income data were re-coded when necessary to ensure that all data were entered in a number only format (i.e., change 70K to 70000). The knowledge questions were recoded into scores for correct or incorrect answers (i.e., correct answer = 1, I don't know answer = 2, incorrect answer = 3). Third, a new variable for cultural cognition "type" was created based on where participants fit according to the median of both scales (i.e., Hierarchical individualism = 1, Hierarchical communitarianism = 2, Egalitarian individualism = 3, Egalitarian communitarianism = 4).

Chapter 5: Results

5.1 Participants

After data screening, the sample size consisted of 152 residents of British Columbia. The mean age of participants was 47 years (*SD* = 17 years), and the sample consisted of 69 male participants (45%) and 83 female participants (55%). Of the participants who chose to provide their household income level (*n* = 57), the average income was $56,026 (*SD* = 35,166).

A small number of participants (*n* = 4 or 2.6%) had not completed high school, 48 participants had a high school diploma or equivalent (31.6%), 53 had a college degree (34.9%), 31 had a bachelor's degree (20.4%), and the rest had a master's degree (*n* = 9 or 5.9%), a professional degree (*n* = 5 or 3.3%) or a doctorate degree (*n* = 2 or 1.3%).

5.2 Data screening

Two-hundred participants were initially recruited to participate in this survey. To ensure quality control, two validation questions were included in different sections of the survey (e.g., to validate your continued participation, please select strongly agree for this question). Seventeen participants were removed from the sample because they incorrectly answered at least one of the validation questions. For better data quality, a cut-off survey completion time of 10 minutes or more was established based on a pilot study; an additional 30 participants were removed because they answered the survey in less than 10 minutes. One participant was considered an extreme case; this participant reported a barrier perception of six, which is more than three standard deviations from the mean (*N*

= 153, *M* = 2.63, *SD* = 0.94). This outlier was removed from the sample. Thus, 152 participants remained after data screening.

5.3 Missing data

Because the online survey software includes a forced-response option, which requires participants to answer a question before moving on to the next, most questions in my survey did not allow for missing data. Only two questions resulted in missing data; income and behaviour frequency. Therefore, analyses involving the income variable have a smaller sample size (*n* = 57). When possible, missing data for behaviour frequency was imputed.

5.3.1 Data imputation

Participants were given "not applicable" options for the behaviour frequency questions in order to account for behaviour that was beyond their control (e.g., apartment renters installing solar panels). These "not applicable" answers resulted in missing data. On a participant-by-participant basis, I conducted horizontal mean imputation if less than 30% of the questions were missing (e.g., not missing more than 3 out of 11 behaviours). As opposed to vertical mean imputation, which is based on the group mean, this method is preferred because it is based on each participant's behaviour frequency mean.

Behaviours 1 through 11 are curtailment behaviours. These were measured on a 5-point Likert scale. Two participants had more than 30% missing data thus their behaviour frequency data were not imputed. These participants are excluded from all the behaviour frequency analyses, resulting in a sample size of 150 for these analyses.

For the efficiency behaviours (i.e., behaviours 12 through 16), many participants answered “not applicable”, most likely because these participants are not homeowners. This resulted in too much missing data to impute; 59 out of 152 participants have more than 30% of the questions missing. Because using only the remaining participants would greatly reduced my sample size (n = 93), I chose not to use the efficiency questions when calculating the behaviour frequency score. The behaviour frequency score is instead based on the average of behaviours 1 through 11 (i.e., curtailment) after horizontal mean imputation.

5.4 Reliabilities

5.4.1 Barrier perception scale

The items in each sub-barrier scale were analysed and weak items (i.e., if included, reduced the alpha below .70) were removed. Four items were removed because their removal increased the Cronbach’s alpha for that barrier scale. These items were removed from all analyses, including the overall barrier score. Barrier sub-scales, items and Cronbach’s alpha are included in Appendix 7.

The 32-item barrier scale had a high Cronbach’s alpha (α = .95, N = 152). The 7-item scepticism barrier scale, which consisted of denial and mistrust items, had a high Cronbach’s alpha (α = .91, N = 152).

5.4.2 Other scales

The following scales had reliable Cronbach’s alphas and therefore their score was calculated based on item average. The two cultural scales were reasonably reliable (see Appendix 2); the 6-item hierarchy-egalitarianism scale had a Cronbach’s alpha of .72 and

the 6-item individualism-communitarianism scale had a Cronbach's alpha of .76. After missing data imputation, the 11-item behaviour frequency scale also had sufficiently high Cronbach's alpha (α = .74, see Appendix 4). The climate change risk perception scale had a high Cronbach's alpha (α = .93, see Appendix 3).

The 11-item knowledge measure did not have sufficient Cronbach's alpha (α = .34). Instead of averaging the scores, I added the number of correct answers for each participant to create a continuous knowledge measure.

5.5 Descriptives

A descriptives table is included Appendix 8.

5.5.1 Cultural cognition

Measured on a 6-point Likert scale, a high score on hierarchy-egalitarianism scale indicated a more hierarchical orientation. On average the participants in my sample were almost evenly split between the two orientations, with a slightly more egalitarian average (M = 2.63, SD = 0.91). A high score on individualism-communitarianism scale indicated a more individualist orientation. The participants in my sample were slightly more individualist than communitarian on average (M = 3.65, SD = 0.84).

Thirty-five participants fit the Hierarchical individualism type (n = 131, 26.7%), 32 fit the Hierarchical communitarianism (n = 131, 24.4%), 26 fit the Egalitarian individualism (n = 131, 19.8%) and 38 fit the Egalitarian communitarianism type (n = 131, 29%). Twenty-one participants could not be classified into types because they had median scores on either or both of the cultural cognition scales.

5.5.2 Barrier perception

Measured on a 7-point Likert scale, a high score indicated a strong perception of barriers to pro-environmental behaviour. On average, barrier perception in my sample was relatively low (M = 2.60, SD = 0.90).

5.5.3 Climate change risk perception

Measured on a 4-point Likert scale, a high score indicated more climate change risk perception. On average, climate change risk perception was ranked somewhere between somewhat serious and serious (M = 2.59, SD = 0.81).

5.5.4 Pro-environmental behaviour

Behaviour frequency was measured on a 5-point Likert scale. A high score indicated more pro-environmental behaviour frequency. On average, the participants in this sample indicated mid-to-high levels of behaviour frequency (M = 3.81, SD = 0.56).

5.5.6 Climate change knowledge

Objective climate change knowledge was measured using 11 questions. A high score indicated more climate change knowledge. On average, the participants in this sample had low levels of climate change knowledge, although variance was high (M = 3.55, SD = 2.05).

5.5.7 Inter-item correlations

A correlation matrix is included in Appendix 9. Using a cut-off of .80 as my guideline for highly correlated items (see Field, 2013), I concluded that collinearity is not a problem in my data.

5.6 Normality

The normality of my data was checked for skewness and kurtosis before analysis for the main variables (i.e., hierarchy-egalitarianism scale, individualism-communitarianism scale, behaviour frequency, barriers, risk and knowledge). These variables were all symmetrical and non-kurtotic for my sample (see Appendix 8) except for risk perception, which was slightly negatively kurtotic (z = -2.14). Transformation of the data was not necessary because this kurtosis was small.

5.7 Hypothesis testing

5.7.1 Barrier perception

To examine the relations between cultural cognition and the perception of barriers, multiple linear regression analyses were conducted. Both cultural cognition scales were entered (i.e., forced entry) as predictors of barrier perception in the model. The cultural cognition model significantly predicted barrier perception and explained 16% of the variance (F = 13.8, p < .01, R^2 = .16, R^2_{adj} = .15), which represents a medium effect size. However, only the hierarchy-egalitarianism scale contributed significantly to this model (β = .39, sr^2 = .15, p < .01). More hierarchical participants perceived more barriers to pro-environmental behaviour. Therefore, hypothesis 1 was partially supported; cultural cognition significantly explained barrier perception, but only the hierarchy-egalitarianism scale did so.

Another correlation test was conducted, this time comparing the cultural cognition scales with the perception of a specific barrier; climate change scepticism. The cultural cognition model significantly predicted climate change scepticism and explained 21% of

the variance ($F = 19.95$, $p < .01$, $R^2 = .21$, $R^2_{adj} = .20$), which represents a medium effect size. Although the contribution of the individualism-communitarianism scale might be considered marginally significant ($\beta = .13$, $sr^2 = .02$, $p = .08$), only the hierarchy-egalitarianism scale significantly predicted scepticism ($\beta = .43$, $sr^2 = .18$, $p < .01$). Hierarchical participants were more sceptical about the occurrence of climate change and its causes. Therefore, hypothesis 2 was partially supported; cultural cognition significantly explains scepticism, but only the hierarchy-egalitarianism scale is significant.

I then conducted exploratory analyses to discover the most important predictors of barrier perception (Table 2). In the full barrier model, seven predictors of barrier perception were included: hierarchy-egalitarianism scale, individualism-communitarianism scale, risk perception, knowledge, and socio-demographic variables. Income was omitted because of missing data. The full model significantly predicted barrier perception and explained 39% of the variance ($F = 13.04$, $R^2 = .39$, $p < .01$), which represents a large effect size. Risk perception was the most important predictor ($\beta = -.51$, $p < .01$), followed by the hierarchy-egalitarianism scale ($\beta = .22$, $p < .01$). Barrier perception decreased as individuals perceived more climate change risk and were more egalitarian. No other variable significantly contributed to the model.

The semipartial correlation squared (sr^2) indicates the unique proportion of variance explained by each predictor (Field, 2013). Following conventions established by Cohen (1998)[1], the results show that climate change risk perception has a medium-to-large effect size while the hierarchy-egalitarianism scale has a small effect size.

[1] Small effect size : R^2 (or sr^2) = .02, r = .10, d = .2 ; Medium effect size : R^2 (or sr^2) = .13, r = .30, d = .5 ; Large effect size : R^2 (or sr^2) = .26, r = .50, d = .8 (Cohen, 1998).

Table 2.

Barrier Perception Predicted

Predictors	β	sr^2
Hierarchy-Egalitarianism	.22**	.04
Individualism-Communitarianism	-.07	.00
Risk Perception	-.51***	.21
Knowledge	-.04	.00
Age	-.03	.00
Gender	.02	.00
Education	-.07	.00
F	13.04***	
R^2	.39	
Adjusted R^2	.36	
N	152	

$p < .10$*, $p < .05$**, $p < .01$***

5.7.2 Pro-environmental behaviour frequency

To examine the relations between the perception of barriers and the frequency of reported pro-environmental behaviour, a correlation analysis was conducted. A significant negative relation was found ($r = -.32$, $p < .01$). This indicates that stronger barrier perception correlates with less reported pro-environmental behaviour and results in a medium effect size, which supports hypothesis 3.

Furthermore, the relations between cultural values and behaviour frequency were examined with regression analyses. Cultural cognition does not significantly explain the variance in behaviour frequency ($F = .40$, $p = .67$). The hypothesis (4) that hierarchs and individualists will be correlated with less behaviour is therefore not supported in this sample.

All predictors of behaviour frequency were entered (i.e., forced entry) into a regression model for exploratory analysis (Table 3). Possible predictors of behaviour gathered in this study are cultural cognition, climate change risk perception, barriers

perception, knowledge, and socio-demographic variables. The full model significantly explained 25% of the variance in behaviour frequency ($F = 5.74$, $R^2 = .25$, $p < .01$). Climate change risk perception is the most important predictor in the model ($\beta = .35$, $p < .01$). Age is the only other variable that significantly contributes to the model ($\beta = .21$, $p < .01$). Both of these variables represent small effect sizes.

Table 3.

Reported Behaviour Frequency Predicted

Predictors	β	sr^2
Hierarchy-Egalitarianism	.07	.00
Individualism-Communitarianism	.06	.00
Barrier Perception	-.13	.01
Risk Perception	.35***	.07
Knowledge	.03	.00
Age	.21***	.04
Gender	-.01	.00
Education	.11	.00
F	5.76***	
R^2	.25	
Adjusted R^2	.20	
N	152	

$p < .10$*, $p < .05$**, $p < .01$***

However, the relation between perceived barriers and pro-environmental behaviour (hypothesis 3) disappears when the full model is used. I thus conducted exploratory analyses to tease out the relations between risk, barriers and behaviour. When tested separately, climate change risk and barriers perception both significantly correlate with pro-environmental behaviour frequency. However, adding barriers to risk perception as a predictor in the second step of a stepwise regression does not significantly increase the variance explained ($R^2_{change} = .01$, $p = .21$), suggesting that barrier perception does not explain any unique variance in pro-environmental behaviour.

5.7.3 Climate change risk perception

Multiple regression analysis was conducted to examine the relations between cultural cognition and climate change risk perception. Cultural cognition significantly explains 14% of the variance in risk perception ($F = 12.41$, $p < .01$, $R^2 = .14$, $R^2_{adj} = .13$), which represents a medium effect size (Cohen, 1998). Both hierarchy-egalitarianism scale ($\beta = -.33$, $p < .01$) and the individualism-communitarianism scale ($\beta = -.16$, $p < .01$) were significant in the model, indicating that hierarchical and individualist people perceived less risk. Therefore, the model supports hypothesis 5 that perception of risk associated with climate change will decrease as individuals are more hierarchical or individualists.

A *T*-test was conducted to learn whether participants perceive more risk in places farther away from where they live. Hypothesis 6 was supported: participants perceived significantly more risk worldwide ($M = 2.73$, $SD = 0.88$) than where they live ($M = 2.17$, $SD = 0.94$, $t = 10.76$, $p < .01$). This difference represents a medium effect size ($d = .61$).

In order to examine the influences of climate change risk perception, all possible predictors were entered (i.e., forced entry) in a multiple regression model (Table 4). Possible predictors of risk gathered in this study are hierarchy-egalitarianism scale, individualism-communitarianism scale, knowledge, and socio-demographic variables. This model explained 20% of the variance in risk perception ($F = 5.86$, $p < .01$, $R^2 = .20$), which represents a medium effect size. The hierarchy-egalitarianism scale was the most significant predictor of risk perception ($\beta = -.31$, $p < .01$). Gender was also a significant predictor in this model ($\beta = .17$, $p < .05$). The individualism-communitarianism scale, knowledge, and age were almost but not quite significant by the customary $p < .05$ standard in this model. The hierarchy-egalitarianism scale has a small-to-medium effect

size while individualism-communitarianism scale, knowledge, age and gender have small effect sizes.

Table 4.

Climate Change Risk Perception Predicted

Predictors	β	sr^2
Hierarchy-Egalitarianism	-.31***	.09
Individualism-Communitarianism	-.15*	.02
Knowledge	.15*	.02
Age	.15*	.02
Gender	.17**	.02
Education	.02	.00
F	5.86***	
R^2	.20	
Adjusted R^2	.16	
N	152	

p < .10*, *p* <. 05**, *p* <. 01***

5.8 Other analyses and findings

5.8.1 Other barriers

After having answered the barrier scale questions, participants were given the opportunity to express "other" reasons why they find it difficult to engage in pro-environmental behaviour. Fifty-four participants chose to do so. Of these reasons, cost (*n* = 24 or 44%) was by far the most common justification. Others mentioned inconvenience (i.e., comfort or habit) (*n* = 9 or 17%) and renting (*n* = 7 or 13%). Still, others stated they felt that the large scale of the problem made it difficult for them to feel motivated to act, or perceived a lack of alternatives (e.g., technological alternative or alternative to car use), or were worried about the efficacy of changing behaviour such as cold-water dish washing (*n* = 4 or 7% for each). One reported feeling confused about which energy efficient brand to buy.

5.8.2 Socio-demographic variables

All socio-demographic variables were tested as possible moderators using the PROCESS tool in SPSS (Hayes, 2015). The variables were standardized prior to analysis. The PROCESS tool centers both predictors and computes the interaction term, and then enters the two predictors and interaction term in a regression. Only age and education were found to have a significant moderation effect.

When the interaction term between age and risk is entered into the regression, it explained a significant increase in barrier perception ($R^2_{change} = .02$, $F = 5.54$, $p = .02$). Thus, age moderates the relation between risk perception and barriers perception (Table 5).

As illustrated in Figure 6, simple slopes for the association between climate change risk and barrier perception were examined for younger (-1 *SD* below the mean), average age, and older (+1 *SD* above the mean) participants. Each of the simple slope tests revealed a significant negative association between risk and barriers, but risk was more strongly related to barriers for older participants ($b = -.70$, $se = .08$, $t = -8.43$, $p < .001$) than for mean age ($b = -.54$, $se = .07$, $t = -7.94$, $p < .001$) or younger ($b = -.38$, $se = .11$, $t = -3.52$, $p < .001$) participants.

Table 5.

Interaction Effect of Age and Risk on Barriers

	b	se	*t*	*p*
Constant	.00	.07	.05	.96
Age	.03	.07	.47	.64
Risk	-.54	.07	-7.94	.00
Age x Risk	-.16	.07	-2.35	.02

$R^2 = .36$, $p = .00$, $R^2_{change} = .02$, $p < .05$

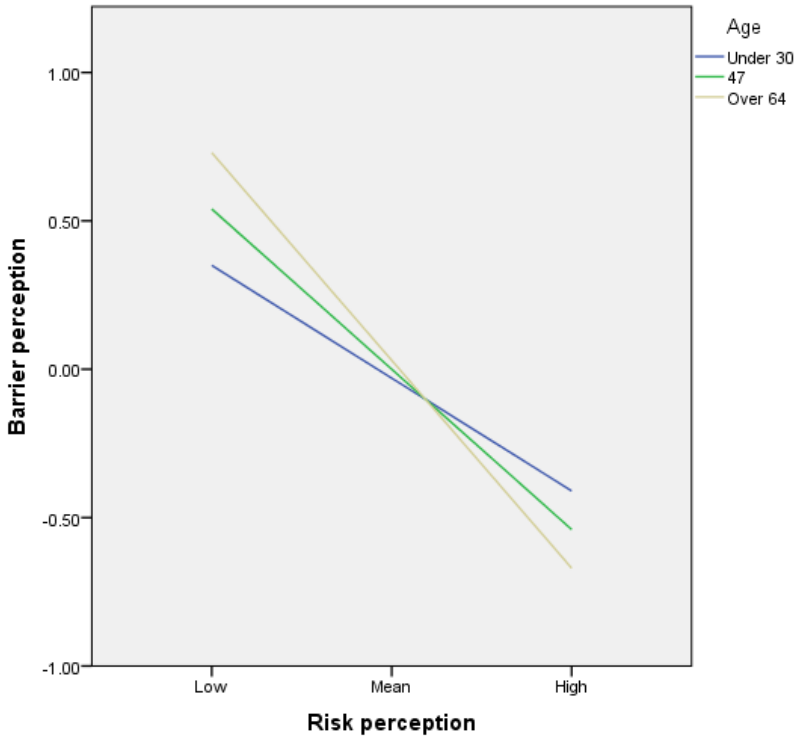

Figure 6. **Age as moderator of the relation between risk and barriers.**

Age also moderates the relations between the hierarchy-egalitarianism scale and barrier perception (Table 6). When the interaction term for age and hierarchy-egalitarianism scale was entered into the regression, it explained a significant increase in barrier perception ($R^2_{\text{change}} = .03$, $F = 6.20$, $p = .01$).

A significant positive relation between hierarchy-egalitarianism scale and barrier perception was found and this relation gets stronger with age (Figure 7). Simple slopes for the association between hierarchy-egalitarianism scale and barriers were tested for younger (-1 *SD* below the mean), average, and older (+1 *SD* above the mean) participants. The simple slope for 1 *SD* below the mean age was $b = .23$ ($se = .11$, $t = 2.12$, $p < .05$), the simple slope for the mean age was $b = .41$ ($se = .08$, $t = 5.38$, $p < .01$), and the simple slope for 1 *SD* above the mean age was $b = .59$ ($se = .10$, $t = 5.68$, $p < .01$).

Table 6.

Interaction Effect of Age and Hierarchy-Egalitarianism Scale on Barriers

	b	se	*t*	*p*
Constant	-.05	.08	-.60	.55
Age	-.10	.08	-1.27	.21
HScale	.41	.08	5.38	.00
Age x HScale	.18	.07	2.49	.01

R^2 = .20, p = .00, R^2_{change} = .03, p = .01

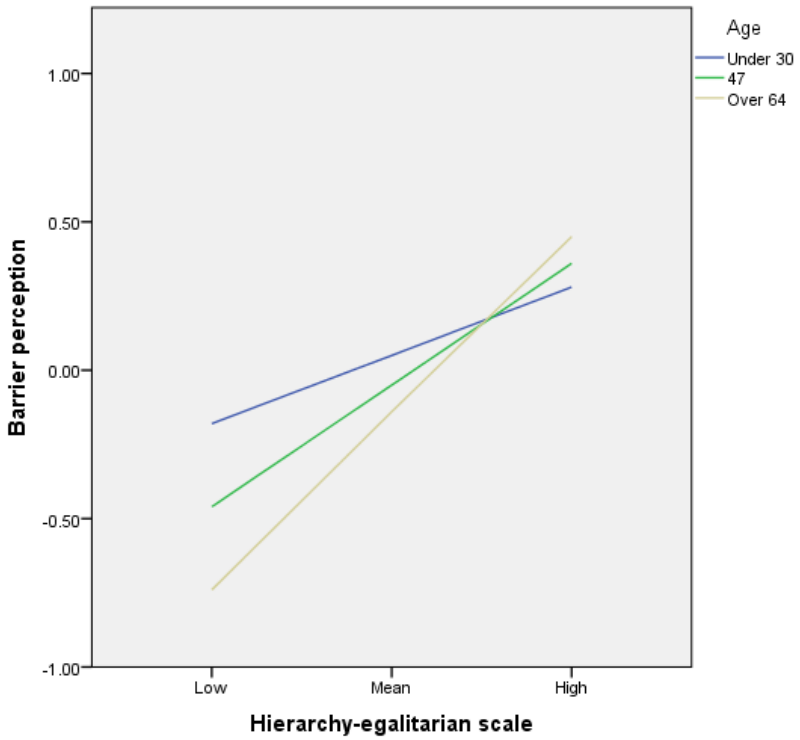

Figure 7. **Age as moderator of the relation between hierarchy-egalitarianism values and barriers.**

Education moderates the relation between perceived barriers and pro-environmental behaviour (Table 7). When the interaction term between education and perceived barriers was entered into the regression, it explained a significant increase in reported behaviour frequency (R^2_{change} = .05, F = 8.30, p < .01).

There is a non-significant negative relation between perceived barriers and pro-environmental behaviour at low levels of education but this relation becomes significant for participants that are more educated. Simple slopes for the association between perceived barriers and reported behaviour were examined for participants with lower (-1 *SD* below the mean), mean, and higher levels of education (+1 *SD* above the mean). As illustrated in Figure 8, each of the simple slope tests revealed a negative association between perceived barriers and pro-environmental behaviour, but barriers were more strongly related to reported behaviour at higher levels of education (b = -.63, se = .16, t = -3.91, p = .00) than for mean levels of education (b = -.34, se = .10, t = -3.28, p = .00) or lower levels of education (b = -.04, se = .13, t = -.35, p = .72).

Table 7.

Interaction Effect of Education and Barriers on Behaviour

	b	se	*t*	*p*
Constant	-.14	.10	-1.42	.16
Education	-.06	.11	-.54	.59
Barriers	-.34	.10	-3.28	.00
Education x Barriers	-.29	.10	-2.88	.00

R^2 = .10, p = .00, R^2_{change} = .05, p = .00

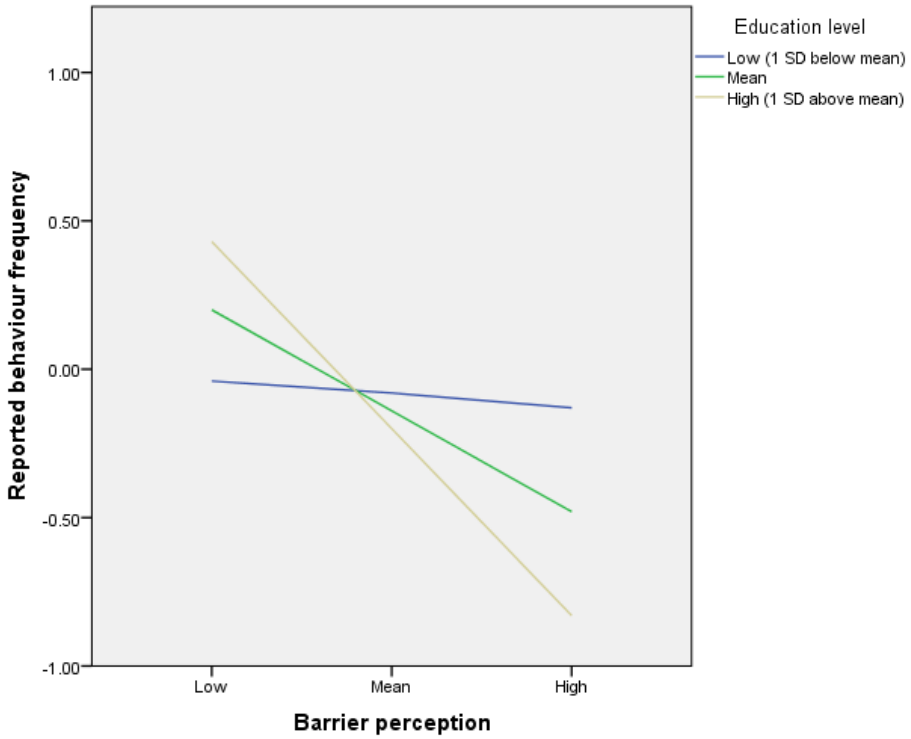

Figure 8. **Education as moderator of the relation between barriers and behaviour.**

5.8.3 Climate change knowledge

I conducted exploratory correlation analyses in an attempt to clarify the relations between climate change knowledge and barrier perception, climate change knowledge and pro-environmental behaviour, and climate change knowledge and risk perception. A negative relation was found between knowledge and perception of barriers, which suggests that more knowledge correlates with lower barrier perception (r = -.13, p = .12). A positive relation was found between knowledge and behaviour frequency, which suggests that more knowledge correlates with high behaviour frequency (r = .10, p = .21). However, neither of these correlations is significant. A positive relation was found between knowledge and climate change risk perception, suggesting that more knowledge correlates with stronger risk perception. This relation was almost but not quite significant (r = .14, p = .08). Even though the sample size was not large enough to achieve statistical

significance, the relations between knowledge and risk perception, barrier perception, and behaviour frequency represents a small effect size and could have practical significance.

After taking a closer look at the answers for each climate change knowledge question, I found that the level of climate change knowledge varies based on the type of knowledge assessed. The majority of participants know that Canada is one of the top three per-capita contributors to carbon emissions (75%). They also know which gases are greenhouse gases (57%) and have a basic understanding of the processes leading to climate change (54%). In contrast, knowledge of actual temperature changes (25%) or changes in atmospheric concentration of carbon dioxide (19%) are low. Furthermore, individuals confuse the issues of ozone depletion and climate change; the majority believes that the hole in the ozone layer is related to the climate change we are seeing today (68%).

5.8.4 Curtailment or efficiency behaviour

As mentioned earlier, efficiency behaviours have more potential for impact reduction than curtailment behaviours. Therefore, examining barrier perception by behaviour type has practical value. As a reminder, participants were asked to choose a behaviour from a list (see Appendix 4) and think of this behaviour when evaluating barriers. Seventy-one participants chose curtailment behaviour while 48 chose efficiency behaviours. I compared the level of perceived barriers for the different behaviour types with a *t*-test. No significant difference was found in barriers levels based on behaviour type ($t = 1.05$, $p = .30$).

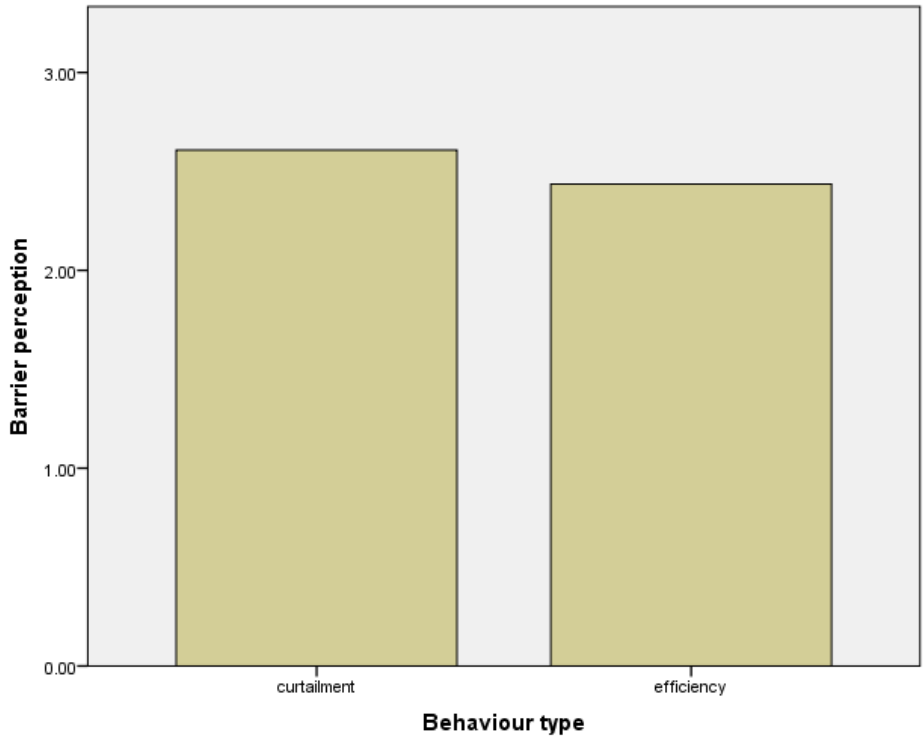

Figure 9. **Barrier perception by behaviour type.**

5.8.5 Conceptual model revisited

My conceptual model is supported in this study; each variable in the chain directly affects the next. Some of the variables are also closely related to more distant variables. However, multiple regression analyses (Table 2 and 4) suggest that the two scales of cultural cognition should be explored separately. For this reason, bivariate correlations are shown for hierarchy-egalitarianism model (Figure 10) and for the individualism-communitarianism model separately (Figure 11).

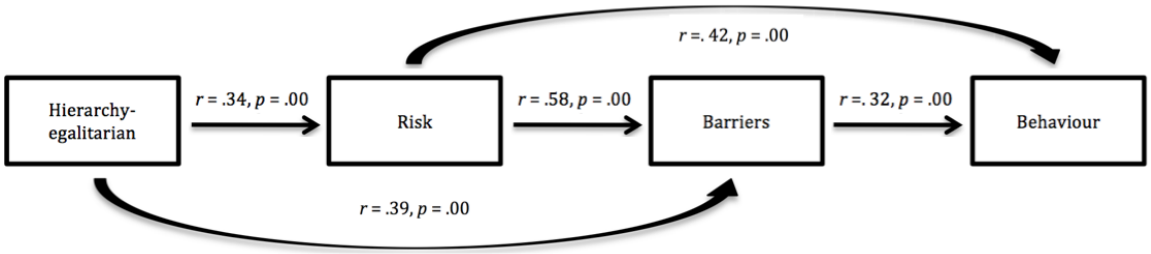

Figure 10. **Hierarchy-egalitarianism conceptual model**

Notes: Entries are bivariate correlations. The correlation between hierarchy-egalitarianism values and pro-environmental behaviour is not significant (r = .07, p = .38).

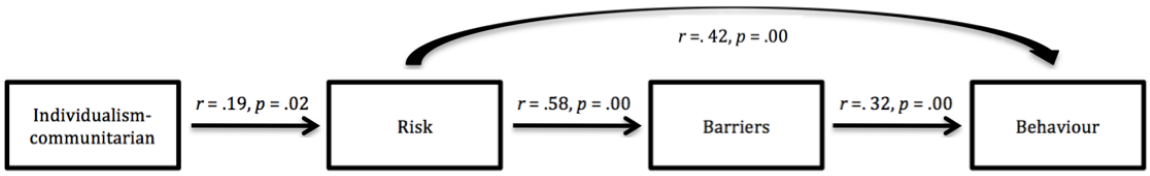

Figure 11. **Individualism-communitarianism conceptual model**

Notes: Entries are bivariate correlations. The correlation between individualism-communitarianism values and perceived barriers is not significant (r = .08, p = .34). The correlation between individualism-communitarianism values and pro-environmental behaviour is also not significant (r = .02, p = .78).

Furthermore, some caveats apply to my conceptual model. First, education levels strongly affected the relation between perceived barriers and reported behaviour; this relation was not significant at low levels of education. Second, the relation between perceived barriers and reported pro-environmental behaviour lost significance when climate change risk perception was included. Therefore, the relation between perceived barriers, *as they were measured in the present study*, and pro-environmental behaviour was not significant. This relation remains uncertain and seems to depend on how the psychological barriers are conceptualised and measured. The following model is more appropriate based on the findings from the present study (Figure 12).

Figure 12. **Conceptual model revised.**

5.9 Exploratory analysis of the barriers

Eleven barriers were included in this study. These barriers were composed of rational choice items that are only starting to be tested empirically. I hoped to contribute to the refinement of the barrier scale by analysing how the barriers group together in my sample using principal component analysis (PCA).

I conducted a PCA with Varimax rotation. Instead of the original 11 barriers divided into five barrier categories, six components were found in my sample (Table 8). These items encompassed logical themes; low priority / conflicting goals, mistrust and denial, perceived behavioural control, peer-pressure, ignorance, and technological salvation (Table 9). The PCA themes are similar to the original barrier categories, the main difference being that ignorance and perceived behavioural control items seem to fit into separate barrier themes, as opposed to them being classified together under the limited cognition category of barriers (Gifford, 2011). Furthermore, it seems that inequity and perceived behavioural control are more closely linked than was originally theorized.

Table 8.

Principal Component Analysis on Barrier items

Items	Components					
	1	2	3	4	5	6
[Financial investments-1] I can't change because I'm invested in my current lifestyle.	.75					
[Denial-1] There's no need to change because I'm not convinced that a serious environmental problem even exists.	.50					
[Conflicting goals, values and aspirations-1] Making this change would interfere too much with my other goals in life.	.66					
[Financial investments-2] I've put a lot of time and effort into my current lifestyle, and so I don't want to change.	.80					
[Conflicting goals, values and aspirations-2] Other things are more important to me right now than making this change.	.70					
[Conflicting goals, values and aspirations-3] I prefer doing things that I enjoy rather than make this change.	.79					
[Perceived inequity-4] I don't see why I should inconvenience myself when others are not making this change.	.54					
[Mistrust-1] I don't trust the companies that are promoting this change because it's probably just another example of green-washing.		.55				
[Mistrust-2] I think that "climate scientists" have a hidden motive for promoting this change.		.78				
[Denial-2] There's no need to change because the current "environmental crisis" has been exaggerated.		.70				
[Mistrust-3] I don't believe that the news media have honest intentions when they encourage this change.		.75				
[Denial-3] Honestly I don't think that the "problem" that this would solve is actually a problem.		.53				
[Mistrust-4] I don't trust the supposedly scientific models that are used to call for this change.		.79				
[Perceived behavioural control-1] Unfortunately, I don't think one person changing will make much difference.			.70			
[Perceived inequity-1] It wouldn't be fair for me to change, because others are not changing.			.54			
[Uncertainty-1] I'm not sure whether or not making this change would help the			.63			

environment.						
[Perceived behavioural control-2] Even if most people made this change it wouldn't help enough.			.69			
[Perceived Inequity-2] It's not fair for me to have to change when really it's industry that's causing the majority of environmental problems.			.64			
[Uncertainty-3] I doubt that making this change would have a positive impact on the environmental situation.			.65			
[Social norms-1] Making this change would be criticized by those around me.				.72		
[Social norms-2] If I made this change, I probably would be embarrassed when others noticed what I was doing.				.76		
[Social norms-3] I'm worried that my friends will criticize me for making this change.				.83		
[Ignorance-2] I don't understand many of the details about how to make this change.					.78	
[Ignorance-3] There's so much information out there that I'm confused about how to make this change.					.71	
[Technosalvation-2] It's necessary for individuals to make changes, such as this, to help mitigate climate change because other technological solutions will not be sufficient to solve environmental problems *(reversed)*						.68
[Technosalvation-3] Large-scale technological changes are only part of the solution – it's also necessary that individuals make changes such as this in their personal lives *(reversed)*						.80

Table 9.

Component Items and Cronbach's Alphas

Component 1: Low priority/ conflicting goals (α = .89)	I can't change because I'm invested in my current lifestyle.
	There's no need to change because I'm not convinced that a serious environmental problem even exists.
	Making this change would interfere too much with my other goals in life.
	I've put a lot of time and effort into my current lifestyle, and so I don't want to change.
	Other things are more important to me right now than making this change.
	I prefer doing things that I enjoy rather than make this change.
	I don't see why I should inconvenience myself when others are not making this change.
Component 2: Mistrust and denial (α = .91)	I don't trust the companies that are promoting this change because it's probably just another example of green-washing.
	I think that "climate scientists" have a hidden motive for promoting this change.
	There's no need to change because the current "environmental crisis" has been exaggerated.
	I don't believe that the news media have honest intentions when they encourage this change.
	Honestly I don't think that the "problem" that this would solve is actually a problem.
	I don't trust the supposedly scientific models that are used to call for this change.
Component 3: Perceived behavioural control (α = .86)	Unfortunately, I don't think one person changing will make much difference.
	It wouldn't be fair for me to change, because others are not changing.
	I'm not sure whether or not making this change would help the environment.
	Even if most people made this change it wouldn't help enough.
	It's not fair for me to have to change when really it's industry that's causing the majority of environmental problems.
	I doubt that making this change would have a positive impact on the environmental situation.
Component 4: Peer-pressure (α = .80)	Making this change would be criticized by those around me.
	If I made this change, I probably would be embarrassed when others noticed what I was doing.
	I'm worried that my friends will criticize me for making this change.
Component 5: Ignorance (α = .66)	I don't understand many of the details about how to make this change.
	There's so much information out there that I'm confused about how to make this change.
Component 6: Technological salvation (α = .55)	It's necessary for individuals to make changes, such as this, to help mitigate climate change because other technological solutions will not be sufficient to solve environmental problems (*reversed*).

	Large-scale technological changes are only part of the solution – it's also necessary that individuals make changes such as this in their personal lives (*reversed*).

5.10 Critical analysis of cultural cognition theory

Cultural cognition is comprised of two scales; the hierarchy-egalitarianism scale and the individualism-communitarianism scale. These scales were partly created in an attempt to address the criticisms related to the cultural theory measurements and construct validity. I conducted exploratory analyses to verify if the earlier criticisms of cultural theory were addressed with the cultural cognition approach.

5.10.1 Principal Component Analysis

According to Kahan (2012), the scales generate orthogonal principal components. To analyse the structure of the cultural cognition scales, I conducted principal component analysis on the 12 cultural cognition scale items, forcing a 2-factor extraction. My results provide additional support for the cultural cognition scales, this time using a Canadian sample. Other than two weaker items that fall below the cut-off loading of .05 (i.e., items H-2 and C-1), the items load on only one of the two components (Table 10).

Table 10.

Principal Component Analysis of Cultural Cognition Items

Items	Component 1	Component 2
[H-1] We have gone too far in pushing equal rights in this country	.08	-.68
[I-1] The government should stop telling people how to live their lives	.78	.05
[H-2] Society as a whole has become too soft and feminine	.47	-.41
[I-2] It's not the government's business to try to protect people from themselves	.69	-.18
[H-3] It seems like women, gays, minorities and other groups don't want equal rights, they want special rights just for them	.35	-.62
[I-3] The government interferes far too much in our everyday lives	.80	.09

[E-1] Discrimination against minorities is still a very serious problem in our society	.13	.71
[C-1] Sometimes government needs to make laws that keep people from hurting themselves	-.33	.13
[E-2] We need to dramatically reduce inequalities between the rich and the poor, whites and people of colour, and men and women	.18	.72
[C-2] Government should put limits on the choices individuals can make so they don't get in the way of what's good for society	-.59	-.14
[E-3] Our society would be better off if the distribution of wealth was more equal	.03	.67
[C-3] The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals	-.62	-.13
Rotation method: Varimax rotation with Kaiser normalization.		

After removing the two weak items, the scales roughly generate orthogonal principal components (Figure 13).

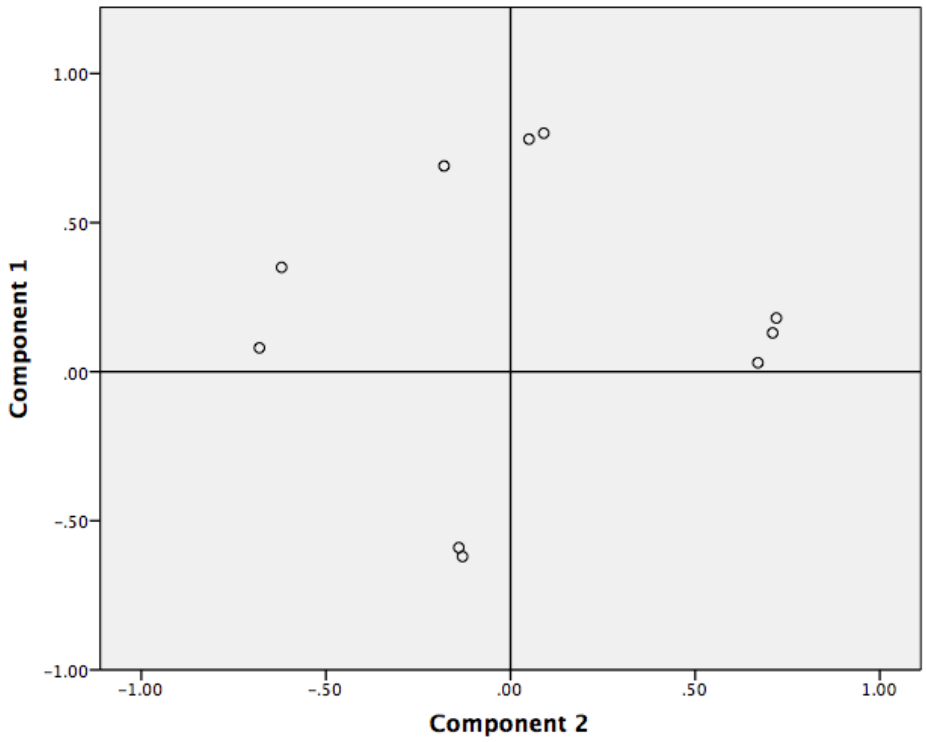

Figure 13. **Component loadings of cultural cognition items.**

5.10.2 Construct validity

Rippl (2002) criticised the construct validity of the original cultural theory groups, maintaining that opposing groups (i.e., individualism and hierarchical, and egalitarian and fatalistic) should be negatively correlated, and neighbouring groups should have a weak correlation. A similar approach can be applied to test the cultural cognition scales. According to cultural cognition, hierarchical-individualist and egalitarian-communitarian should have the most opposite cultural values. Consequently, I hypothesize that they should also have the most opposite level of risk perception given that risk perception is influenced by cultural values. To verify this, participants were first separated into cultural types according to their score relative to the median on both cultural cognition scales (Figure 14).

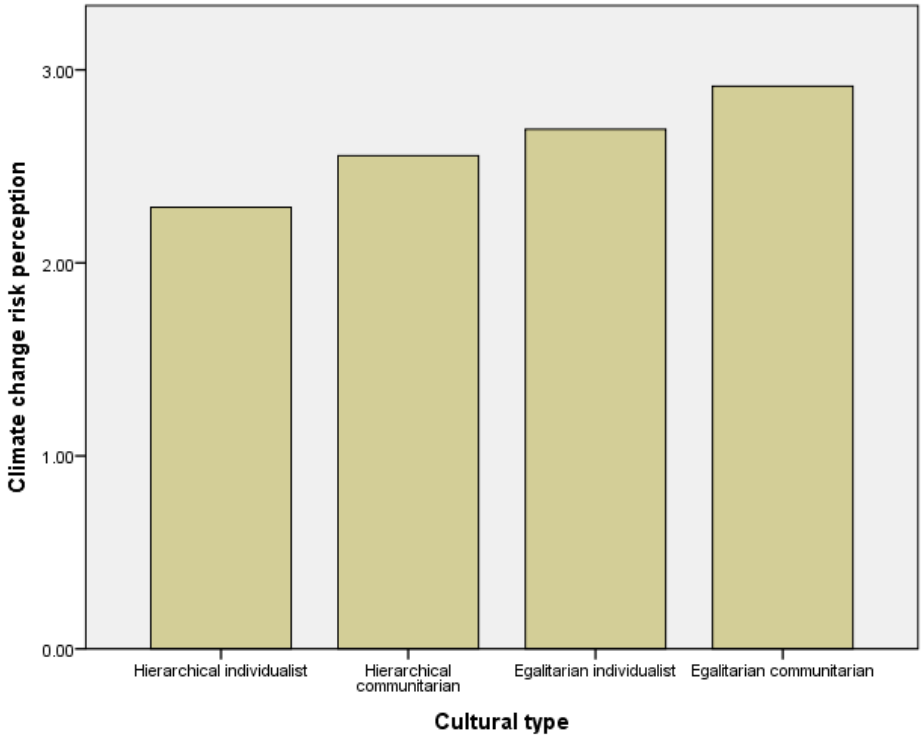

Figure 14. **Climate change risk perception by cultural type.**

I then conducted *t*-tests to compare risk perception for the four cultural cognition types. Two significant differences were found; on average Hierarchical individualists (*M*

= 2.29, *SD* = 0.81) perceive significantly less barriers than Egalitarian communitarians (*M* = 2.92, *SD* = 0.75, *t* = 3.44, *p* < .01), and Hierarchical communitarians (*M* = 2.56, *SD* = 0.73) perceive significantly less barriers than Egalitarian communitarians (*M* = 2.92 *SD* = 0.75 *t* = 2.031, *p* < .05).

As seen in Table 11, the effect size was calculated using Cohen's *d* (Cohen, 1988); the difference between Hierarchical individualists and Egalitarian communitarians represents a large effect size (*d* = .81), while the difference between Hierarchical communitarians and Egalitarian communitarians represents a medium effect size (*d* = .49). Thus, the exploratory hypothesis is supported in my sample; Hierarchical individualists and Egalitarian communitarians have the most opposite level of risk perception.

Table 11.

Differences Between Cultural Groups for Risk Perception

Cultural group	*n*	*M*	*SD*
H-I	35	2.29	0.81
H-C	32	2.56	0.73
E-C	38	2.92	0.75

Group comparison	Mean differences	Pool Standard Deviation	Cohen's *d*
H-I and E-C	0.63	0.78	0.81
H-C and E-C	0.36	0.74	0.49

Note: Only significant *t*-tests (i.e., *p* < .05) are reported under group comparison. A Cohen's *d* of .8 is considered a large effect, .5 a medium effect, and .2 a small effect (Cohen, 1988).

5.10.3 Cultural values and risk perception

Cultural cognition theory suggests risks are socially constructed and that cultural values have an influence on risk perception because of an individual's beliefs about how society should function. Combined with my conceptual model, (a) barriers should be

explained by values and risk (confirmed in Table 2) and (b) part of the variance in barriers explained by cultural values should be mediated by risk perception. Mediation was investigated using the mediation PROCESS tool in SPSS (Hayes, 2015). Variables were standardized prior to conducting the analyses.

The results confirm that the relation between the hierarchy-egalitarianism scale and barrier perception is partially mediated through risk perception (Figure 15). The total effect of hierarchy-egalitarianism scale on barriers decreases from $b = .39$, $p < .01$ to $b = .22$, $p < .01$ when risk perception is taken into account, which is a significant indirect effect ($b = .17$, $Z = 3.8$, $p = .00$), representing an effect size of 18% (i.e., $k^2 = .18$, 95% *CI* [.10, .28]), a medium-to-large effect size (Field, 2013). Furthermore, stepwise regression analyses show that the proportion of variance in barriers explained by the hierarchy-egalitarianism scale decreases from 15% to 4% when risk perception is included, as indicated by the semipartial correlation squared.

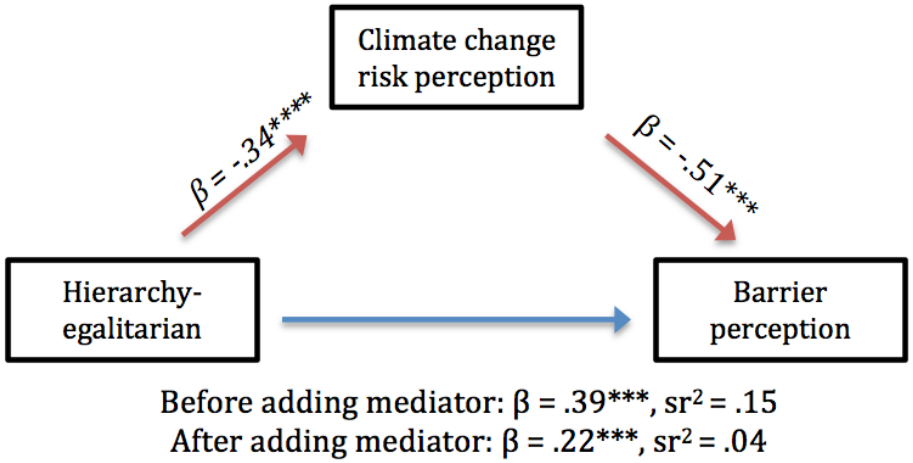

Figure 15. **Climate change risk perception as mediator.**

Notes:
Sobel test for indirect effect: $b = .17$, $se = .05$, $Z = 3.80$, $p = .00$
R^2 mediation effect size = .11, 95% *BCa Ci* [.05, .21]
k^2 effect size = .18, 95% *BCa C*i [.10, .28]
Full model $R^2 = .38$, $p = .00$

Chapter 6: Discussion

This study confirmed that cultural values influence the level of climate change risk perception and also demonstrated that they influence perceived barriers to pro-environmental behaviour. This study also showed that climate change risk perception is the most important predictor of perceived barriers to pro-environmental behaviour and of self-reported pro-environmental behaviour frequency. Research findings, limitations, and implications are discussed in this section.

6.1 Hypotheses

All but one of my hypotheses were at least partially supported. I summarized my results below, compared them to previous findings, and provided insight for the hypotheses that were not entirely supported.

6.1.1 Climate change risk perception

The first hypothesis, that cultural cognition will explain climate change risk perception, was supported. According to my results, cultural values, more specifically the hierarchy-egalitarianism values, and gender are important predictors of climate change risk perception. Although they did not quite achieve statistical significance in the regression model, individualism-communitarianism cultural values, climate change knowledge, and age had a small effect on risk perception. My findings and effect sizes are similar to previous research investigating cultural values and environmental risk perception (Kahan, Braman, Gastil, et al., 2007; Kahan, Braman, Slovic, et al., 2007; Leiserowitz, 2006). Furthermore, it extends the literature by providing evidence of this link in a Canadian sample.

However, it is important to note that both cultural cognition dimensions are not equally significant in predicting climate change risk perception; my findings show that the hierarchy-egalitarianism dimension has a larger regression coefficient than individualism-communitarianism. Although Kahan et al. (2007) consider the two scales together as a composite of cultural cognition and therefore do not make a distinction between the two scales in terms of their relative explanatory power, a closer look at their results demonstrate similar nuances to those found in the present study. Individualism-communitarianism and hierarchy-egalitarianism had almost identical importance for gun-risk perception and abortion risks (Kahan, Braman, Gastil, et al., 2007). However, hierarchy-egalitarianism had more than double the predictive ability than did individualism-communitarianism when regressed on environmental risks. My results for climate change risk perception are similar.

Therefore, although the two cultural constructs have proven equally relevant to explaining other kinds of risk perception (e.g., gun or abortion risks), they are not as equally important for to climate change risk perception. Instead, this suggests that hierarchy-egalitarianism is more important for this type of risk.

A closer look at each construct might help explain this. Individualism-communitarianism is concerned with beliefs about government regulation and social assistance (see Appendix 2) and hierarchy-egalitarianism is about general beliefs on equality and discrimination. Participants in this study perceived more climate change risk worldwide than to themselves personally (Hypothesis 6). Bearing in mind the emphasis on equality (or non-equality) in hierarchy-egalitarianism, the perception of risk as unequally distributed worldwide may interact with beliefs about equality. For individuals

who believe in equality, the overall perception of climate change risk may be as important as their personal risk. In other words, perceiving high worldwide climate change risk acts as a motivator for those believing in equality. That the beliefs in equality are not central to individualism-communitarianism might explain why it was not as strongly related to climate change risk perception. Beliefs about social equality might be more salient than beliefs about government regulation for climate change risk perception.

6.1.2 Barrier perception

The hypothesis that cultural cognition will explain barrier perception is partially supported in my study. According to my results, it seems that barrier perception is explained by cultural values, more specifically hierarchical or egalitarian values. Data analyses shows that only hierarchy-egalitarianism and climate change risk perception explain unique variance in perception of barriers to pro-environmental behaviour. In addition, mediation analysis demonstrated that the effect of egalitarian-hierarchical values on barrier perception is partially mediated through risk.

6.1.3 Pro-environmental behaviour

The hypothesis that barrier perception will be correlated with behaviour was supported in my study. According to my results, it seems that greater barrier perception is correlated with less pro-environmental behaviour, and this has a medium effect size. However, this relation becomes non-significant when climate change risk perception is added to the regression. This finding demonstrates that perceived barriers do not explain any unique variance in behaviour when risk is included in the analysis; instead barrier perception shares all of its variance explained with climate change risk perception. The implications of this finding will be discussed shortly.

Furthermore, the hypothesis that cultural values will explain behaviour frequency was not supported. In contrast to studies having found a direct link between traditional values, openness to change values and achievement values and energy use (Abrahamse & Steg, 2011) or between altruistic values and consumer behaviour (i.e, Stern et al., 1999), no direct link between values and behaviour frequency was found in the present study. Instead, my results suggest that cultural cognition may affect behaviour through its effect on risk and barriers. Considering that variables closer in causality to behaviour should be better predictors than the more distant variables (Dietz, Stern, & Guagnano, 1998; Stern et al., 1999; Stern, Dietz, & Guagnano, 1995), this finding is not surprising.

My results are similar to other studies examining cultural values. Steg and Sievers (2000) did not find a signification relation between cultural theory values (i.e., myths of nature) and behaviour (i.e., car use). This further supports the suggestion that general beliefs are not directly related to behaviour, but that they are related to specific beliefs, attitudes and norms (Dietz et al., 1998; Stern et al., 1995). One possible explanation for the discrepancy in these findings lies in how values are measured. Cultural values, as measured by cultural cognition or cultural theory (Steg & Sievers, 2000), might be more distal to behaviour than values as measured by Schwartz' value scale (Abrahamse & Steg, 2011; Stern et al., 1999).

6.2 Limitations

Several limitations resulting from the design of the study and measurement approaches should be addressed. The sample size was a limitation because my study had low power to detect small effect sizes. For this reason, climate change knowledge was not significantly correlated with behaviour frequency, barriers or risk perception even though

a small effect size was found. These small effect sizes may be of practical importance, specifically for climate change risk perception, where climate change knowledge has the same effect size as age, gender or the individualism-communitarianism scale.

Although using objective knowledge instead of self-reported knowledge is an improvement on previous attempts at measuring climate change knowledge (e.g., Kellstedt, Zahran, & Vedlitz, 2008; Malka, Krosnick, & Langer, 2009; Milfont, 2012), the climate change knowledge scale could be further improved. For example, recent studies investigating climate change risk perception make a distinction between the types of knowledge, which suggests that future studies should distinguish between knowledge of climate change causes, impacts, and responses (van der Linden, 2015).

My study focused on psychological barriers. Had it included structural barriers, a clearer picture of the relations between risk, psychological, structural barriers and pro-environmental behaviour could have emerged given that many participants identified structural barriers when asked about other reasons why they find it difficult to engage in pro-environmental behaviour (e.g., renting and lack of alternatives). Furthermore, the moderation analyses suggested that psychological barriers are not correlated with reported pro-environmental behaviour for individuals with low levels of education. Therefore, for individuals with lower levels of education, other factors such as structural barriers might be at play.

In terms of psychological barriers, although many items were improved during the pilot study, some of the barrier scales did not achieve sufficient Cronbach's alpha, suggesting that the barrier scale needs further improvement. In addition, the barrier scale in this study included items for only 11 out of the 30 theorized dragons of inaction

(Gifford, 2011). If more barriers had been included (e.g., inconvenience and habit was mentioned by many participants in one open-ended question), perhaps stronger relations between barriers and behaviours would have been observed. A more complete set of barriers would also have allowed me to compare my PCA results with previous studies and shed some additional light on barrier themes. Future research should improve the measurement of the barriers, attempt to measure more barriers, and compare with previous PCA themes (Chen & Gifford, 2015; Gifford & Chen, in preparation).

Lastly, PCA on the cultural cognition items shows that two out of 12 items did not distinctively fall onto the desired scales. My study was the first time the cultural cognition scale was tested in Canada and with a smaller sample size (i.e., less than 1,500 participants), which suggests the scales may need to be modified further.

6.3 Implications and future directions

This study indicates that climate change risk perception is an influential variable in terms of the perception of barriers to pro-environmental behaviour and the frequency of pro-environmental behaviour. My sample also suggests that cultural values are the most important predictor of climate change risk perception. My findings are complimented by a recent study showing perhaps the most complete model for explaining variance in climate change risk perception so far, which demonstrates that socio-cultural influences play a central role (van der Linden, 2015). However, these socio-cultural influences include not only values, similar to the ones measured in this study, but also social norms. Therefore, normative influences and values should both be considered during climate change risk communication efforts.

Furthermore, belief in anthropogenic climate change is important for risk perception (Safi et al., 2012). Increasing the perception of scientific consensus on climate change is a gateway belief for the acceptance of anthropogenic climate change and, in turn, for more support for public action on climate change (van der Linden et al., 2015). Additionally, providing information about the scientific consensus on climate change can lessen the negative effect of political worldviews (i.e., free-market endorsement) on climate change acceptance (Lewandowsky et al., 2013). These studies indicate that a starting point is to increase the perception of scientific consensus on climate change.

Bearing this in mind, my results demonstrate that cultural values predict the belief that experts disagree on the occurrence or the cause of climate change (i.e., measured as scepticism). The socio-cultural values of the audience should be considered during the design of climate change communications (Johnson, 2012; van der Linden, 2015). Communicators should seek a wide cultural variety of advocates for climate policy or behavior promotion in order to include advocates whose cultural values align with the cultural values of diverse audience members (Kahan, Braman, Gastil, et al., 2007).

Furthermore, research on climate change message framing seems to indicate that focusing on the prevention of environmental losses is a better approach than to focus on an environmental benefit (Avineri & Owen D. Waygood, 2013; Morton, Rabinovich, Marshall, & Bretschneider, 2011) but that this is more true for individuals with lower concern or weaker attitudes for climate change (Newman, Howlett, Burton, & Kozup, 2012; Van de Velde, Verbeke, Popp, & Van Huylenbroeck, 2010). In addition, communicators should avoid the use of sacrifice messages (e.g., I am going to have less

money in my pocket) and instead focus on motivational messages (e.g., The economy will be stronger) (Gifford & Comeau, 2011).

Experiential processes such as affect and personal experience with climate change also are very important. Emphasizing the more direct or local impacts of climate change increases risk perception (e.g., Johnson, 2012; Safi et al., 2012). Combined with the present findings, more emphasis on local impacts of climate change might decrease the discrepancy between local and global climate change risk perception and thus increase the motivation to act for individuals whose cultural values are less inclined towards equality.

Future research should consider how climate change risk perception and the *dragons of inaction* interact. The *dragons of inaction* include perceived risk as a general barrier category (Table 1), however, this refers specifically to risks in adopting a pro-environmental behaviour, such as the functional or financial risks of purchasing a plug-in hybrid electric vehicle. On the other hand, climate change risk perception refers to an individual's belief that climate change is or is not a threat. My results suggest that weak climate change risk perception is *in itself* a barrier. I am hesitant, however, to suggest adding climate change risk perception to the list of *dragons of inaction* because stepwise regression implies that risk perception would remain a more important barrier than the overall *dragons of inaction* as measured in this study. Referring back to newly established predictors of climate change risk perception (van der Linden, 2015), climate change risk perception is influenced by a combination of general barrier categories (i.e., limited cognition, ideologies, comparison with others) and, as such, possibly represents a higher order or overarching barrier.

Future research should focus on spatial and temporal connections between the barriers. Knowing how they interact and influence each other would help tease out the most influential barriers and in turn provide avenues for more effective climate policies and programs by helping find influential variables that are easier to manipulate.

6.4 Conclusion

The current study examined the perception of barriers to pro-environmental behaviour for participants with different cultural values. Findings show that climate change risk perception is an important predictor of both barrier perception and pro-environmental behaviour. Furthermore, I found that risk perception partly mediates the relation between cultural values and barrier perception, meaning that the relation between cultural values and barrier perception diminishes when risk perception is included in the analysis.

Future research should focus on increasing belief in anthropogenic climate change, negative affect, and personal experience with climate change thus increasing climate change risk perception and frequency of pro-environmental behaviour. More specifically, research should aim to alleviate the polarization of opinions on issues like climate change. Addressing the discrepancy between scientific risk perception and public risk perception might help limit the severity of physical, psychological and economic risks associated with climate change.

Climate change is caused by harmful human behaviour and will in turn need to be addressed through changes in behaviour at the individual and societal level. Public acceptance of climate change is perhaps a necessary first step but a combination of voluntary approaches and regulatory approaches will be needed to reduce GHG

emissions. Lastly, more efficient climate change communication should be based on sound empirical research and will require continued cooperation between climate scientists, social scientists and policy makers.

References

Abrahamse, W., & Steg, L. (2011). Factors related to household energy use and intention to reduce it: The role of psychological and socio-demographic variables. *Human Ecological Review, 18,* 30–40.

Abrahamse, W., Steg, L., Gifford, R., & Vlek, C. (2009). Factors influencing car use for commuting and the intention to reduce it: A question of self-interest or morality? *Transportation Research Part F: Traffic Psychology and Behaviour*, *12*, 317–324. http://doi.org/10.1016/j.trf.2009.04.004

Ajzen, I. (1991). The Theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211. http://doi.org/10.1016/0749-5978(91)90020-T

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: a meta-analytic review. *The British Journal of Social Psychology / the British Psychological Society*, *40*, 471–499. http://doi.org/10.1348/014466601164939

Avineri, E., & Owen D. Waygood, E. (2013). Applying valence framing to enhance the effect of information on transport-related carbon dioxide emissions. *Transportation Research Part A: Policy and Practice*, *48*, 31–38. http://doi.org/10.1016/j.tra.2012.10.003

Blake, J. (1999). Overcoming the "value- action gap" in environmental policy: Tensions between national policy and local experience. *Local Environment*, *4*, 257–278. http://doi.org/10.1080/13549839908725599

Bradburn, N. M., Sudman, S., & Wansink, B. (2004). *Asking questions: The definitive guide to questionnaire design*. San Francisco: Jossey-Bass.

Brody, S. D., Zahran, S., Vedlitz, A., & Grover, H. (2008). Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States. *Environment and Behavior, 40*, 72–95. http://doi.org/10.1177/0013916506298800

Brody, S., Grover, H., & Vedlitz, A. (2012). Examining the willingness of Americans to alter behaviour to mitigate climate change. *Climate Policy, 12*, 1–22. http://doi.org/10.1080/14693062.2011.579261

Brownlee, M. T. J., Powell, R. B., & Hallo, J. C. (2013). A review of the foundational processes that influence beliefs in climate change: opportunities for environmental education research. *Environmental Education Research, 19*, 1–20. http://doi.org/10.1080/13504622.2012.683389

Chan, K. (1998). Mass communication and pro-environmental behaviour: waste recycling in Hong Kong. *Journal of Environmental Management, 52*, 317–325. http://doi.org/10.1006/jema.1998.0189

Chen, A., & Gifford, R. (2015). "I wanted to cooperate, but... ": Justifying Suboptimal Cooperation in a Commons Dillemma. *Canadian Journal of Behavioural Science*.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, N.J: Routledge.

Dake, K. (1991). Orienting dispositions in the perception of risk: An analysis of contemporary worldviews and cultural biases. *Journal of Cross-Cultural Psychology, 22*, 61–82. http://doi.org/10.1177/0022022191221006

Dake, K. (1992). Myths of nature: Culture and the social construction of risk. *Journal of Social Issues*, *48*, 21–37. http://doi.org/10.1111/j.1540-4560.1992.tb01943.x

De Groot, J. I. M., & Steg, L. (2010). Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *Journal of Environmental Psychology*, *30*, 368–378. http://doi.org/10.1016/j.jenvp.2010.04.002

Department for Environment Food and Rural Affairs. (2008). A framework for pro-environmental behaviours. Department for Environment Food and Rural Affairs. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69277/pb13574-behaviours-report-080110.pdf

Dietz, T., Gardner, G. T., Gilligan, J., Stern, P. C., & Vandenbergh, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences of the United States of America*, *106*, 18452–18456. http://doi.org/10.1073/pnas.0908738106

Dietz, T., Stern, P. C., & Guagnano, G. A. (1998). Social structural and social psychological bases of environmental concern. *Environment and Behavior*, *30*, 450–471. http://doi.org/10.1177/001391659803000402

Dietz, T., Stern, P. C., & Weber, E. U. (2013). Reducing carbon-based energy consumption through changes in household behavior. *Daedalus*, *142*, 78–89. http://doi.org/10.1162/DAED_a_00186

Douglas, M. (1978). *Cultural bias*. London, United Kingdom: Royal Anthropological Institute.

Douglas, M. (1982). Introduction to grid/group analysis. In *Essays in the sociology of perception*. London: Routledge & Kegan Paul Ltd.

Downing, P., & Ballantyne, J. (2007). Tipping point or turning point? Ipsos-Mori Social Research Institute. Retrieved from http://www.lowcvp.org.uk/assets/reports/IPSOS_MORI_ turning-point-or-tipping-point.pdf.

Environics Institute. (2013). Canadian public opinion about climate change. Retrieved from http://www.davidsuzuki.org/media/news/downloads/Focus%20Canada%202013%20-%20Canadian%20public%20opinion%20about%20climate%20change.pdf

Field, A. P. (2013). *Discovering statistics using IBM SPSS Statistics* (4th ed.). Los Angeles, USA: SAGE.

Fischer, E. M., & Knutti, R. (2015). Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes. *Nature Climate Change*, *5*(6), 560–564. http://doi.org/10.1038/nclimate2617

Fujii, S. (2006). Environmental concern, attitude toward frugality, and ease of behavior as determinants of pro-environmental behavior intentions. *Journal of Environmental Psychology*, *26*, 262–268. http://doi.org/10.1016/j.jenvp.2006.09.003

Gardner, G. T., & Stern, P. C. (2008). The short list: The most effective actions U.S. households can take to curb climate change. *Current*, 31–36. http://doi.org/10.3200/ENVT.50.5.12-25

Gifford, R. (2007). *Environmental psychology: Principles and practice* (4th ed.). Colville, WA: Optimal Books.

Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist, 66,* 290–302. http://doi.org/10.1037/a0023566

Gifford, R. (2014). Environmental psychology matters. *Annual Review of Psychology, 65,* 541–579. http://doi.org/10.1146/annurev-psych-010213-115048

Gifford, R., & Chen, A. (in preparation). Psychological Barriers to Climate-Positive Food Choices and Other Climate Change-Related Outcomes.

Gifford, R., & Comeau, L. A. (2011). Message framing influences perceived climate change competence, engagement, and behavioral intentions. *Global Environmental Change, 21,* 1301–1307. http://doi.org/10.1016/j.gloenvcha.2011.06.004

Gifford, R., Scannell, L., Kormos, C., Smolova, L., Biel, A., Boncu, S., … Uzzell, D. (2009). Temporal pessimism and spatial optimism in environmental assessments: An 18-nation study. *Journal of Environmental Psychology, 29,* 1–12. http://doi.org/10.1016/j.jenvp.2008.06.001

Government of Canada. (2008). Greenhouse gas emissions–a focus on Canadian households. Retrieved from http://www.statcan.gc.ca/pub/16-002-x/2008004/article/10749-eng.htm

Greaves, M., Zibarras, L. D., & Stride, C. (2013). Using the theory of planned behavior to explore environmental behavioral intentions in the workplace. *Journal of Environmental Psychology, 34,* 109–120. http://doi.org/10.1016/j.jenvp.2013.02.003

Grønhøj, A., & Thøgersen, J. (2012). Action speaks louder than words: The effect of personal attitudes and family norms on adolescents' pro-environmental behaviour. *Journal of Economic Psychology*, *33*, 292–302. http://doi.org/10.1016/j.joep.2011.10.001

Hayes, A. F. (2015). PROCESS macro for SPSS and SAS. Retrieved from http://processmacro.org/

Heath, Y., & Gifford, R. (2002). Extending the theory of planned behavior: Predicting the use of public transportation1. *Journal of Applied Social Psychology*, *32*, 2154–2189. http://doi.org/10.1111/j.1559-1816.2002.tb02068.x

Huddart Kennedy, E., Beckley, T. M., & Nadeau, S. (2009). Why we don't "walk the talk": Understanding the environmental values/behaviour gap in Canada. *Human Ecology Review*, *16*, 151–160.

International Panel on Climate Change. (2013). Climate change 2013: The physical science basis. International Panel on Climate Change. Retrieved from http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf

International Panel on Climate Change. (2014). Climate change 2014: Impacts, adaptation and vulnerability. International Panel on Climate Change. Retrieved from http://ipcc-wg2.gov/AR5/images/uploads/IPCC_WG2AR5_SPM_Approved.pdf

Johnson, B. B. (2012). Climate change communication: A provocative inquiry into motives, meanings, and means. *Risk Analysis*, *32*, 973–991. http://doi.org/10.1111/j.1539-6924.2011.01731.x

Jones, M. D. (2011). Leading the way to compromise? Cultural Theory and climate change opinion. *PS: Political Science & Politics, 44*, 720–725. http://doi.org/10.1017/S104909651100134X

Kahan, D. M. (2012). Cultural cognition as a conception of the cultural theory of risk. In S. Roeser, R. Hillerbrand, P. Sandin, & M. Petersen (Eds.), *Handbook of risk theory: Epistemology, decision theory, ethics, and social implications of risk* (pp. 725–759). Dordrecht, Netherlands: Springer. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1123807

Kahan, D. M., & Braman, D. (2003). More statistics, less persuasion: A cultural theory of gun-risk perceptions. *University of Pennsylvania Law Review, 151*, 1291–1327. http://doi.org/10.2307/3312930

Kahan, D. M., & Braman, D. (2006). Cultural cognition and public policy. *Yale Law & Policy Review*, *24*, 149–172.

Kahan, D. M., Braman, D., Gastil, J., Slovic, P., & Mertz, C. K. (2007). Culture and identity-protective cognition: Explaining the white-male effect in risk perception. *Journal of Empirical Legal Studies*, *4*, 465–505. http://doi.org/10.1111/j.1740-1461.2007.00097.x

Kahan, D. M., Braman, D., Slovic, P., Gastil, J., & Cohen, G. (2007). The second national risk and culture study: Making sense of—and making progress in—the American culture war of fact. *The Cultural Cognition Project at Yale Law School*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1017189

Kahan, D. M., Jenkins- Smith, H., & Braman, D. (2011). Cultural cognition of scientific consensus. *Journal of Risk Research, 14*, 147–174. http://doi.org/10.1080/13669877.2010.511246

Kahn, M. E., & Morris, E. A. (2009). Walking the Walk: The Association Between Community Environmentalism and Green Travel Behavior. *Journal of the American Planning Association, 75*, 389–405. http://doi.org/10.1080/01944360903082290

Kaiser, F. G., & Keller, C. (2001). Disclosing situational constraints to ecological behavior: A confirmatory application of the mixed Rasch model. *European Journal of Psychological Assessment, 17*, 212–221. http://doi.org/10.1027//1015-5759.17.3.212

Kazdin, A. E. (2009). Psychological science's contributions to a sustainable environment: Extending our reach to a grand challenge of society. *American Psychologist, 64*, 339–356. http://doi.org/10.1037/a0015685

Kellstedt, P. M., Zahran, S., & Vedlitz, A. (2008). Personal efficacy, the information environment, and attitudes toward global warming and climate change in the United States. *Risk Analysis, 28*, 113–126. http://doi.org/10.1111/j.1539-6924.2008.01010.x

Kormos, C., Gifford, R., & Crawford, C. (2011, July). *Psychological Influences on Public Acceptance of the Plug-in Hybrid Electric Vehicle (PHEV)*. Presented at the Canadian Psychological Association Convention, Toronto.

Leiserowitz, A. (2005). American risk perceptions: Is climate change dangerous? *Risk Analysis, 25*, 1433–1442. http://doi.org/10.1111/j.1540-6261.2005.00690.x

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change*, *77*, 45–72. http://doi.org/10.1007/s10584-006-9059-9

Lewandowsky, S., Gignac, G. E., & Vaughan, S. (2013). The pivotal role of perceived scientific consensus in acceptance of science. *Nature Climate Change*, *3*, 399–404. http://doi.org/10.1038/nclimate1720

Lima, M. L., & Castro, P. (2005). Cultural theory meets the community: Worldviews and local issues. *Journal of Environmental Psychology*, *25*, 23–35. http://doi.org/10.1016/j.jenvp.2004.11.004

Lindenberg, S., & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social Issues*, *63*, 117–137. http://doi.org/10.1111/j.1540-4560.2007.00499.x

Lorenzoni, I., Nicholson-Cole, S., & Whitmarsh, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, *17*, 445–459. http://doi.org/10.1016/j.gloenvcha.2007.01.004

Lorenzoni, I., & Pidgeon, N. F. (2006). Public views on climate change: European and USA perspectives. *Climatic Change*, *77*, 73–95. http://doi.org/10.1007/s10584-006-9072-z

Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis*, *29*, 633–647. http://doi.org/10.1111/j.1539-6924.2009.01220.x.

Mamadouh, V. (1999). Grid-group cultural theory: an introduction. *GeoJournal*, *47*, 395–409. http://doi.org/10.1023/A:1007024008646

Marris, C., Langford, I. H., & O'Riordan, T. (1998). A quantitative test of the cultural theory of risk perceptions: Comparison with the psychometric paradigm. *Risk Analysis*, *18*, 635–647. http://doi.org/10.1111/j.1539-6924.1998.tb00376.x

McCright, A. M., Dunlap, R. E., & Xiao, C. (2013). Perceived scientific agreement and support for government action on climate change in the USA. *Climatic Change*, *119*, 511–518. http://doi.org/10.1007/s10584-013-0704-9

McIntyre, A. (Unpublished). Value-based environmental concern.

Milfont, T. L. (2012). The interplay between knowledge, perceived efficacy, and concern about global warming and climate change: a one-year longitudinal study. *Risk Analysis: An Official Publication Of The Society For Risk Analysis*, *32*, 1003–1020. http://doi.org/10.1111/j.1539-6924.2012.01800.x

Mirosa, M., Lawson, R., & Gnoth, D. (2011). Linking personal values to energy-efficient behaviors in the home. *Environment and Behavior*, *45*, 455–475. http://doi.org/10.1177/0013916511432332

Morton, T. A., Rabinovich, A., Marshall, D., & Bretschneider, P. (2011). The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications. *Global Environmental Change*, *21*, 103–109. http://doi.org/10.1016/j.gloenvcha.2010.09.013

Myers, D., Spencer, S., & Jordan, C. (2009). *Social Psychology* (Canadian edition). Toronto: McGraw-Hill Ryerson Higher Education.

Newman, C. L., Howlett, E., Burton, S., & Kozup, J. C. (2012). The influence of consumer concern about global climate change on framing effects for environmental sustainability messages. *International Journal of Advertising*, *31*, 511. http://doi.org/10.2501/IJA-31-3-511-527

O'Connor, R. E., Bord, R. J., Yarnal, B., & Wiefek, N. (2002). Who wants to reduce greenhouse gas emissions? *Social Science Quarterly*, *83*, 1–17. http://doi.org/10.1111/1540-6237.00067

Overdevest, C., & Christiansen, L. (2013). Using "cultural cognition" to predict environmental risk perceptions in a Florida water-supply planning process. *Society & Natural Resources*, *26*, 987–1007. http://doi.org/10.1080/08941920.2012.724152

Patchen, M. (2010). What shapes public reactions to climate change? Overview of research and policy implications. *Analyses of Social Issues and Public Policy*, *10*, 47–68. http://doi.org/10.1111/j.1530-2415.2009.01201.x

Poortinga, W., Steg, L., & Vlek, C. (2002). Environmental risk concern and preferences for energy-saving measures. *Environment and Behavior*, *34*, 455–478. http://doi.org/10.1177/00116502034004003

Rippl, S. (2002). Cultural theory and risk perception: a proposal for a better measurement. *Journal of Risk Research*, *5*, 147–165. http://doi.org/10.1080/13669870110042598

Safi, A. S., Smith Jr., W. J., & Liu, Z. (2012). Rural Nevada and climate change: Vulnerability, beliefs,and risk perception. *Risk Analysis*, *32*. http://doi.org/DOI: 10.1111/j.1539-6924.2012.01836.x

Schuldt, J. P., Roh, S., & Schwarz, N. (2015). Questionnaire design effects in climate change surveys: Implications for the partisan divide. *The ANNALS of the American Academy of Political and Social Science, 658*, 67–85. http://doi.org/10.1177/0002716214555066

Scott, F. L., Jones, C. R., & Webb, T. L. (2014). What do people living in deprived communities in the UK think about household energy efficiency interventions? *Energy Policy*, *66*, 335–349. http://doi.org/10.1016/j.enpol.2013.10.084

Slovic, P. (2000). *The perception of risk*. London, United Kingdom: Earthscan Publications.

Steg, L., Dreijerink, L., & Abrahamse, W. (2005). Factors influencing the acceptability of energy policies: A test of VBN theory. *Journal of Environmental Psychology*, *25*, 415–425. http://doi.org/10.1016/j.jenvp.2005.08.003

Steg, L., & Sievers, I. (2000). Cultural theory and individual perceptions of environmental risks. *Environment and Behavior*, *32*, 250–269. http://doi.org/10.1177/00139160021972513

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, *56*, 407–424. http://doi.org/10.1111/0022-4537.00175

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, *6*(2), 81–98.

Stern, P. C., Dietz, T., & Guagnano, G. A. (1995). The New ecological paradigm in social-psychological context. *Environment and Behavior*, *27*, 723–743. http://doi.org/10.1177/0013916595276001

Stoll-Kleemann, S., O'Riordan, T., & Jaeger, C. C. (2001). The psychology of denial concerning climate mitigation measures: evidence from Swiss focus groups. *Global Environmental Change*, *11*, 107–117. http://doi.org/10.1016/S0959-3780(00)00061-3

Sundblad, E.-L., Biel, A., & Gärling, T. (2007). Cognitive and affective risk judgements related to climate change. *Journal of Environmental Psychology*, *27*, 97–106. http://doi.org/10.1016/j.jenvp.2007.01.003

Takacs-Santa, A. (2007). Barriers to environmental concern. *Research in Human Ecology*, *14*, 26–38.

Tansey, J. (2004). Risk as politics, culture as power. *Journal of Risk Research*, *7*, 17–32. http://doi.org/10.1080/1366987042000151188

Thompson, M., Ellis, R., & Wildavsky, A. (1990). *Cultural theory*. Boulder, Colorado: Westview press.

Tikir, A., & Lehmann, B. (2011). Climate change, theory of planned behavior and values: a structural equation model with mediation analysis: A letter. *Climatic Change*, *104*, 389–402. http://doi.org/10.1007/s10584-010-9937-z

Tonglet, M., Phillips, P. S., & Bates, M. P. (2004). Determining the drivers for householder pro-environmental behaviour: waste minimisation compared to recycling. *Resources, Conservation and Recycling*, *42*, 27–48. http://doi.org/10.1016/j.resconrec.2004.02.001

Van der Linden, S. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology*, *41*, 112–124. http://doi.org/10.1016/j.jenvp.2014.11.012

Van der Linden, S., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. (2015). The scientific consensus on climate change as a gateway belief: Experimental evidence. *PLOS ONE*, *10*, e0118489. http://doi.org/10.1371/journal.pone.0118489

Van de Velde, L., Verbeke, W., Popp, M., & Van Huylenbroeck, G. (2010). The importance of message framing for providing information about sustainability and environmental aspects of energy. *Energy Policy*, *38*, 5541–5549. http://doi.org/10.1016/j.enpol.2010.04.053

Whitmarsh, L. (2009). Behavioural responses to climate change: Asymmetry of intentions and impacts. *Journal of Environmental Psychology*, *29*, 13–23. http://doi.org/10.1016/j.jenvp.2008.05.003

Whitmarsh, L. (2011). Scepticism and uncertainty about climate change: Dimensions, determinants and change over time. *Global Environmental Change*, *21*, 690–700. http://doi.org/10.1016/j.gloenvcha.2011.01.016

Xue, W., Hine, D. W., Loi, N. M., Thorsteinsson, E. B., & Phillips, W. J. (2014). Cultural worldviews and environmental risk perceptions: A meta-analysis. *Journal of Environmental Psychology*, *40*, 249–258. http://doi.org/10.1016/j.jenvp.2014.07.002

Zahran, S., Brody, S. D., Grover, H., & Vedlitz, A. (2006). Climate change vulnerability and policy support. *Society & Natural Resources*, *19*, 771–789. http://doi.org/10.1080/08941920600835528

Appendices

Appendix 1 – Barriers items

Barrier	Items
Ignorance	I haven't paid much attention to this issue.*
	I don't understand many of the details about how to make this change.
	There's so much information out there that I'm confused about how to make this change.
	I don't understand the reasons why this change is important.
Uncertainty	I'm not sure whether or not making this change would help the environment.
	I don't see why I should make this change when even experts are uncertain about what's going to happen with the environment.
	I doubt that making this change would have a positive impact on the environmental situation.
Perceived behavioural control	Unfortunately, I don't think one person changing will make much difference.
	Even if most people made this change it wouldn't help enough.
	This change is simply not under my control.
Political worldviews	My political understanding makes me realize that changes like this are not necessary.
	This change would be inconsistent with my political views.
	This type of change follows from my political worldview.*
Technosalvation	There's not much point in me making a change like this because I feel confident in the ability of technological innovators to help solve climate change.*
	It's necessary for individuals to make changes, such as this, to help mitigate climate change because other technological solutions will not be sufficient to solve environmental problems.*(reversed)*
	Large-scale technological changes are only part of the solution – it's also necessary that individuals make changes such as this in their personal lives. *(reversed)*
Social norms	Making this change would be criticized by those around me.
	If I made this change, I probably would be embarrassed when others noticed what I was doing
	I'm worried that my friends will criticize me for making this change.
Perceived inequity	It wouldn't be fair for me to change, because others are not changing.
	It's not fair for me to have to change when really it's industry that's causing the majority of environmental problems.
	It wouldn't be equitable for me to put more effort into this than

	others around me.
	I don't see why I should inconvenience myself when others are not making this change.
Financial investments	I can't change because I'm invested in my current lifestyle.
	I've put a lot of time and effort into my current lifestyle, and so I don't want to change.
	I have spent quite a bit of money on my current choices, so I would lose too much if I changed now.*
Conflicting values, goals, and aspirations	Making this change would interfere too much with my other goals in life.
	Other things are more important to me right now than making this change.
	I prefer doing things that I enjoy rather than make this change.
Mistrust	I don't trust the companies that are promoting this change because it's probably just another example of green-washing.
	I think that "climate scientists" have a hidden motive for promoting this change.
	I don't believe that the news media have honest intentions when they encourage this change.
	I don't trust the supposedly scientific models that are used to call for this change.
Denial	There's no need to change because I'm not convinced that a serious environmental problem even exists.
	There's no need to change because the current "environmental crisis" has been exaggerated.
	Honestly I don't think that the "problem" that this would solve is actually a problem.

Notes:
Items were randomly ordered in the survey and assessed using a 7-point Likert scale from strongly disagree to strongly agree.
Items with * were removed from barrier scale based on reliability – see Appendix 7.

Appendix 2 – Cultural cognition scale

	Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree
We have gone too far in pushing equal rights in this country.						
The government should stop telling people how to live their lives.						
Society as a whole has become too soft and feminine.						
It's not the government's business to try to protect people from themselves.						
It seems like women, gays, minorities and other groups don't want equal rights, they want special rights just for them.*						
The government interferes far too much in our everyday lives.						
Discrimination against minorities is still a very serious problem in our society *(reversed).*						
Sometimes government needs to make laws that keep people from hurting themselves *(reversed).*						
We need to dramatically reduce inequalities between the rich and the poor, whites and people of colour, and men and women *(reversed).*						
Government should put limits on the choices individuals can make so they don't get in the way of what's good for society *(reversed).*						
Our society would be better off if the distribution of wealth was more equal *(reversed).*						
The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals *(reversed).*						

Notes:
Item marked with * was slightly modified for Canadian sample. See Kahan, Jenkins-Smith, & Braman (2011) for original items.
Hierarchy-egalitarianism scale items indicated by grey shade (6 items, α=.72).
Individualism-communitarianism scale items not shaded (6 items, α=.76).

Appendix 3 – Climate change risk perception scale

Please indicate your level of concern.

	Not concerned			Very concerned
How concerned are you about global warming?	1	2	3	4

Please indicate the extent to which you feel the following are serious or not serious.

	Not serious			Very serious
How serious of a threat do you believe global warming is to non-human nature?	1	2	3	4
How serious are the current impacts of global warming around the world?	1	2	3	4

How likely do you think it is that each of the following will occur during the next 50 years due to global warming?

	Not likely			Very likely
Worldwide, many people's standard of living will decrease.	1	2	3	4
Worldwide water shortages will occur.	1	2	3	4
Increased rates of serious disease worldwide.	1	2	3	4
My standard of living will decrease.	1	2	3	4
Water shortages will occur where I live.	1	2	3	4
My chance of getting a serious disease will increase.	1	2	3	4

Notes:
Risk perception index selected from Leiserowitz (2006).
Cronbach's alpha for 9 item scale ($\alpha = .93$).

Appendix 4 – Pro-environmental behaviour frequency

Curtailment behaviours

Please indicate how often you engage in the following behaviours. Select "not applicable" if your living situation does not allow you to engage in certain behaviours.

	Never	Rarely	Sometimes	Often	Always	Not applicable
I turn off the lights in rooms that are not used.						
I switch off the television and computer when not in use.						
I line dry clothes.						
I buy energy efficient light bulbs.						
I refrain from washing clothes in hot water.						
I rinse the dishes in cold water.						
I wait for a full load before using the dishwasher.						
I take showers that are less than 5 minutes long.						
I wear a sweater rather than turn up the heat.						
I turn down the heat when I leave my residence for more than 4 hours.						
The heater in my house if shut off late at night.						

Note: 11-item behaviour frequency scale ($\alpha = .93$).

Efficiency behaviours

Please indicate if you have engaged in the following behaviours in the past. Select "not applicable" if your living situation does not allow you to engage in certain behaviours.

	Yes	No	Not applicable
I have purchased a low-flow showerhead.			
I have purchased energy-efficient appliances (e.g., refrigerator, washing machine, television).			
I have purchased an energy-efficient water heater.			
I have installed insulation and sealed up drafts in windows and doors.			
I have purchased solar panels to produce energy.			

Appendix 5 – Objective climate change knowledge

Which one of these is a greenhouse gas?
- ❍ Hydrogen (1)
- ❍ Helium (2)
- ❍ Oxygen (3)
- ❍ Methane (4)
- ❍ No idea (5)

What are the processes leading to global warming?
- ❍ Carbon-based gases trapping heat at the Earth's surface (1)
- ❍ Letting more of the sun's heat into the Earth's atmosphere through a thinner ozone layer (2)
- ❍ Chemical reactions using up the air's oxygen (3)
- ❍ Pesticides changing the chemical makeup of the air (4)
- ❍ No idea (5)

The major greenhouse gases in the atmosphere intercept the incoming solar radiation from the sun and re-emit it back towards space.
- ❍ True (1)
- ❍ False (2)
- ❍ No idea (3)

Which industrialized countries have the largest per capita emissions of greenhouse gases?
- ❍ Australia, United States and Canada (1)
- ❍ Italy, Germany and United States (2)
- ❍ Canada, Sweden and United Kingdom (3)
- ❍ United States, France and Japan (4)
- ❍ No idea (5)

About how much has the atmospheric concentration of carbon dioxide increased since pre-industrial times?
- ❍ 0% (1)
- ❍ 10% (2)
- ❍ 20% (3)
- ❍ 40% (4)
- ❍ 70% (5)
- ❍ No idea (6)

About how much has Earth's average temperature changed over the past century?
- ❍ -2°F / -1.1°C (1)
- ❍ 0°F/ 0°C (2)

- ❍ +1.4°F / +0.8°C (3)
- ❍ +2.8°F / +1.5°C (4)
- ❍ +3.8°F / +2.1°C (5)
- ❍ No idea (6)

Is the hole in the ozone layer related to the climate change we are seeing today?
- ❍ Yes (1)
- ❍ No (2)
- ❍ No idea (3)

Over the last 30 years or so, is solar activity causing climate change?
- ❍ Yes (1)
- ❍ No (2)
- ❍ No idea (3)

Which of the following four options identifies the major greenhouse gases?
- ❍ oxygen, carbon dioxide (CO2), chlorofluorocarbons (CFCs), methane, nitrous oxide (1)
- ❍ carbon dioxide (CO2), chlorofluorocarbons (CFCs), methane, nitrous oxide (2)
- ❍ nitrogen, carbon dioxide (CO2), chlorofluorocarbons (CFCs), methane, nitrous oxide (3)
- ❍ water vapour, carbon dioxide (CO2), chlorofluorocarbons (CFCs), methane, nitrous oxide (4)
- ❍ No idea (5)

Compared to other greenhouse gases, carbon dioxide (C02) is the most effective at trapping heat at the surface of the Earth.
- ❍ True (1)
- ❍ False (2)
- ❍ No idea (3)

As average global temperature rises,
- ❍ average precipitation increases (1)
- ❍ average precipitation decreases (2)
- ❍ average precipitation is unchanged (3)
- ❍ No idea (4)

Note: Questions were created in consultation with my thesis supervisor and the Pacific Institute for Climate Solutions website.

Appendix 6 – Socio-demographic variables

Please provide the following information. Remember, your answers are completely anonymous.

Age
What is your age?

Gender
What is your gender?
- ❍ Male (1)
- ❍ Female (2)
- ❍ Other (3)

Income
What was your total household income before taxes during year 2013?

Education
What is the highest degree that you have completed?
- ❍ Elementary school diploma (1)
- ❍ High school diploma or equivalent (2)
- ❍ College degree (3)
- ❍ Bachelor's degree (4)
- ❍ Master's degree (5)
- ❍ Professional degree (6)
- ❍ Doctorate degree (7)

Appendix 7 – Reliability analysis of barrier items

Barrier	Cronbach's α	# of items
Ignorance	.69	3
Perceived behavioural control	.60	3
Political worldviews	.60	2
Technosalvation	.55	2
Social norms	.79	3
Perceived inequity	.83	3
Financial investments	.79	2
Conflicting values, goals, and aspirations	.76	4
Mistrust	.87	4
Denial	.88	3
ALL BARRIERS	.95	32

Appendix 8 – Descriptives, skewness and kurtosis.

	Minimum	Maximum	Mean	SD	Skewness	SE skewness	Skewness *z*-score	Kurtosis	SE kurtosis	Kurtosis *z*-score
Hierarchy-egalitarianism scale	1	4.83	2.63	0.91	0.04	0.20	0.21	-0.45	0.39	-1.14
Individualism-communitarianism scale	1	6	3.65	0.84	-0.03	0.20	-0.16	0.709	0.39	1.79
Behaviour frequency	2.18	5	3.81	0.56	-0.27	0.20	-1.36	-0.27	0.39	-0.70
Barrier scale	1	4.75	2.6	0.9	0.32	0.20	1.61	-0.69	0.39	-1.77
Risk perception	1	4	2.59	0.81	-0.08	0.20	-0.41	-0.84	0.39	-2.14
Knowledge	0	8	3.55	2.04	0.13	0.20	0.68	-0.75	0.39	-1.92

Appendix 9 – Inter-item correlations.

	H-E scale	I-C scale	Behaviour frequency	Barrier scale	Risk perception	Knowledge	Age	Gender	Education	Income
Hierarchy-egalitarianism scale	1									
Individualism-communitarianism scale	0.10	1								
Behaviour frequency	-0.07	-0.02	1							
Barrier scale	.39**	0.08	-.32**	1						
Risk perception	-.34**	-.19*	.42**	-.58**	1					
Knowledge	-0.06	-0.03	0.10	-0.13	0.14	1				
Age	.25**	0.09	.22**	0.02	0.02	-0.01	1			
Gender	-.22**	-0.08	0.02	-0.11	.19*	-.20*	-.23**	1		
Education	-.25**	-.40**	0.12	-.18*	.18*	0.06	-.17*	.18*	1	
Income	-0.05	-.51**	0.09	-0.24	0.11	-0.02	-0.11	-0.02	.59**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

N = 152 for all except behaviour frequency (N = 150) and income (N = 57)

Appendix 10 – Participant information sheet

Welcome!

The purpose of this study is to examine people's perceptions of barriers to engaging in pro-environmental behaviour.

We will ask you to respond to some questions about climate change causes and risks. You can participate in this study whether you believe in human-induced climate change or not. We will then ask you questions about energy consuming behaviour that you engage in and your perception of obstacles you face when attempting to change this behaviour (i.e., reduce your energy consumption). We will also ask about your more general beliefs in regards to the ideal society and basic demographic questions.

Participation in this study should involve no physical or mental discomfort, and no risks beyond those of everyday living. You are free to withdraw from this study at any time by not finishing the survey. If you do withdraw, the materials that you have completed to that point will not be included in the study.

The information you provide will only be used for research purposes. All data collected in this study will be stored confidentially. All data will be coded in a de-identified manner and analyzed and reported so that responses will not be able to be linked to any individual.

Your confidentiality and the confidentiality of your data will be protected by storing it on a secured computer that is password protected and only accessible by the researchers**.**

Please be advised that this research study includes data storage in the U.S.A. As such, there is a possibility that information about you that is gathered for this research study may be accessed without your knowledge or consent by the U.S. government in compliance with the U.S. Patriot Act.

Appendix 11 – Letter of information for implied consent

School of Environmental Studies
PO Box 1700 STN CSC
Victoria, British Columbia V8W 2Y2 Canada
Tel (250) 721-7354, Fax (250) 721-8985
Web http://ses.uvic.ca/

Letter of Information for Implied Consent

You are invited to participate in a study entitled Understanding the perception of barriers to pro-environmental behaviour using cultural cognition that is being conducted by Karine Lacroix. Karine Lacroix is a Graduate student in the School of Environmental Studies at the University of Victoria and you may contact her if you have further questions at lacroixk@uvic.ca. As a Graduate student, Karine is required to conduct research as part of a Masters of Environmental Studies degree. It is being conducted under the supervisor of Dr. Robert Gifford. You may contact her supervisor at rgifford@uvic.ca.

Purpose and Objectives
The purpose of this research project is to examine people's perception of barriers to engaging in more pro-environmental behaviour. Research of this type helps better understand perceptions about the barriers people face when attempting to engage in more pro-environmental behaviour and possible solutions for removing these barriers. It is anticipated that the results of this study will be shared with others through a thesis paper, defense presentation, academic and media presentations, and published scholarly articles. However, no individuals' names will ever be used in any dissemination of the results. There are no known or anticipated risks to you by participating in this research.

Participant selection, compensation and voluntary participation
You have been selected for participation in this research according to Qualtrics' standard recruiting procedures as well as the fact that you meet the eligibility criteria for the study (i.e., are a resident of British Columbia and are age 18 or older). You will receive compensation from Qualtrics for your participation in this study. If you agree to participate in this study, this form of compensation to you must not be coercive. It is unethical to provide undue compensation or inducements to research participants. Your participation in this research must be completely voluntary. If you do decide to participate, you may withdraw at any time during the survey (simply close the page in your web browser) without any consequences or any explanation. If you do withdraw from the study your data will be destroyed.

Anonymity and confidentiality
Your data will be collected anonymously, with the data only tagged to a random identification number. This random identification number cannot be used by anyone to re-identify you. Also, the panel company maintains a secure data storage operation to protect the security of client and Account Holder details. To protect your anonymity, it will not be possible for you to withdraw from the study once you have completed the

survey. Your confidentiality and the confidentiality of your data will be protected by storing it on a secured computer that is password protected and only accessible by the researchers. Data from this study will be disposed of five years after publication of the results. Computer files will be deleted and paper copies will be shredded. Please be advised that this research study includes data storage in the U.S.A. As such, there is a possibility that information about you that is gathered for this research study may be accessed without your knowledge or consent by the U.S. government in compliance with the U.S. Patriot Act.

Ethics approval

You may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

If you agree to participate in this research, your participation will include filling out a questionnaire about your views on climate change, obstacles to pro-environmental behaviour, and general beliefs about our ideal society. It will take approximately 30 minutes.

By clicking on "I agree to take part (Proceed to survey)" (below), your free and informed consent is implied and indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers. **You can withdraw at any time by simply closing the page in your web browser.**

○ I **agree** to take part (Proceed to survey)

○ I **do not** wish to take part

Appendix 12 – Debriefing statement

Thank you for completing this questionnaire. Using the information you and others have provided, we will examine whether general beliefs about the ideal society are related to the beliefs about climate change risks and current levels of pro-environmental behaviour. We will also investigate the relations between these views about society and the perception of barriers to pro-environmental behaviour.

In the survey, we asked about the energy consuming behaviours that you engage in and the obstacles you face in your attempts to reduce your energy consumption. We also asked you to rate a number of statements about people and society. Questions about your personal views on society were included so we can relate these views to people's personal views on climate change.

Through this research, we will be able to better understand some of the obstacles people face when attempting to behave in more environmentally friendly ways. We will also understand how these obstacles are linked to views about the ideal society. We will try to understand how these obstacles can potentially be addressed trough climate policies and programs by comparing our results to previous research on environmental management preferences for different groups of people based on their general views about society (i.e., cultural cognition theory).

This research is being completed as part of requirements for the completion of a Masters in Environmental Studies at the University of Victoria.

Thank you again for participating in this study.