



The Social-Psychological Determinants of Climate Change Risk  
Perceptions, Intentions and Behaviours: A National Study

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## **Declaration**

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## **List of Publications:**

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*Tho' much is taken, much abides; and tho'  
We are not now that strength which in old days  
Moved earth and heaven, that which we are, we are;  
One equal temper of heroic hearts,  
Made weak by time and fate, but strong in will*

*"To strive, to seek, to find, and not to yield".*

- Lord Alfred Tennyson (Ulysses)

To my loving parents.

## Abstract

Although human-caused climate change is one of the greatest societal challenges of the 21<sup>st</sup> century, insights from social and environmental psychology remain underrepresented in the mitigation debate. This is surprising given that the collective potential for reducing national carbon emissions through changes in individual lifestyles and behaviours has clearly been demonstrated. Accordingly, this PhD thesis aims to provide a more systematic and detailed understanding of individual mitigation behaviour. It does so specifically by examining the social-psychological determinants of climate change risk perceptions, intentions and behaviours using a longitudinal UK national survey ( $N = 808$ , wave 1) and ( $N = 501$ , wave 2).

In total, three separate analyses were conducted using the national survey data. In the first analysis (chapter 4), a social-psychological model of climate change risk perceptions is advanced. The model proposes that public risk perceptions of climate change are influenced by three key psychological dimensions, namely; (i) cognitive, (ii) experiential and (iii) socio-cultural factors. Results confirm the model's validity and show that nearly 70% of the variance in risk perception can be explained by the model's components. Main findings also provide empirical support for a distinction between personal and societal risk judgements and highlight important differences in their psychological antecedents. The second analysis (chapter 5) specifically investigates the interrelation between personal experience with extreme weather, affect and risk perception and situates their conceptual relationship within the cognition-emotion debate. Results provide strong support for a dual-process model, where risk perception and affect mutually influence each other in a stable feedback system.

In the third analysis (chapter 6), a domain-context-behaviour (DCB) model is advanced. The purpose of the model is to causally conceptualize and systematically organize the social-psychological determinants of climate change mitigation behaviours. A key aspect of the DCB model is the notion that environmental values (i.e. the "domain") and climate change cognitions, norms and emotions (i.e. the "context") do not influence specific mitigation intentions and behaviours (e.g. energy conservation) directly. Rather, they influence a broad and general orienting intention to help reduce climate change. This general intention in turn activates and predicts specific mitigation intentions directly as well as indirectly via behaviour-specific determinants. Important differences emerge between high-impact and low-impact behavioural changes. Overall, results from this thesis have important implications for public policy, risk communication and behavioural change interventions.

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## Table of Contents

Abstract.....	5
Acknowledgements .....	6
Table of Contents .....	8
List of Tables .....	14
List of Figures .....	15
Abbreviations.....	16
<b>CHAPTER 1: GENERAL INTRODUCTION .....</b>	<b>17</b>
1.1 Chapter Outline and Structure of Thesis .....	18
1.1 Problem Context: Climate Change.....	20
1.1.1 Global Warming.....	20
1.1.2 Human Causation: The Scientific Consensus.....	21
1.1.3 A Changing Climate.....	21
1.2 Addressing Climate Change: A Social-Psychological Approach.....	23
1.2.1 Psychology: An Undervalued Perspective?.....	24
1.2.2 Adaptation vs. Mitigation.....	26
1.2.3 Scope and Contribution of Thesis .....	28
1.3 General Philosophy and Approach.....	30
1.3.1 The Individual Level: Some Critical Reflections .....	30
1.3.2 Situating the Current Work.....	32
1.4 Methodology .....	35
1.4.1 Qualitative vs. Quantitative Considerations .....	35
1.4.2 The Psychometric vs. Experimental Paradigm .....	36
1.4.3 Sample and Participants .....	38
1.4.4 Design and Structure of National Survey .....	40
1.5 Outline of Thesis.....	42
References.....	44
<b>CHAPTER 2: TOWARDS A NEW MODEL FOR COMMUNICATING CLIMATE CHANGE.....</b>	<b>59</b>
Abstract.....	60
1.0 Introduction .....	61
2.0 The Cognitive-Analytical Approach.....	64
2.1 The Homo Logicus?.....	64
2.2 Information Processing and the Structural Organisation of Knowledge.....	66



2.3	Does Knowing Make a Difference? The Relationship Between Knowledge and Behaviour.....	68
3.0	The Affective-Experiential Approach .....	72
3.1	The Homo Expertus?.....	72
3.2	Risk as Feelings .....	74
3.3	The Link Between Personal Experience, Risk Perception and Behavioural Change.....	76
3.4	Scaring People, Does It Work?.....	79
4.0	The Social-Normative Approach.....	82
4.1	The Homo Sociologicus?.....	82
4.2	Evidence for the Role of Normative Influences on Environmental Behaviour ..85	
5.0	Towards a New Framework for Communicating Climate Change .....	87
5.1	An Integrated Understanding: Theories of Dual-Processing in the Brain.....	87
5.2	The Pivotal role of Determinants of Behaviour in Communicating Change .....	90
5.3	A New Framework for Communicating Climate Change.....	91
	References.....	97

<b>CHAPTER 3: THE ROLE OF KNOWLEDGE, LEARNING AND MENTAL MODELS IN PUBLIC PERCEPTIONS OF CLIMATE CHANGE RELATED RISKS .....</b>	<b>118</b>
Abstract.....	119
1.0 Introduction .....	120
2.0 Through the Looking-Glass: The Multi-Dimensional Nature of Risk Perception.....	121
2.1 Reasoning About Risk.....	121
2.2 Conversations with the Unconscious .....	125
2.3 Feeling at Risk .....	126
2.4 A Culture of Risk? .....	128
2.5 The Risky Individual .....	130
3.0 Mind the Gap: Risk Perceptions of Climate Change and Public Action .....	131
4.0 Conclusion and Policy Implications .....	135
References.....	138

<b>CHAPTER 4: THE SOCIAL-PSYCHOLOGICAL DETERMINANTS OF CLIMATE CHANGE RISK PERCEPTIONS: TOWARDS A COMPREHENSIVE MODEL .....</b>	<b>147</b>
Abstract.....	148
1.0 Introduction .....	149
2.0 The Present Research.....	154

2.1	Cognitive Dimensions of Risk .....	154
2.1.1	Knowledge about Climate Change .....	154
2.2	Experiential Processes .....	156
2.2.1	Affect.....	156
2.2.2	Personal Experience .....	158
2.3	Socio-Cultural Influences.....	159
2.3.1	Culture, Values and Worldviews .....	159
2.3.2	The Social Construction of Risk .....	162
2.4	Socio-Demographic Characteristics .....	163
3.0	The Climate Change Risk Perception Model (CCRPM) .....	164
4.0	Method.....	166
4.1	Participants .....	166
4.2	Materials and Procedure .....	166
4.3	Measures .....	167
4.3.1	Risk Perception .....	167
4.3.2	Knowledge about Climate Change .....	167
4.3.3	Holistic Affect.....	168
4.3.4	Personal Experience with Extreme Weather Events.....	168
4.3.5	Broad Value Orientations .....	168
4.3.6	Social Norms .....	169
4.3.7	Socio-Demographic Characteristics.....	169
5.0	Results.....	170
5.1	Descriptive Statistics .....	170
5.2	The Climate Change Risk Perception Model.....	171
5.3	The Relative Importance of Cognitive, Experiential and Socio-Cultural Factors in Explaining Climate Change Risk Perceptions .....	174
5.4	Climate Change Risk Perception: A Two Dimensional Construct?.....	176
5.5	Psychological Antecedents of Societal and Personal Risk Perceptions.....	177
6.0	Discussion .....	180
6.1	Evidence for a Climate Change Risk Perception Model.....	180
6.1.2	Socio-Demographic Characteristics.....	181
6.1.3	Cognitive Factors .....	181
6.1.4	Experiential Processes.....	182
6.1.5	Socio-Cultural Influences .....	183
6.2	Implications for Risk Communication and Future Research .....	184
7.0	Conclusion.....	187
	References.....	188

**CHAPTER 5: ON THE RELATIONSHIP BETWEEN PERSONAL EXPERIENCE, AFFECT AND RISK PERCEPTION: THE CASE OF CLIMATE CHANGE ..... 201**

Abstract..... 202

1.0 Introduction ..... 203

2.0 The Present Study..... 205

    2.1 Model 1: Affect as an Information Processing Heuristic ..... 205

    2.2 Model 2: Affect as a Post-Cognitive Process ..... 206

    2.3 Model 3: A Dual-Processing Perspective: The Case of Climate Change ..... 207

3.0 Method ..... 209

    3.1 Sample and Participants ..... 209

    3.2 Materials and Procedure ..... 209

    3.3 Measures ..... 210

        3.3.1 Risk Perception ..... 210

        3.3.2 Generalised Affect ..... 210

        3.3.3 Personal Experience with Extreme Weather Events..... 211

        3.3.4 Cause Knowledge ..... 211

4.0 Results..... 212

    4.1 Overview of Statistical Analyses ..... 212

        4.1.1 Recursive vs. Non-Recursive Structural Equation Models ..... 212

        4.1.2 Assessment of Model Fit..... 213

    4.2 Validating the Measurement Model..... 214

    4.3 The “Affective” vs. “Cognitive” Model..... 216

    4.4 A Dual-Process Model of Risk Perception and Affect..... 219

5.0 Discussion ..... 223

    5.1 A Causal Tale: Personal Experience with Extreme Weather, Negative Affective Evaluations and Risk Perceptions of Climate Change. .... 223

    5.2 Implications for Risk Communication..... 226

    5.3 Some Final Thoughts on Cognition, Emotion, Causality and Future Research ..... 227

References..... 229

**CHAPTER 6: THE SOCIAL-PSYCHOLOGICAL DETERMINANTS OF CLIMATE CHANGE MITIGATION INTENTIONS AND BEHAVIOURS: A DOMAIN-CONTEXT-BEHAVIOUR (DCB) MODEL..... 238**

Abstract..... 239

1.0 Introduction ..... 240

2.0 The Present Study: A Domain-Context-Behaviour (DCB) Model..... 243

    2.1. The Domain: Environmental Value Structures..... 247

2.2	The Context: Climate Change.....	249
2.3	The Behaviour: Situation-Specific Influences.....	251
3.0	Climate Change Mitigation Intentions and Behaviour .....	255
3.1	One To Bind Them All? .....	255
4.0	Method .....	257
4.1	Sample and Participants .....	257
4.2	Materials and Procedure .....	258
4.3	Measures .....	259
4.3.1	Biospheric, Altruistic and Egoistic Values.....	259
4.3.2	Risk Perception .....	259
4.3.3	Knowledge about Climate Change .....	260
4.3.4	Descriptive Social Norm .....	261
4.3.5	Attitude Toward the Behaviour .....	261
4.3.6	Perceived Behavioural Control.....	261
4.3.7	Situational Constraints .....	262
4.3.8	Habit .....	262
4.3.9	General Intention.....	262
4.4.0	Specific Mitigation Intentions .....	263
4.4.1	Specific Mitigation Behaviour.....	263
4.4.2	Socio-Demographics .....	263
5.0	Results.....	264
5.1.	Overview of Statistical Analyses.....	264
5.1.2	Assessment of Model Fit .....	264
5.1.3	Missing Data.....	265
5.2.	Descriptive Statistics.....	266
5.3.	The Domain-Context-Behaviour Model (DCB).....	269
5.4.	Psychological Determinants of High vs. Low Cost Behavioural Changes ..	272
5.5	Socio-Demographics & Non-Trivial Competing Model Structures .....	278
6.0	Discussion .....	281
6.1	The Domain-Context-Behaviour Model.....	281
6.2	The Psychological Determinants of Low Impact vs. High-Impact Behavioural Changes .....	284
6.3	The DCB, Other Behavioural Models and Future Research .....	285
6.4	Implications for Public Communication & Behavioural Change .....	288
6.5	Conclusion .....	289
	References.....	290

<b>CHAPTER 7: GENERAL DISCUSSION AND CONCLUSION .....</b>	<b>309</b>
7.1 Summary of Findings and Contribution of Thesis .....	310
7.1.1 Theoretical Advances and Contribution to Literature.....	310
7.1.2 Methodological Contributions .....	317
7.2 Implications for Risk Communication, Behavioural Change and Public Policy.....	318
7.3 Limitations of Thesis and Future Research .....	323
7.4 Conclusion .....	326
References.....	327
 <b>APPENDICES .....</b>	 <b>335</b>
Appendix A: Supplement 1 to Chapter 6.....	335
Appendix B: Supplement 2 to Chapter 6.....	337
Appendix C: Sample Characteristics.....	339
Appendix D: National Survey Questions and Items .....	341
Appendix E: Focus Group Study Form / Human Subjects Approval .....	361

## List of Tables

Table 1.1: Outline of Chapters and PhD thesis .....	43
Table 2.1: Categorisation of Human Neural Functioning .....	88
Table 4.1: Overview of Major Risk Perception Studies.....	153
Table 4.2: Descriptive Statistics and Intercorrelations.....	170
Table 4.3: Climate Change Risk Perception Model Results.....	173
Table 4.4: Relative Importance of Cognitive, Experiential & Socio-Cultural Factors...175	
Table 4.5: Factor Loadings for Societal and Personal Risk Perception Measures. ....	177
Table 4.6: Goodness of Fit Statistics for a Two vs. One Factor Solution (CFA) .....	177
Table 4.7: Antecedents of Societal and Personal Risk Perceptions .....	179
Table 5.1: Factor Loadings and Scale Reliabilities of Measurement Items .....	215
Table 5.2: Descriptive Statistics and Intercorrelations.....	216
Table 6.1: Climate Change Mitigation Scale Items .....	267
Table 6.2: Intercorrelation Matrix and Descriptive Statistics.....	268
Table 6.3: SEM Parameters Full DCB Model .....	272
Table 6.4: Perceived Situational Constraints for High-Cost, High-Impact Changes.....	275
Table 6.5: Model Parameters Low-Cost Model.....	278
Table 6.6: Model Parameters High-Cost Model .....	278
Table 6.7: Comparison of Model Fit: TPB vs. DCB.....	280
Table A.1: Factor Loadings from Principal Component Analysis (PCA).....	335
Table A.2: Effect of Socio-Demographics on General Intentions .....	336
Table C.1: Sample Characteristics .....	339

## List of Figures

<i>Figure 2.1: An Integrated Framework for Public Communication Interventions</i> .....	92
<i>Figure 3.1: Experience, Perception and Attribution of Risk</i> .....	133
<i>Figure 4.1: The Climate Change Risk Perception Model.</i> .....	165
<i>Figure 5.1: Hypothesised Causal Flow Model 1 (the “affective” model)</i> .....	206
<i>Figure 5.2: Hypothesised Causal Flow Model 2 (the “cognitive” model)</i> .....	207
<i>Figure 5.3: Hypothesised Causal flow Model 3 (the “dual-process” model)</i> .....	208
<i>Figure 5.4: Affect as an Information Processing Heuristic (the “affective” model)</i> .....	217
<i>Figure 5.5: Affect as a Post-Cognitive Process (the “cognitive” model)</i> .....	218
<i>Figure 5.6: Recursive (Cognitive) Structural Equation Model</i> .....	222
<i>Figure 5.7: Non-Recursive (Dual-Process) Structural Equation Model</i> .....	223
<i>Figure 6.1: The Measurement Correspondence Problem</i> .....	244
<i>Figure 6.2: The Domain-Context-Behaviour Model (DCB)</i> .....	254
<i>Figure 6.3: The Domain-Context-Behaviour (DCB) Model Results</i> .....	271
<i>Figure 6.4: Graphical Representation of Mitigation Intentions</i> .....	275
<i>Figure 6.5: DCB Model Results for Low-Cost, Low Impact Behaviours</i> .....	277
<i>Figure 6.6: DCB Model Results for High-Cost, High-Impact Behaviours</i> .....	277
<i>Figure A.1: Theory of Planned Behaviour (Ajzen, 1991)</i> .....	337
<i>Figure A.2: Value-Belief-Norm Theory (Stern et al., 199; Stern, 2000)</i> .....	337
<i>Figure A.3: Theory of Interpersonal Behaviour (Triandis, 1977)</i> .....	338

## Abbreviations

APA	American Psychological Association
CC	Climate Change
CCRPM	Climate Change Risk Perception Model
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CO <sub>2</sub>	Carbon Dioxide
DCB	Domain-Context-Behaviour Model
EFA	Exploratory Factor Analysis
FIML	Full Information Maximum Likelihood
GHG	Greenhouse Gas
GW	Global Warming
IPCC	Intergovernmental Panel on Climate Change
KAB	Knowledge-Attitude-Behaviour
MTMM	Multitrait-Multimethod
PCA	Principal Component Analysis
RMSEA	Root Mean Square Error Approximation
SARF	Social Amplification of Risk Framework
SEM	Structural Equation Model(ing)
SRT	Social Representations Theory
TIB	Theory of Interpersonal Behaviour
TPB	Theory of Planned Behaviour
VBN	Value-Belief-Norm Theory



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## **CHAPTER 1: GENERAL INTRODUCTION**

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## 1.1 Chapter Outline and Structure of Thesis

During my first year as a doctoral student I came across a Washington Post article written by David Fahrenthold. In the article, Fahrenthold (2009, p.1) summarizes;

*“To a psychologist, climate change looks as if it was designed to be ignored. It is a global problem, with no obvious villains and no one-step solutions, whose worst effects seem as if they’ll befall somebody else at some other time. In short, if someone set out to draw up a problem that people would not care about, it would look exactly like climate change.”*

Fahrenthold’s ironic portrayal of the issue captures an important reality: while global climate change is now widely considered to be the greatest environmental threat of the 21<sup>st</sup> century, it is also an unprecedented psychological challenge, requiring perhaps one of the greatest exercises in understanding and achieving large-scale behavioural change. Unfortunately, the human dimension of the climate change problem is also the least understood dimension (Gifford, 2014). This becomes apparent from the fact that while large majorities of the public, both in the UK and elsewhere, are currently aware of and broadly concerned about climate change, behavioural engagement is lacking (Whitmarsh, Seyfang, & O’Neill, 2011). Accordingly, the central aim and contribution of this thesis is to advance a detailed and systematic social-psychological understanding of how people feel, think about and perceive the risk of climate change on one hand, and subsequently act on their values, perceptions, attitudes and intentions on the other.

More specifically, this thesis consists of a collection of five independent but related papers which (including the introduction and general discussion) are presented in seven consecutive chapters. The first two chapters provide a detailed overview of the risk perception, communication and behavioural change literature and advance a new conceptual framework for communicating climate change. The empirical part of this

thesis (which comprises three out of the five papers) is based on results from a large national survey of the UK population. Very broadly, this thesis can conceptually be divided into two parts. In the first part, a detailed and integrated understanding is advanced of how people form risk judgements about climate change. To this extent, a comprehensive model of climate change risk perceptions is presented and subsequently tested and validated empirically. After the dimensional foundations for understanding public risk perceptions of climate change are laid out, the complex interrelationship between personal experiences with extreme weather, affective reactions and risk perception are explored in more detail through the lens of a dual-processing perspective.

A major thematic link throughout this thesis is the notion that in order to build a more comprehensive and practically relevant social-psychological understanding of the problem, the way that people perceive, feel and think about climate change needs to be linked to not only people's willingness to help reduce climate change but also to a set of impactful and specific mitigation behaviours – which is the subject of the second part of this thesis. More specifically, a domain-context-behaviour (DCB) model for explaining and predicting a wide range of mitigation behaviours is introduced and tested empirically.

The rest of this introduction is structured as follows; first a brief contextual introduction to the climate change problem is provided. This section is followed by an explanation of the viewpoint and contribution that psychology as a discipline has to offer to the climate change problem. After explaining the rationale for a social-psychological approach to the issue, the scope and contribution of this thesis is discussed in more detail, particularly as to how it situates itself within the current literature. A detailed overview of the general philosophy and overarching methodological approach adopted in this thesis is given as well, including a description of the national survey design. The introduction section ends with an outline of the structure for the remainder of this thesis.

## 1.1 Problem Context: Climate Change

*“Climate change is probably the greatest long-term challenge facing the human race”*

Tony Blair (2006, p.4).

### 1.1.1 Global Warming

The temperature on earth is determined by a careful balance between solar energy received from the sun (input) and the reflection of some of this energy back into space (output). Much of the solar radiation that is not reflected back into space is absorbed by the earth's land and oceans, warming the planet's surface. As a result of this warming, so-called “long-wave” (infrared) radiation is emitted by the earth. Greenhouse gases such as carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) essentially function as a thermal blanket by “trapping” the radiation (heat) – causing the atmosphere to warm (Maslin, 2009).

While the “greenhouse” effect is a natural process and an essential feature of life on earth, since the industrial revolution, human activities have substantially increased the amount of greenhouse gases (“GHGs”) such as CO<sub>2</sub> in the atmosphere, causing it to trap more heat than it would otherwise. In fact, current levels of atmospheric greenhouse gas concentrations are the highest in 800,000 years and the global average temperature on earth has increased by about 0.85% over the last 130 years (Intergovernmental Panel on Climate Change, 2013). Moreover, the projected rate of temperature change for this century steadily outpaces any extended global warming period that has occurred over the last 65 million years (American Association for the Advancement of Science, 2013).

### *1.1.2 Human Causation: The Scientific Consensus*

The Intergovernmental Panel on Climate Change report is widely regarded as the most authoritative international scientific investigation into global warming and their latest findings suggest, with 95% certainty, that anthropogenic (i.e. human-caused) climate change is a reality (IPCC, 2013). The IPCC is certainly not alone in its conclusion: a recent study that surveyed over 12,500 peer-reviewed abstracts on the subject of global climate change found that 97% of the papers support the consensus position that humans are causing global warming (Cook et al., 2013). Indeed, as Maibach, Myers and Leiserowitz (2014) note, evidence of a near-unanimous scientific consensus on the human causes of climate change has consistently been demonstrated by a wide variety of studies (e.g. see Anderegg et al., 2010; Doran & Zimmerman, 2009; Oreskes, 2004).

### *1.1.3 A Changing Climate*

Climate change is a statistical property that refers to the average long-term variability in the earth's climate (IPCC, 2013). As previously mentioned, the earth's climate is changing, primarily as a result of human activities. For example, the atmosphere and oceans have warmed, the amount of snow and ice has decreased and the average sea level has risen (IPCC, 2013). In particular, the rate of (global) warming has steadily increased over the last 50 years and the last three decades have likely been the warmest 30-year period of the last 1400 years. As ice glaciers continue to shrink worldwide, the average rate of sea level rise (since the mid-19<sup>th</sup> century) has steadily surpassed the average rate observed during the previous two thousand years (IPCC, 2013). Moreover, further increases in the average global temperature are likely to significantly disrupt the earth's climate system (National Resource Council, 2013).

Because the climate system is comprised of very complex feedback mechanisms, there is a reasonable amount of uncertainty associated with specific impact-predictions on the global, national and regional levels. Yet, some likely consequences of global climate change include; more frequent extreme weather events (e.g. heavy precipitation, flooding, freak storms, heat waves etc.), droughts, increased wildfires, resource scarcity, impacts on human health (e.g. spreading of infectious disease), social unrest, species extinctions, loss of biodiversity and flooding of low-lying coastal countries, small island nations and wetland ecosystems (IPCC, 2013).

Downscaled effects for the UK in particular are likely to include increased flooding as a result of both heavier downpours and sea-level rise along with greater extremes of heat and drought, stresses on water resources, loss of flora and fauna as well as at least some loss of low-lying coastal land (Met Office, 2011). In fact, some of the impacts of climate change are already visible around the world (e.g. Coumou & Rahmstorf, 2012; Ki-Min et al., 2011; Parmesan, 2006; Parmesan & Yohe, 2003). Over the last seven years alone, increased heat waves, (summer) floods and prolonged cold periods (heavy snow) have significantly damaged and interrupted UK infrastructure, costing the economy billions of pounds (Defra, 2012).

As highlighted by the UK Treasury's "Stern Review", the benefits of early mitigation and adaptation strategies strongly outweigh the associated costs. In fact, without substantial action, the societal and economic costs of unhalted climate change are going to be grave (Stern, 2007). Indeed, if catastrophic consequences are to be avoided, the scientific consensus suggests that warming should be kept below 2°C by the end of the century (IPCC, 2013). Yet, in order to do so, widespread public support and action will be required (Milfont, 2012).

## 1.2 Addressing Climate Change: A Social-Psychological Approach

*“Psychologists provide a theoretically and empirically based understanding of human behaviour at the individual level. This level of analysis is relevant for understanding the human causes of climate change because it is the collective impact of human behaviours that is contributing to climate change” – (APA, 2009, p. 15)*

Whether or not disastrous climate change can be avoided by keeping future warming of the planet to a minimum will ultimately be the result of (collective) human behaviour and decision making. Indeed, it is said that we have entered the age of the “anthropocene”, where human activities increasingly control the ultimate direction and functioning of the Earth’s systems (Steffen, 2010). The human activities that drive climate change mainly refer to behaviours that involve the release of three primary greenhouse gases (GHGs), including; *carbon dioxide* emissions through the burning of fossil fuels such as oil, coal and gas (e.g. automobiles, household heating, air travel), agricultural activities that are responsible for the release of *methane* (e.g. raising cattle, livestock, meat consumption) as well as the emission of *nitrous oxide* (e.g. through industrial processes).

As highlighted by a special task-force report of the American Psychological Association, because climate change is driven by human behaviour, the value of a psychological perspective is indispensable (APA, 2009). Indeed, as Stern (2011) comments; “psychology can make a significant contribution to limiting the magnitude of climate change” (p.1). Particularly, because the very nature of (applied) psychology revolves around understanding, explaining and changing behaviour in response to a problem (Kaiser, Schultz, & Scheuthle, 2007; Klöckner & Blobaum, 2010). Overall, there is little question that psychology (and environmental psychology in particular) is uniquely suited to contribute to a better understanding of the human dimensions of climate change

(Ernst & Wenzel, 2014; Gifford, 2008, 2014; Schmuck & Vlek, 2003; Spence, Pidgeon, & Uzzell, 2009; Stern, 2011).

### *1.2.1 Psychology: An Undervalued Perspective?*

The value of a psychological perspective is evident in that the most important dimension of the climate change system (i.e. the human-dimension) is also the least understood (Gifford et al., 2011). In fact, not only is it the least understood dimension, it is also the most overlooked. For example, Spence and Pidgeon (2009) argue that despite the clear human, cultural and social dimensions of climate change, solutions are mostly framed in terms of new technologies, industry incentives and other economic and market-based instruments. Indeed, insights from social and environmental psychology remain severely underrepresented in the mitigation debate (Klöckner, 2011; Ernst & Wenzel, 2014).

To this extent, Klöckner (2011) highlights the technocratic bias that becomes apparent when reading past IPCC reports (i.e. there is virtually no mentioning of insights from psychology). On the whole it is not unfair to conclude that; *“discourse on climate change in the media and among policy-makers is virtually silent on the role of psychology”* (Gifford, 2008, p. 273). This is not a new development per se, as during the 1970 energy crisis so-called “technological fixes” and “price mechanisms” were (despite limited success) equally given priority, while in fact, social psychology had much to say about energy conservation (e.g. Ester, 1985; Gaskell & Ellis, 1982; Gaskell & Pike, 1983). While technological advances and economic strategies such as incentives and price mechanisms are undoubtedly important in their own right, they tend to focus solely on creating “extrinsic motivation” – a strategy which has consistently shown to crowd out people’s “intrinsic motivation” to help the environment (e.g. Ariely, Bracha, & Meier, 2009; Evans et al., 2013; Frey, 1994; Frey & Oberholtzer-Gee, 1997). In fact, external



incentives only tend to work as long as the incentive is maintained (e.g. if someone decides to reduce their energy consumption in order to save or earn money, changes in that person's economic circumstances might quickly negate such conservation efforts). In short, external incentives are not stable, long-term motivators of pro-environmental behaviour (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014). Yet, the determinants of stable pro-environmental conduct is a central area of research for both social and environmental psychologists (Gifford, 2008, 2014).

The continued lack of consideration of a psychological perspective is therefore astonishing, especially given the fact that figures from both the US and the UK indicate that changes in individual lifestyles and behaviours could reduce national carbon dioxide emissions by as much as 20% to 30% (Dietz et al., 2009; Dietz, Stern, & Weber, 2013; Gardner & Stern, 2008; UKERC, 2009). Such “mitigation”<sup>1</sup> behaviours include personal transport choices, home energy and water usage as well as various food and consumption behaviours (Defra, 2008). In fact, the adoption of voluntary mitigation behaviours by the public will play a central role in transitioning to a low-carbon society (Whitmarsh, Seyfang, & O'Neill, 2011), especially in light of the ambitious targets set by the EU and the UK Climate Change Act, which aim for an 80% to 95% GHG emissions reduction by 2050 relative to the 1990 baseline (HM Government, 2008).

Thus, understanding behavioural change in the context of climate change is therefore critical (Brody, Grover, & Vedlitz, 2012). Yet, while the potential for change is clear, so far, public engagement with climate change in the UK (and elsewhere) remains

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<sup>1</sup> The terms “mitigation”, “low-carbon”, “conservation”, “pro-environmental” and “sustainable” are often used interchangeably. The term “mitigation behaviour” is generally preferred here in the context of climate change because it specifically and unambiguously refers to behavioural changes that can help reduce the human impact on the climate system. The terms pro-environmental / sustainable may refer to a broader class of behaviours (such as keeping a public park clean) and the term “low-carbon” tends to downplay the impact of other important behaviours and greenhouse gases (e.g. agricultural activities, methane).

limited, which is problematic as many individual behaviours need to be changed in a relatively short amount of time (De Young, 1993, 2011). In fact, despite international awareness and general concern for the issue (Bord, Fisher, & O'Connor, 1998; Eurobarometer, 2014; Kim & Nahmias, 2014; Lorenzoni & Pidgeon, 2006; Pidgeon, 2012), climate change is; (a) generally viewed as a psychologically distant risk, both temporally as well as spatially (Leiserowitz, 2005, 2006; O'Neill & Hulme, 2009; Spence, Poortinga, & Pidgeon, 2012) and (b) of low personal importance to people (Lorenzoni et al., 2006; Weber, 2010), especially in comparison to other urgent economic and societal problems (Poortinga & Pidgeon, 2003; Pew, 2012). As a result, behavioural engagement has remained low (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Whitmarsh, Seyfang, & O'Neill, 2011). The apparent gap between general awareness and concern for the risk of climate change on one hand, and the clear lack of personal action on the other, is often dubbed the “value-action” (Kollmuss & Agyeman, 2002) or “attitude-behaviour” (Newhouse, 1990) gap – which is of fundamental interest to both social and environmental psychologists.

### 1.2.2 *Adaptation vs. Mitigation*

The lack of appropriate action refers to both *adaptation* and *mitigation* (the two broad response options to human-induced climate change). While mitigation is primarily focused on reducing the human emission of greenhouse gases (GHGs) to avoid further and potentially more dangerous climate change, adaptation is more concerned with managing both current and future impacts of climate change (e.g. through building dikes and more resilient infrastructures). It is evident that both approaches are essential as regardless of future mitigation efforts, some level of climate change is going to be inevitable - making adaptation a necessity (Parry et al., 1998).

Yet, while the importance of adaptation strategies is duly acknowledged, the focus of this thesis is mostly on mitigation behaviour. Primarily because there are important differences between the two approaches that make mitigation a particularly interesting problem for psychology, namely; (a) the spatial and temporal scales on which they are effective and (b) the relative distribution of the associated costs and benefits (Klein, Schipper, & Dessai, 2005). For example, adaptation is relatively obvious in that it requires individuals to respond to a visible or imaginable local risk (e.g. flooding) for which the physical and psychological benefits of immediate action are relatively clear.

Mitigation on the other hand, calls for a (significant) personal cost at present for a potentially large but uncertain and globally distributed benefit in the future (Klein, Schipper, & Dessai, 2005). In fact, the mitigation issue can be described as a *social dilemma*, *common resource* or *collective action problem* (Dawes, 1980; Hardin, 1968; Olson, 1965). As Otto, Kaiser and Arnold (2014) highlight, there is a constant conflict between prioritizing short-term selfish interests (e.g. driving out of convenience) over behavioural changes that pose a cost today but ultimately benefit a long-term collective good (i.e. limiting global climate change).

Lastly, while adaptation to the impacts of climate change will largely be in the public's interest, the benefits of voluntary mitigation actions are predicated on a shared belief that humans are causing global warming – which, despite the scientific evidence, is certainly not a universal belief (e.g. Leiserowitz et al., 2013; Leviston & Walker, 2013; Poortinga et al., 2011). In short, the level (local vs. global) on which benefits and costs are construed mentally differ for adaptation and mitigation. Particularly, the concerns and benefits that motivate adaptation tend to be psychologically closer and less “challenging” than those which influence mitigation responses (Haden et al., 2012; Whitmarsh, 2008).

### *1.2.3 Scope and Contribution of Thesis*

A central characteristic of the climate change problem revolves around the notion of “risk”. The way in which people come to perceive climate change as a risk on one hand, and the extent to which people then subsequently act on their perceptions, values and intentions on the other, is the central topic of this thesis. In fact, the current thesis broadly situates itself between two separate but closely related contributions that psychology can make to the climate change debate. First, psychology can help advance understanding of how people think and feel about climate change risks, which is important because these factors in turn affect people’s motivations and behavioural responses (Swim et al., 2011).

More specifically, it has been noted that the environmental psychology literature lacks theoretical integration (e.g. Castro, 2006; Klöckner & Blobaum, 2010), this is reflected in both the variety of models and approaches used to explain and describe public risk perceptions as well as in terms of systematically mapping the psychosocial determinants of mitigation behaviours. For example, Wählberg (2001) notes that while it is now well-known that people experience risk in different dimensions, no coherent attempt has been made to piece them together to arrive at a more integrated and comprehensive understanding. To this extent, the current thesis advances a novel and integrated framework for understanding and measuring risk perception in the context of climate change. In particular, this thesis suggests that public risk perceptions of climate change are influenced by three core psychological dimensions, namely; cognitive, experiential and socio-cultural factors (controlling for key socio-demographic characteristics). These conceptual foundations are validated empirically using a national quota sample of the UK population and at the time of this writing, the model proposed in this thesis offers the most comprehensive explanatory account of climate change risk perceptions (at least, in terms of variance explained).

Secondly, Finucane (2012) comments that; “clarifying the mechanisms by which feelings and cognitions are related and integrated in human judgement and decision making is a critical next step in understanding perceived risk” (p. 61). Indeed, most prior investigations have assumed a unidirectional and linear relationship between key perceptual and psychological risk constructs. While this may, to some extent, reflect a limitation in the methodology that is available to (most) psychologists and risk researchers, the current thesis ventures beyond traditional modes of thinking by being the first to explore the interdependent relationship between personal experiences with extreme weather events, the formation of (negative) affective evaluations and risk perceptions of climate change. In particular, this thesis uses a non-recursive (i.e. feedback) structural equation modelling approach to examine how cognitive and affective factors reciprocally influence each other to shape perceptions of climate change.

As mentioned, closely related, a second contribution that psychology can make to the climate change debate is “to improve our understanding of the behaviours that drive climate change by building more effective behavioural models based on empirical analyses that contribute to a deeper and more detailed understanding of individual behaviour” (APA, 2009, p.8). With regard to the psychological determinants of mitigation behaviours, a specific focus on climate change has been lacking (Brody et al., 2012; Roser-Renouf & Nisbet, 2008) and as Whitmarsh (2009) points out, existing research has so far mostly been exploratory in nature. In particular, it has remained unclear how broad value structures and general concern for the environment are related to specific norms, beliefs and perceptions about climate change and in turn, how beliefs and perceptions about climate change influence specific mitigation intentions and behaviours. This thesis offers a novel explanation to this problem by introducing and validating a domain-context-behaviour (DCB) model. The DCB model structurally organises key social-

psychological determinants in a theoretically coherent manner to explain and predict a wide range of mitigation intentions and behaviours. The DCB model further improves current understanding by identifying key common psychological antecedents (as well as differences) between important low and high impact behavioural changes.

Overall, this thesis advances a more integrated, systematic and comprehensive social-psychological understanding of climate change risk perceptions, intentions and behaviours and as such, is likely to help increase the saliency of psychological research in the mitigation debate (Klöckner, 2011), especially in light of a growing demand for more “evidence-based” public policy (Gifford, 2008). For example, a systematic understanding of the key psychological determinants that shape and influence climate change risk perceptions, intentions and behaviours is likely to assist organisations and policy-makers in communicating the risk of climate change more effectively and allow interventionists to design better targeted and more informed behavioural change campaigns.

### **1.3 General Philosophy and Approach**

*“There is nothing so practical as a good theory”* (Kurt Lewin, 1951 p. 169)

#### *1.3.1 The Individual Level: Some Critical Reflections*

Some of social psychology’s predominant focus on the role of individual-level perceptions, values, attitudes and behaviours has not gone without criticism (e.g. Farr, 1991, 1996; Gaskell, 2001; Howarth, 2006), particularly for neglecting the notion that individual behaviours tend to be “deeply embedded in social situations, institutional contexts and cultural norms” (Shove, 2010, p. 1276). Indeed, the progressive “individualisation” and “decontextualisation” of social psychology is often said to have taken the “social” out of social psychology (Howarth, 2006; Graumann, 1986).

Some of these philosophical differences in psychological research can be traced back to different cultural traditions. In Europe, psychology was essentially born out of the philosophy of mind (Farr, 1991), given it a strong theoretical focus, whereas mainstream American social-psychological research is often characterised as being “individualistic” and mostly “empirically-driven” (Greenwood, 2004; Voelklein & Howarth, 2005). While, stereotypically, American social psychology may de-emphasise theory and overly concern itself with the importance of individual information processing, European social-psychological theories that deal with more complex collective social concepts are often difficult to test empirically and may lack controlled experimental rigour (Eysenck, 2001).

Despite these stereotypes, it is important to note that both approaches bring an equally valuable perspective to the table. Yet, Shove (2010) continues to criticise psychology’s attempt to model social-contextual factors by “importing” them as causal factors of and external drivers to behaviour rather than emphasizing the endogenous, dynamic and emergent nature of social practice. Shove is also dismissive of any potential for integration between the two disciplines, which is surprising given the fact that other scholars have long fostered a joint venture between psychology and sociology, a field perhaps better known as “*societal psychology*” (Himmelweit & Gaskell, 1990). Similarly, in the context of risk perception, Jackson, Allum & Gaskell (2006) highlight the benefits of integrating psychological and sociological approaches. Yet, the persistent argument that social psychology has become “asocial” is somewhat misleading. It is misleading “*because it tends to suggest that social psychology ought to concern itself with the emergent properties of supra-individual social groups as opposed to the psychological properties of individuals who constitute social groups*” (Greenwood, 2004, p.11).

Furthermore, as Whitmarsh, O’Neill, & Lorenzoni (2011) note in their reply to Shove (2010), the overly simplistic portrayal of psychological models of behaviour and

the general dismissal of non-sociological approaches to behavioural change is entirely unwarranted. Ultimately, a social-psychological “approach” is not a unidimensional one and as I hope to have illustrated, there is no shortage of different philosophies on the historical conception and representation of the “individual” vs. the “social”.

### *1.3.2 Situating the Current Work*

The above debate is meaningful in situating the current work, which is born out of and influenced by both traditions. While Shove (2010) seems to be entirely dismissive of social psychology’s attempt to “incorporate” social-contextual factors (e.g. by exploring how social norms affect behaviour), it is generally uncontested in psychology that social norms are one way of representing the “social” – even although more radical approaches may exist (Howarth, 2006). In fact, in line with the more practical and constructive views of Whitmarsh et al. (2011), the current thesis aims to better incorporate “contextual” factors in applied social-psychological theories, which is much needed in the environmental domain (Gifford, 2008; Steg & Vlek, 2009).

Overall, the current thesis aligns itself with the philosophy that the “social” can be represented as part of the perspective of the “individual”. Primarily because ultimately, social-psychological states and behavioural dispositions *neither* belong to metaphysically (dubious) emergent entities *nor* to “trans-or-supra individual processes and structures”, rather, they belong to the individual and to the individual mind alone (Greenwald, 2004, p. 12). While Uzzell (2010) agrees with the basic notion that attitudes and values reside within the individual mind, he emphasises the connection to contextual factors by stressing that; “we must remember that they have gotten there somehow” (p. 882).

Thus, in comparison to other recent important social-psychological work that has, for example, explored social representations theory (Smith & Joffe, 2012) or the larger



socio-cultural meaning of the climate change debate (Capstick, 2012; Tanner, 2011), the overarching epistemological approach adopted in this thesis may be type-casted as an “individualistic environmental psychology” (Vlek, 2000) - where the fundamental unit of analysis is the individual. As Gifford (2008, p. 279) notes; “we can, and should, do the fundamental research on individuals and climate change“. After all, “one of psychology’s unique contributions is to the understanding of behaviour at the individual level” (APA, 2009, p.8). In fact, the driving motivation behind this thesis is strongly aligned with Gifford’s (2008) view that while the importance of “contextual” factors should be acknowledged, the ultimate solution to climate change lies with (changing) the psychology of the individual. As I have noted elsewhere, while incremental behavioural change approaches may be criticised for not fundamentally questioning wider socio-cultural practices, this criticism is distracting as it devalues the important contribution that psychology can make in terms of offering a practical and empirically-informed understanding of human behaviour at the individual level (van der Linden, 2012).

Yet, at the same time, climate change is an inherently interdisciplinary problem and doing so requires an integrated effort (Pidgeon & Fischhoff, 2011; Swim et al., 2011). While its theories and methods are very much influenced by social and cognitive psychology (Steg, van den Berg, & De Groot, 2013), environmental psychology by its very nature has a long history of crossing disciplinary boundaries (Gifford, 2008), closely collaborating with geographers and environmental scientists. The current thesis follows in this tradition: while the overarching approach is social-psychological in nature, insights are gathered and applied from across the social, environmental and behavioural sciences.

In addition, every study reported in this thesis starts with a strong theoretical outlook and is based on a (primarily) deductive and theory-driven approach. Particularly because a deductive strategy in this context allows for; (1) precise operationalisation of

theoretical constructs, (2) the ability to explain the causal processes through which they affect behaviour and (3) a systematic and comparative investigation of competing models and hypotheses (Bamberg & Schmidt, 2003). For example, a major theme throughout this thesis is a distinction between *models of behaviour* and *theories of change*. While “models of behaviour” aid in understanding specific behaviours by identifying the underlying factors that influence them, theories of change show how behaviours can be changed and / or change over time (Darnton, 2008; van der Linden, 2013a).

While having distinct purposes, the two approaches are also highly complementary. In fact, the general philosophy adopted in this thesis is that as opposed to finding out “what works” experimentally on a “hit and miss” basis, in order to successfully change any behaviour, a grounded theoretical and empirical understanding of the factors that influence and determine relevant perceptions and behaviours must be established first (Government Communication Network, 2009; Gifford et al., 2011; van der Linden, 2013a). Indeed, trying to engage the public with mass communication campaigns is going to be of little success if such efforts are not founded on sound behavioural research (Pidgeon & Fischhoff, 2011). Thus, in line with this philosophy, throughout this thesis a symbiotic relationship between “models of behaviour” and “theories of change” is maintained.

## 1.4 Methodology

### 1.4.1 *Qualitative vs. Quantitative Considerations*

The value of any scientific approach must be evaluated in light of the research question that it is trying to answer. While the *behavioural* and *social sciences* are certainly interrelated, they are not quite one and the same, as they differ in their level of scientific analysis. While the social sciences tend to apply conceptual frameworks to the study of human society and the role of individuals within society (e.g. by studying structural systems, cultures and the impacts of social organisation), the behavioural sciences mainly focus on systematically abstracting empirical data to understand, explain and predict behavioural processes within a social system, including human decision-making and communication strategies (Klemke, Hollinger, & Kline, 1980). Of course, these distinctions are never hard and fast, as some areas of psychology lean more towards a social science perspective, whereas others take a more behavioural scientific approach.

While qualitative (e.g. case studies, discourse analysis, field work) and quantitative approaches (e.g. experiments, close-ended surveys) are not mutually exclusive and often complement each other (Bauer & Gaskell, 2000), not all methods are equally well-equipped to answer a particular research question. For example, while qualitative research is often concerned with understanding the perspective of participants, developing theory from field work or to define phenomena in terms of experienced (interpretive) meanings, quantitative methods are particularly well-suited for testing hypothesised (causal) relationships, generalisability of findings and for evaluating the validity, reliability and underlying factor structure of psychological measures (Elliot, Fischer, & Rennie, 1999).

The major focus of this thesis is on testing hypothesised theoretical/causal relationships between psychological constructs in order to explain key perceptual and behavioural processes that are relevant to understanding human responses to climate change. In addition, this thesis explores the underlying factor structure of important psychological constructs (e.g. risk perception) and aims to identify systematic and robust data patterns that can be generalised across a representative sample. Thus, while drawing on some qualitative work (e.g. a focus group), the overarching scientific approach taken in this thesis is positivist and grounded in a quantitative survey methodology that draws heavily on the psychometric paradigm (i.e. the theory of psychological measurement).

#### 1.4.2 *The Psychometric vs. Experimental Paradigm*

The question may be raised why, in this context, a survey methodology is thought to be better suited than an experimental approach. In short, the reason for this is that a national survey has high external validity, is generally a good method for reaching larger populations as well as for studying the relationships among psychological variables (Steg, van den Berg, & De Groot, 2013). In fact, while experiments tend to maximize internal validity at the expense of external validity (Argyris, 1975), this thesis is more concerned with identifying meaningful theoretical relationships between psychological properties that are generalisable to a larger population. To this extent, online survey research is welcomed in psychology (Gosling et al., 2004), as Gifford (2008) notes, in order to tackle climate change, research should, preferably, be generalisable beyond (a) the “laboratory” and (b) “introduction to psychology” students - two ever present conditions which have not served social psychology well (Sears, 1986; Peterson, 2001).

Furthermore, the difference between *psychometric* and *experimental* variables is often poorly understood (Bindra & Scheier, 1954). Experimental investigations tend to

produce variation by altering the subject's external environment, internal state, or both. In other words, the experimentalist obtains variation by subjecting groups or individuals to different treatment conditions. In contrast, in psychometric research, no attempt is made to produce any change in the individual under investigation (in fact, the individual is to stay put). Instead, variation is obtained by surveying individuals that differ with respect to the psychological construct(s) of interest (Bindra & Scheier, 1954).

This thesis is concerned with keeping the psychological properties under investigation (e.g. risk perceptions of climate change) constant in order to learn more about how individuals differ with respect to those properties while advancing and testing a theoretically novel explanation for the observed level of variation. Of course, both approaches could be combined and a variable (e.g. risk) can be expressed both psychometrically (e.g. risk perception) as well as experimentally (e.g. under varying levels of induced threat). Yet, given the research objective of this thesis, the psychometric paradigm is able to obtain an amount of variation that cannot be achieved through experimentation, no matter how rigorously conditions are manipulated. For example, a survey instrument allows for the measurement of a large number of self-reported behaviours at the same time - enabling a more systematic investigation of determinants.

It may be argued that people tend to somewhat overestimate their self-reported concern and pro-environmental behaviour (e.g. Bord et al., 1998; Chao & Lam, 2009; Gifford et al., 2011). In addition, the possibility of course exists that the mere act of asking people for their willingness to perform a socially desirable behaviour could inadvertently increase the probability that someone will actually do so, a phenomenon known as the “mere measurement” effect (Morwitz & Fitzsimons, 2004). Yet, the impact of social desirability bias has actually proven to be quite negligible in the environmental domain (Milfont, 2009). Moreover, the alternative, observing, tracking and manipulating

a large number of widely different public (e.g. riding the bus) and private (e.g. shower time) behaviours simultaneously seems neither practical nor feasible (Tobler et al., 2012). Additionally, complex multivariate relationships between different *latent* (i.e. unobserved) psychological constructs (e.g. knowledge, affect, risk perception) can be well represented within a behavioural system using statistical and psychometric techniques such as structural equation modelling (Bullock, Harlow, & Mulaik, 1994).

Furthermore, using a large-scale national survey also constructively builds on existing survey literature, as much research in this area has been limited to *intention-only* research (e.g. Heath & Gifford, 2006; Poortinga et al., 2012; Spence et al., 2011; Tobler et al., 2012), non-representative student samples (e.g. Hidalgo & Pisano, 2010; Klöckner & Blobaum, 2010; Truelove, 2009) or studies that measure psychological dispositions and (past) behaviour(s) at the same point in time (e.g. Semenza et al., 2008; Whitmarsh, 2009). Indeed, separation between the collection of the independent (e.g. risk perception, attitudes, intention) and dependent (e.g. behaviour) measures reduces common method bias and increases the potential for causal inference (Biddle, Slavings, & Anderson, 1985; Podsakoff et al., 2003).

#### *1.4.3 Sample and Participants*

Accordingly, this thesis uses a longitudinal UK national quota sample to survey a wide range of psychological properties, including; risk perceptions, experiences with extreme weather events, values, attitudes, norms, emotions, intentions, habits, barriers and behaviours related to climate change. Given the relatively large degree of internet penetration in the UK (approx. 77% of the population), the survey was administered online via a survey sampling company (Survey Sampling International). Using multi-stage randomisation, participants were selected from a large mixed panel of people who

were willing to participate in web-based research for a small (symbolic) reward that they could choose to either keep or donate. The total cost of the sample was approx. £5,000.

The national quotas were based on *gender*, *age* and *region* and reflect the 2001 Census data for the United Kingdom. The age of the participants ranged between 18 and 65 (see appendix C for full sample characteristics). The questionnaire took about 15 to 20 minutes to complete and was carried out in two waves. During the first wave in October of 2012, respondents (N = 808) were surveyed on all constructs except for self-reported behaviour. Four weeks later, the same panel members were asked to report on their behaviour and (N = 501) participants responded. The panel attrition rate was 38%. Panel attrition often only marginally affects the composition of the sample (Chang & Krosnick, 2009). Yet, the pattern of missingness in the current study is not fully random but can reasonably be controlled for and is further detailed in other sections of this thesis.

The rationale behind the online survey method is that online (web-based) surveys offer many measurement advantages over more traditional telephone or face-to-face techniques, including less random error, less surveys satisficing, less social desirability bias and more valid self-reports (Chang & Krosnick, 2009; Yeager et al., 2011). However, these benefits do not negate the fact that online panels suffer from what is generally referred to as an “opt-in selection bias” (Yeager et al., 2011). It should be mentioned however that participants did not pre or self-select what surveys they wanted to participate in. In addition, while online panels or so-called “non-probability” samples are generally deemed to be less representative (even after weighting adjustments have been made) by some (e.g. Chang & Krosnick, 2009; Malhotra & Krosnick, 2007; Yeager et al., 2011), this remains an active area of debate (Couper, 2000), particularly now that internet access among the UK general population has increased to over 77% (Office of National Statistics, 2011).

For example, probability samples with very low response rates are not necessarily less “biased” (Brick, 2011; Couper, 2000). Moreover, another study that compared the validity of traditional random digit dialing (RDD) techniques to that of web-surveys (both quota and probability-based) specifically in the context of climate change found that (a) when it comes to statistical inferences about relational differences between variables of interest, modest differences between the three methods exist but parameter estimates tend to be similar and (b) national quota samples obtained from large online panels are often sufficiently “representative” in comparison (Berrens et al., 2003).

#### *1.4.4 Design and Structure of National Survey*

The survey (appendix D) was designed partly at the London School of Economics and Political Science and partly at the Yale Project on Climate Change Communication. In designing the survey, the time-lapsed between measurement points (i.e. four weeks) was based on a careful trade-off between temporal contiguity and temporal erosion (Rindfleisch et al., 2008). This is a complicated matter in the sense that capturing the right temporal sequence is very much dependent on theory and context (Marini & Singer, 1988; Mitchell & James, 2001). Yet, while any time period is unlikely to perfectly accommodate the idiosyncratic circumstances of each respondent and every behaviour, on average, four weeks was chosen to (a) reduce the cognitive accessibility of previous responses and (b) to allow enough time for psychological dispositions (e.g. intentions) to materialise into behaviour but not to the extent that it “erodes” the cause-effect relationship (Bradburn, Rips, & Shevell, 1987; Ajzen, 2011) or that the action becomes too difficult for people to accurately recall (Gaskell, Wright, & O’Muircheartaigh, 2000).

In addition, while crafting the survey debates about terminology (climate change vs. global warming) were taken into account. Although the two terms are often used



interchangeably in the literature, some studies report that people tend to have different cognitive and affective associations with each term while other studies have found that levels of awareness and concern do not differ much between the two terms (cf. Schuldt, Konrath, & Schwarz, 2011; Villar & Krosnick, 2011; Whitmarsh, 2009b). Because the scientific term is “climate change” and because climate change has become the predominant frame in the UK media (Doyle, 2011; Capstick, 2012), the term “climate change” (rather than global warming) was used throughout the survey.

Yet, as suggested by Leiserowitz (personal communication), to avoid confusion between the two terms (and to differentiate historical from recent climate change), at the start of the survey, respondents were given a brief but objective explanation of what is meant by the term “climate change”: *“You may have heard of the term ‘climate change’ (also referred to as ‘global warming’ in the media). Climate change refers to the idea that the world’s average temperature has been increasing in the last 150 years, may be increasing in the future and that the world’s climate may change as a result”*.

Furthermore, in designing the survey, common method biases and other design challenges (e.g. priming, order and context effects) were duly taken into account (e.g. see Krosnick, 1999; O’Muircheartaigh, Gaskell, & Wright, 1993; Podsakoff et al., 2003; Wright, Gaskell, & O’Muircheartaigh, 1997) and addressed when possible (e.g. through question / item randomisation). In addition, “don’t know” and “not applicable” options were provided where relevant - which is generally considered good practice in survey research (Leiserowitz, personal communication; Spence et al., 2012). Moreover, in order to tailor the survey to the UK context and to make sure that the language, questions and response options were clearly formulated and perceived as unambiguous by the target audience, the survey was pilot tested first using a focus group of (N = 15) members of the general public. The focus group was conducted at the behavioural research lab of the LSE

(appendix E). One issue that cropped up during the session was the length of the survey, which was eventually reduced to 20 minutes (maximum). Other issues included the initial list of potential “barriers”, which did not encompass some of the challenges to behavioural change frequently mentioned by the participants (e.g. autonomy of the decision). Results from the pilot study were used to refine and finalise the questionnaire.

## **1.5 Outline of Thesis**

The remainder of this thesis is organised around five chapters that jointly build a comprehensive and systematic understanding of the social-psychological determinants of climate change risk perceptions, intentions and behaviours (Table 1.1). First, in chapter 2, a detailed survey of the literature is offered, with a particular emphasis on exploring the gap between communicating (the risk of) climate change and changing individual behaviour. Chapter 3 provides a more specific review of how people form risk perceptions of climate change psychologically and lays the conceptual foundations for a new integrated model. The empirical part of this thesis (chapters 4, 5 and 6) is based on data from a national survey and reported as three separate analyses. Building on chapter 3, a new social-psychological model of climate change risk perceptions is advanced and validated empirically in chapter 4. The fifth chapter extends this research by specifically exploring the complex interrelationship between affective and cognitive aspects of climate change risk judgements. In chapter 6, a domain-context-behaviour (DCB) model is advanced. The DCB is a new behaviour prediction model that conceptually links the way people feel, think about and perceive the risk of climate change to the performance of specific mitigation behaviours by structurally organising the social-psychological antecedents of these behaviours in a novel theoretical framework. Last but not least, chapter 7 summarises the main findings of this thesis and ends with a general discussion.

**Table 1.1: Outline of Chapters and PhD thesis**

<i>Outline of PhD Chapters</i>	<i>Key Research Aims</i>	<i>Method</i>
1. Introduction.		
2. Towards a new model for communicating climate change.	Broad review of the communication and behaviour change literature; advance new communication model	<i>Qualitative Review</i>
3. The role of knowledge, learning and mental models in public perceptions of climate change related risks.	Specific review of risk perception literature; propose and explore key conceptual dimensions.	<i>Qualitative Review</i>
4. The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model.	Advance and test a new integrated risk perception model. Explore differences in determinants between personal and societal risk judgements.	<i>National Survey</i>
5. On the relationship between personal experience, affect and risk perception: the case of climate change.	Explore the complex interrelationship between personal experience with extreme weather, negative affect and risk perceptions of climate change.	<i>National Survey</i>
6. The Psychological Determinants of Climate Change Mitigation Intentions and Behaviours: A Domain-Context-Behaviour (DCB) Model.	Advance and validate a new model for understanding the role of values and climate change beliefs, perceptions and norms in explaining and predicting specific low and high-cost mitigation behaviours.	<i>National Survey</i>
7. General Discussion and Conclusion.		

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## **CHAPTER 2: TOWARDS A NEW MODEL FOR COMMUNICATING CLIMATE CHANGE**

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## Abstract

While nearly 20 years of public communication about climate change has undoubtedly raised international awareness and concern, large-scale behavioural change has not followed. The aim of this paper is therefore twofold, namely; (a) to provide an extensive review of the theoretical and empirical evidence on which past and current climate change campaigns are based and (b) to advance a new communication model. With regard to the former, it is argued that the evolution of public climate change campaigns can be delineated according to the following typology; (1) “*the cognitive-analytical type*”, (2) the “*affective-experiential type*” and (3) “*the social-normative type*”. In addition, three major explanations are offered for the relative ineffectiveness of past campaigns: (a) while human behaviour is often the result of complexly integrated behavioural processes, most public climate change campaigns ought to be, but are unfortunately not, designed in an integrative manner, (b) public campaigns do not pay sufficient attention to the psychological determinants of the behaviours that they are trying to change and (c) often fail to make the climate change context explicit. Based on these shortcomings, an integrated conceptual framework is advanced to guide the design of future public interventions and to help narrow the gap between communicating climate change and changing individual behaviour.

## 1.0 Introduction

It has been well documented that for most people, the media is a prominent and integral source for acquiring information about climate change (e.g. Boykoff & Rajan, 2007; Ungar, 2000). Moreover, the way that information about climate change is framed and communicated can significantly influence the public's knowledge, attitude and perception toward the issue (e.g. Sampei & Aoyagi-Usui, 2009; Sharples, 2010; Stamm et al., 2002; Weingart, Engels, & Pansegrau, 2000). As a result, a popular strategy for inducing behavioural change has been the deployment of persuasion techniques embedded in communication strategies. To this extent, a major area of concern is the apparent disparity between public communication and the lack of actualized behavioural change observed in the general public (Whitmarsh, O'Neill, & Lorenzoni, 2011). While public polls often indicate that people express general awareness and concern (e.g. Eurobarometer, 2011; Globescan, 2006), individuals remain reluctant to take personal action. This phenomenon has also been dubbed the "*value-action*" (e.g. Kollmus & Agyeman, 2002), "*attitude-behaviour*" or "*intention-behaviour*" gap (e.g. Sheeran, 2002).

Traditionally, most communication campaigns have tried to address this gap by providing people with more information, a strategy that has become better known as the "*information-deficit*" model of human behaviour. In fact, a content analysis by Devine-Wright (2004) suggests that a deficit model of human behaviour has played a dominant role in past public behavioural change campaigns and is likely to continue to do so. On the whole, public interventional campaigns only seem to produce modest behavioural changes (Steg, 2008). For example, a 1999 mass public media campaign in the UK; "*Are you doing your bit*" only elicited small consequent changes in attitudes and behaviours (O'Neill & Hulme, 2009). Similar disappointing findings have been observed in The Netherlands (e.g. Staats et al., 1996). While new communication strategies have been

undertaken in recent years, more substantial analyses of such campaigns often remain elusive (i.e. those that go beyond media hits and broad-opinion brushes), making it hard to identify benefits and limitations (Moser, 2010; Steg & Vlek, 2009). Recent research is increasingly pointing out that communication interventions need to be made more locally relevant and designed in such a way that they meaningfully involve and engage the public with climate change (Moser 2006; O'Neill & Nicholson-Cole, 2009). Moser (2006, p.3) defines “effective communication” as; *“any form of public engagement that actually facilitates an intended behavioural, organisational, political or other social change consistent with identified mitigation and adaptation goals”*.

While there certainly has been no shortage in the number of publications that offer “practical” short-lists for effective climate change communication (e.g. Centre for Research on Environmental Decisions, 2009; Climate Change Communication Advisory Group, 2010; Futerra, 2005; Moser, 2010), there is currently no systematic overview of the theoretical and empirical pathways that explain how to get from merely communicating information to actually changing people's behaviour. Moreover, while behavioural change is of course, to a certain extent, a practical matter, a more theory-driven perspective is generally welcomed by behavioural researchers (Steg & Vlek, 2009.) Attaining a more holistic understanding of the link between designing persuasive messages, the communication and processing of that information on one hand and eliciting behavioural change on the other inevitably calls for the integration of insights from all relevant disciplines that deal with the subject matter. Indeed, integrative theoretical research can help synthesise, connect and combine dispersed research findings from various disciplines to advance new insights and improve current knowledge and understanding. Yet, in order to validate the value of a new integrative communication model, it is pivotal to first discuss the theoretical and empirical evidence of past models

as well as their limitations. In an attempt to provide a more systematic overview, the current paper delineates the “evolution” of public climate change campaigns according to the following typology:

- (1) The “*cognitive-analytical*” type (consistent with the traditional knowledge-attitude-behaviour model);
- (2) The “*affective-experiential*” type (congruent with the “risk-as-feelings” model and the use of negative emotional appeals such as “fear” messages); and
- (3) The “*social-normative*” type (consistent with the “normative” paradigm - which seeks to leverage the persuasive potential of social and moral norms on pro-environmental behaviour).

In addition, three major short-comings of past and current public communication interventions are identified:

- (1) Most public interventions ought to be, but are not designed in an integrative manner;
- (2) Current campaigns do not sufficiently target specific behaviours nor do they pay attention to the psychological determinants of the behaviours that they are trying to change; and
- (3) Public campaigns often fail to make the climate change context explicit.

In the first section of this paper, the theoretical and empirical evidence for each of these public communication strategies is critically discussed. In the following section, a more integrated understanding of human behaviour and decision-making is advanced by looking at the combined influence of cognitive, experiential and normative factors on behaviour. In addition, the importance of understanding the psychological determinants of

environmental behaviour is outlined for both, the communication process as well as its integral role in eliciting behavioural change. Finally, a new integrative conceptual framework is proposed in an attempt to advance current understanding of how to transition from merely communicating information about climate change to actually changing individual behaviour.

## **2.0 The Cognitive-Analytical Approach**

### **2.1 The Homo Logicus?**

*“I know that you believe you understand what you think I said, but I’m not sure you realise that what you heard is not what I meant.”*

(Robert McCloskey)

Until recently, the tradition has been to communicate information about climate change in a relatively scientific and analytical format (CRED, 2009), operating under the assumption that people process (uncertain) information predominantly in an analytical matter (Marx et al., 2007). As a result, technical terms such as “stratospheric ozone depletion”, “anthropogenic climate change” and “significant probability” have often been used in communicating information about the long-term developments in the earth’s climate. Yet, whether or not cognitive reasoning abilities in humans are really that well developed is questioned by both comparative neuroanatomical work as well as cognitive psychology. In particular, it has been argued that the “neocortex” (the rational, higher functioning) part of the brain was developed last in the chain of human evolution and is in fact the least developed part of the brain (Maclean, 1990). Similarly, in their heuristics and biases approach, Kahneman, Slovic and Tversky (1982) have highlighted that, when forming judgements under uncertainty, people employ relatively simple heuristics and



cognitive short cuts that may lead to erroneous and biased decision making strategies. In short, recent research has questioned how proficient individuals are in processing abstract and analytical information about climate change (Marx et al., 2007).

Because climate change is such a complex and elusive global hazard, the concept is difficult to communicate to various publics (Moser & Dilling, 2004). This process is even further complicated by the fact that people tend to process information so that it is congruent with their pre-existing beliefs. Selectively attending to evidence that confirms pre-existing beliefs and the negligence, re-interpretation as well as distortion of information to the contrary is generally referred to as “confirmation bias” (Lewicka, 1998). In fact, most information that is eventually retained in an individual's memory tends to be information that supports pre-existing thoughts and beliefs. For example, in one US study increased levels of knowledge seemed to increase concern for some people (e.g. Democrats) but not for those (e.g. Republicans) who were already sceptical about climate change from the outset (Malka et al., 2009).

Similarly, in a study where US farmers were asked to recall weather statistics, those who believed that their region was undergoing climate change recalled weather statistics consistent with those beliefs while farmers that believed that their region had a constant climate recalled weather statistics congruent with those beliefs (Weber & Sonka, 2004). In sum, the way in which people process information and structurally organise their knowledge can have significant impacts on their behaviour. Yet, how do people cognitively understand climate change? And to what extent does more knowledge of the climate change problem affect people’s behaviour?

## 2.2 Information Processing and the Structural Organisation of Knowledge

Cognitive psychologists have often described the way in which individuals process and organise incoming information as an elaborate network of mental structures that represents an individual's understanding of the external world, a notion perhaps better known as "schema theory" (Anderson, 1977). More recently, the study of "mental models" has gained increased attention. Essentially, a mental model is a person's internal, personalised, intuitive and contextual understanding of how something works (Kearney & Kaplan, 1997). What is important to take away from this is that mental models carry three important functions; (1) they serve as a framework into which people fit new information (2) they define how individuals approach and solve problems and perhaps most important (3) they help formulate actions and behaviour (Carey, 1986; Morgan et al., 2002). The majority of research on mental models has identified several fundamental gaps in the public's understanding of climate change.

For example, the American Psychological Association concluded in a recent report that "*the understanding of climate change, both in its causes and in its likely effects by the average citizen around the world is limited*" (American Psychological Association, 2009, p. 21). Nationally representative surveys in the US point out that climate literacy seems to be low in general (e.g. Leiserowitz, Smith, & Marlon, 2010). In particular, people do not seem to understand the human causes that contribute to climate change nor the scientific consensus on this matter (Leiserowitz, 2007). In some cases, people even perceive a few degrees increase in global mean temperature as something rather pleasant, not understanding the potentially large harmful geophysical consequences of such an increase (Meijnders, 1998). Indeed, despite widespread media coverage of climate change, typical mental models tend to suffer from several fundamental misconceptions (Bostrom et al., 1994).

For example, most explanations given of the physical mechanisms underlying climate change are inconsistent and incomplete. Kempton et al. (1995) found that Americans assimilated information about climate change into pre-existing mental models of ozone depletion. In particular, people mistakenly believe that ozone depletion is a cause of climate change (Meijnders, 1998). This is not just the case in the US: a survey performed by GlobeScan in 1999 (covering 25 countries) found that people worldwide (mistakenly) identified “depletion of the earth’s ozone layer” as a main cause. This development has led to much confusion between the two issues. A likely explanation is that the hole in ozone layer has been scientifically well documented over the years and is much easier to imagine and remember (Ungar, 2000). It is interesting to observe that this was pointed out by Bostrom et al. (1994) and by Kempton et al. (1995) and yet again some 11 years later by Lorenzoni et al. (2006), suggesting that despite past communication efforts, this popular misconception still persists.

People also tend to have difficulty understanding the difference between climate change and other environmental problems (Heskes, 1998; Read et al., 1994). In particular, it is hard for people to differentiate between good environmental conduct more generally and specific actions that help reduce climate change. Often measures such as not buying aerosol spray cans, recycling and reducing waste are mentioned as effective strategies for mitigating climate change, possibly because such apposite behaviours are generally known to be harmful to the environment (Bostrom et al., 1994; Leiserowitz, Smith, & Marlon, 2010; Read et al., 1994). In addition, misconceptions about the relative importance of the various causes of climate change are also widespread. Particularly, people tend to overweigh the effects of deforestation and non-recycling and underestimate the effects of fossil fuel consumption (Bostrom et al., 1994; Whitmarsh, 2009). This also becomes evident from the fact that the general public remains mostly

unaware of the link between air travel and climate change (e.g. Becken, 2007; Cohen & Higham, 2011; Gössling et al., 2006; Gössling & Peeters, 2007) and meat consumption and climate change (e.g. de Boer, Schösler, & Boersema, 2012). Furthermore, it would be erroneous to suggest that a flawed understanding of climate change solely exists among the “lay” or general public. In fact, Stermann and Booth Sweeney (2002; 2007) and Stermann (2008) conducted a series of experiments that identified widespread incorrect beliefs about climate change among highly educated MIT science and engineering majors. In particular, the students were unable to correctly describe the process mechanisms that underlie climate change. Stermann and Booth Sweeney (2007) hypothesised that these deep-seated misperceptions arise as a limitation of people’s mental model with regard to concepts of stock and flow in phenomena of accumulation (Stermann & Booth Sweeney, 2007).

In conclusion, while general awareness of climate change is high and occasionally, some local studies find that people are relatively well informed about basic concepts (e.g. Lorenzoni & Langford, 2001; Truelove, 2009), improvement is slow, confusion persists and a more sophisticated public understanding of climate change still appears to be random and inconsistent (Anable, Lane, & Kelay, 2006; APA, 2009). Understanding the way that individuals’ process, classify and organise new information is important because incorrect mental representations of climate change are likely to contribute to a “wait and see” attitude (Xiang, 2011).

### **2.3 Does Knowing Make a Difference? The Relationship Between Knowledge and Behaviour**

Based on a review of the evidence, it would not be unreasonable to conclude that there is still widespread misunderstanding about (1) *the process mechanisms of climate change*,

(2) *its underlying causes* and (3) *effective response behaviours*. In the face of addressing these issues, there are varying theoretical assumptions concerning the role of knowledge in behaviour. Knowledge is often believed to be a background factor that influences a person's attitude toward a certain behaviour (Ajzen, 1991). Given the known association between attitude and behaviour (Armitage & Connor, 2001), knowledge is thus assumed to influence behaviour indirectly.

The idea behind the attitude-behaviour relationship is that the more people know about and understand the connections between their own behaviour and a range of environmental threats, the more likely it is that a person will adjust their behaviour accordingly. Such models essentially assume a linear progression from increased environmental knowledge to a favourable change in one's attitude which in turn is thought to produce a change in behaviour - a framework that has become better known as the "Knowledge-Attitude-Behaviour" (KAB) model (Kollmus & Agyeman, 2002).

While a historically popular theory in social-psychology, the "KAB" model has (recently) received fierce criticism. For example, Bulkeley (2000, p. 314) states: "*recent research challenges the assumption that public confusion and an apparent gap between stated beliefs and action, arises from a deficit in public knowledge and understanding of environment issues*". Similarly, Moser (2006) and Kollmus and Agyeman (2002) criticise information-based campaigns for being too "rationalist" and "outdated".

While it is certainly true that knowledge is a necessary but not sufficient condition for behavioural change, it would be erroneous to suggest that the role of knowledge is outdated or not important. In fact, the role of knowledge in environmental behaviour is important but often underestimated (Kaiser & Fuhrer, 2003), particularly because researchers fail to make a distinction between three *converging* types of environmental knowledge, namely; *declarative* knowledge (i.e. factual knowledge), *procedural*

*knowledge* (i.e. knowledge of appropriate courses of action) and *effectiveness* knowledge (i.e. knowledge of how effective each course of action is). To illustrate, information about the causes of climate change (e.g. CO<sub>2</sub> emissions) can help create a better understanding of appropriate response behaviours (e.g. reducing energy consumption) and vice versa. While Kollmus and Agyeman (2002) state that only a small fraction of environmental behaviour can directly be explained by environmental knowledge, this argument neglects to consider that the effect of knowledge is often overlooked because it is mediated by other important psychological processes (Kaiser et al., 1999).

For example, one of the first studies that systematically reviewed the psychological determinants of environmental behaviour (Hines, Hungerford, & Tomera, 1986) reported positive and significant correlations between environmental knowledge and environmental behaviour ( $r = 0.30-0.37, p < 0.001$ ). Building on their work, a more recent and extensive meta-review conducted by Bamberg and Moser (2007) found these findings (largely) to be still accurate. Other studies have also corroborated these findings. For example, a study by Meinhold and Malkus (2005) supports the theory that there exists a linear relationship between environmental knowledge, attitudes and behaviour. In particular, environmental knowledge was found to moderate the attitude-behaviour relationship, where both strong pro-environmental attitudes and high environmental knowledge predicted significantly more pro-environmental behaviour. Other critics have argued that if individual knowledge about climate change is generally limited then knowledge should not be able to explain much of the variance in response behaviours (e.g. Maibach, Roser-Renouf, & Leiserowitz, 2008).

It is worth noting here that predicting specific climate change mitigation behaviours (e.g. air travel) based on general environmental knowledge and attitudes may sometimes (unsurprisingly) cause distortion in measurements (Bamberg, 2003; Kaiser et

al., 1999; Whitmarsh, 2009) - as someone can hold general pro-environmental knowledge and beliefs but still maintain different attitudes toward specific behaviours. For these reasons, it is perhaps more appropriate to review to what extent knowledge about climate change is able to predict specific climate change mitigation behaviours. To this extent, some evaluative studies have found that general knowledge about climate change is only weakly related to actual self-reported behaviours (e.g. Staats et al., 1996)

Yet, research by Bord, O'Connor and Fisher (2000) and O' Connor et al. (1999) provides evidence that knowledge is in fact an important predictor. In both studies, knowledge about climate change was an independent predictor of behavioural intentions (even after controlling for general environmental attitudes). In fact, knowledge was the strongest relative predictor of intentions, explaining 11 per cent of the variance to take voluntary action and 20 per cent of the variance to support new government policies (Bord, O'Connor, & Fisher, 2000). Similarly, Ngo, West and Calkins (2009) also found that knowledge successfully predicted a range of climate change mitigation behaviours.

While knowledge of climate change *impacts* has also been implicated in eliciting behavioural change (e.g. Nilsson & Kuller, 2000), Truelove (2009) found that knowledge of appropriate *response behaviours* was the strongest predictor of mitigation intentions. Similarly, research by Semenza et al. (2008) and Hounsam (2006) found that the most popular self-reported barrier to behavioural change was the fact that people did not know how to change their behaviour to reduce their own contribution to climate change.

In conclusion, knowledge can be considered a necessary (but not sufficient) condition for behavioural change, given that knowledge about the causes, impacts and solutions to climate change have all been implicated as significant predictors of behavioural outcomes. However, differences in measurement (e.g. self-reported vs. actual knowledge, intention vs. behaviour) make a clear assessment more difficult. Moreover, in

order to fully leverage the effect of knowledge on behaviour, different forms of knowledge must converge (Kaiser & Fuhrer, 2003). Thus, popular recommendations that public campaigns should prioritize one type of knowledge (e.g. response strategies) over another (e.g. causes) should be exercised with caution as, in some cases, such a strategy is likely to neglect the interdependent relationship between different knowledge structures.

### **3.0 The Affective-Experiential Approach**

#### **3.1 The Homo Expertus?**

*“A man who carries a cat by the tail learns something he can learn in no other way.”*

(Mark Twain)

What Mark Twain jokingly points out is an important fact of life: knowledge and cognition can only do so much for human learning and understanding. Humans have inherited a well-equipped sensory system, and, through interaction with our natural and social environments we are able to learn and understand things in a way that abstract knowledge is unable to provide. While traditional knowledge based approaches assume that the public is not changing their behaviour because they fail to understand the issue (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007), scholars are increasingly pointing out that scientific narratives are unlikely to elicit more engagement (Hargreaves et al., 2003), particularly because of the “yawn factor” that science tends to have on non-experts (Abbasi, 2006). In addition, recent studies have shown that climate change is a temporally and spatially distant concept for most people (Maibach, Roser-Renouf, & Leiserowitz, 2008; O’Neill & Nicholson-Cole, 2009; Spence, Poortinga, & Pidgeon, 2012).

One reason for this is that individuals have difficulty visualizing future periods (Tonn, Hemrick, & Conrad, 2006). For example, a study by O’Neill and Nicholson-Cole



(2009) indicated that respondents could not really articulate what climate change might mean for the United Kingdom. Individuals also tend to display an unrealistic sense of optimism (Weinstein, 1980), particularly to the extent that climate change is likely to affect others (e.g. the third world) but not the individual in question (O'Neill & Nicholson-Cole, 2009). Because climate change cannot be experienced directly, it is likely that individuals will continue to distance themselves psychologically from the issue (Lorenzoni & Pidgeon, 2005). Yet, a study covering 34 countries found that the majority of people in each country believed that climate change was a somewhat to very serious problem (GlobeScan, 2000). In 2006, GlobeScan repeated the study and found that the percentage of respondents that believed that climate change was a “very serious threat” increased significantly in most countries (GlobeScan, 2006). Similarly, studies conducted in the EU and UK also indicate that over 80 per cent of respondents reported to be “concerned” about climate change (e.g. Poortinga et al., 2006; Eurobarometer, 2011).

Yet some researchers have argued that there is an issue with the way this apparent “concern” is conceptualised. Because there is no one coherent method of how an individual’s risk perception is assessed, measures vary greatly and the terms “concern”, “worry” and “perceived seriousness” are often used interchangeably. Yet, the literature often fails to note that these terms mean slightly different things. To illustrate, it is possible to have general concern for an issue without actively worrying about it. Worry is then considered to be a much more active emotional state and a stronger predictor of behaviour than either “concern” or perceived “seriousness” (Leiserowitz, 2007). For example, a survey by the Pew Global Attitudes Project (2006) found that, while varying among countries, personal levels of worry about climate change are generally lower than perceived seriousness or general stated concern.

Thus, while general concern about climate change seems to be well established among the general public, the same cannot be said for personal worry. Furthermore, it is also questionable whether this concern is related to the perception that climate change is an urgent or high-priority problem. For example, while many people are concerned about climate change, they rank it as less important than many other societal issues such as terrorism, health care and the economy (Krosnick et al., 2006). Similar evidence is provided by Poortinga and Pidgeon (2003), based on 1,547 face-to-face interviews the researchers found that while there was some moderate concern for all environmental risks mentioned in the study, climate change was ranked among the least important issues. This evidence leads to the conclusion that although general concern is expressed, there is also a dominant belief that climate change is a distant, non-urgent and non-personal threat (Darnton, 2005), possibly hindering proactive behavioural responses (Lorenzoni & Langford, 2001). These findings have lent support for the hypothesis that if general concern can be transformed into personal worry then perhaps people are more likely to change their behaviour accordingly.

### **3.2 Risk as Feelings**

It has become increasingly apparent that individuals have a hard time relating to technical, descriptive and abstract risk messages. In fact, the public may not act upon simple information about probabilities unless this information is given emotional meaning (Slovic et al., 2004). Accordingly, converging evidence from cognitive, social and clinical psychology has strongly indicated that human perceptions of risk (across domains) are very much influenced by affective and emotion-driven processes (e.g. Chaiken & Trope, 1999; Epstein, 1994; Loewenstein et al., 2001; Sloman, 1996; Slovic et al., 2006; Weber, 2006). At this point it is perhaps warranted to make a conceptual distinction between

“emotion” and “affect”. While specific definitions may vary, an emotion can generally be understood as; “*a complex state of feeling that results in psychophysiological changes that influence thought and behaviour*” (Myers, 2004, p. 500). Emotions are relatively transient and often manifest in a specific feeling-state, such as fear or happiness. *Affect* is a more subtle form of emotion that specifically refers to an evaluative and associative response (positive/negative) towards an external stimulus (Slovic, 1999). For example, affective images can be regarded as a broad construct to which positive and negative feeling states have become attached through learning and experience (Slovic et al., 1998, p.3). To illustrate, most people have an immediate (negative) associative reaction to the word “nazi”. In short, while emotions are complex feelings that cause psychophysiological changes, affect is often conceptualised as a rather fast, specific and automatic evaluation of a stimulus object.

In the context of climate change, Leiserowitz (2006) and Smith & Leiserowitz (2012) found that negative affect and imagery toward climate change were the strongest predictors of risk perception. More specifically, the research indicated that people tend to have strong negative affective associations with the term “global warming”. Similar findings were reported in a study by O’Neill and Nicholson-Cole (2009): while respondents seemed to have a wide range of imaginations and mental visions related to global warming, most of them were negative and bleak.

Yet, to what extent do (negative) affect and emotions influence willingness to help reduce climate change? According to Böhm (2003), environmental behaviours are guided by so-called “prospective” and “retrospective” consequence based emotions, such as fear and worry, which also happen to be the most intense emotions associated with environmental risks. In fact, Böhm and Pfister (2001) theorised that fear and worry over negative consequences should lead people to prevent or reduce environmental damage. In

line with this train of thought, a large amount of research has been geared towards eliciting a sense of “risk” - with the underlying hope that fear will serve as a motivator for behavioural change.

### **3.3 The Link Between Personal Experience, Risk Perception and Behavioural Change**

While it is well known that emotions are an important and significant predictor of environmental behaviour in general (Grob, 1995; Maloney, Ward, & Braucht, 1975), less is known about the specific relationship between experience, emotion, risk perception and behaviour in the context of climate change. Direct experience is thought to influence risk perception and behaviour (Whitmarsh, 2008), in particular, because experiences can invoke strong memorable feelings, possibly making them more dominant in processing (Loewenstein et al., 2001). Consider an individual that encounters an approaching tornado. Such a direct threat can elicit strong instinctive emotions such as fear and anxiety that subsequently guide immediate behaviour (i.e. the so-called *fight-flight response*). These instinctive emotions primarily arise in the brain’s limbic system, an evolutionary older part of the brain that guides behaviour through fast and automatic responses, especially in reaction to threats (Maclean, 1990).

Yet, it is unclear to what extent this model applies to the context of climate change. For example, a sensible response to living in a hurricane prone region would be moving away from the danger zone or perhaps buying flooding insurance (i.e. adaptation measures). In fact, the goal of the response behaviour is to deal with / mitigate immediate threats (not climate change as a broader concept in itself). It is not at all obvious that whenever a person's town or house floods, that person is actively going to diminish his or her carbon footprint in response, unless that person explicitly links the flooding event to

climate change (Helgeson et al., 2012) - which is not always the case. For example, a study by Whitmarsh (2008) reported no difference in risk perceptions of climate change between respondents that had experienced flooding before and those who had not.

Yet, people who live in low-lying coastal areas do tend to have a heightened sense of personal risk (Brody et al., 2008) and a recent study by Spence et al. (2011) did find that past flooding experiences were significantly related to increased preparedness to reduce energy use. In particular, past flooding experiences mediated onto level of concern and perceived local vulnerability, which in turn, increased individual preparedness. Moreover, a significant amount of studies indicate that risk perception is an important predictor of individual willingness to help reduce climate change (e.g. Heath & Gifford, 2006; Hidalgo & Pisano, 2010; Leiserowitz, 2006; Ngo, West, & Calkins, 2009; O' Connor et al., 1999; Semenza et al., 2008). Yet, a second issue revolves around the idea that even if direct experience does matter, there is a disassociation between the cognitive information that informs individuals that there is in fact a risk to be worried about and the inability for many people to observe or experience this risk in their direct environment (Weber, 2006). This lack of personal experience with the potentially negative consequences of climate change is causing a lower level of individual concern than advisable (APA, 2009; Weber, 2006). Thus, although "experience" may indeed raise a person's sense of concern to what is considered a more appropriate level of "worry", direct experience with the impacts of climate change is generally lacking.

A potential solution to this problem has been to try and inflate personal worry among the general public through measures that do not require actual personal experience. One such measure is the use of negative emotional messages, particularly "*fear-appeals*" (Stiff & Mongeau, 2003). The use of fear appeals has gained popularity in climate change communication (Moser & Dilling 2004; O'Neill & Nicholson-Cole,

2009), as the advertisement of extreme events is thought to do better than the idea of slow on going change (Brönnimann, 2002). To understand why fear appeals are often believed to work (at least in theory) it is helpful to briefly consider the development of various theories in the field of persuasive communication.

To start with, the experience of “fear” is a negatively valenced emotion accompanied by a high level of arousal, elicited by a threat that is perceived to be significant and personally relevant (Witte, 2000). In particular, fear appeals are a method of communication that attempts to influence attitudes and behaviours through the threat of some danger (Tanner, Day, & Crask, 1989). A large amount of research has been performed over the years concerning the role of negative threat-related emotion in communication, largely inconclusive about its general effectiveness. One of the earliest theories on fear appraisal was put forth by Janis (1967), who proposed that the relation between fear and attitude change is curvilinear (U shaped). In effect, the theory suggests that moderate levels of fear are more persuasive than lower or higher levels. More specifically, Janis’s drive theory argues that fear arousal is needed to elicit a motivational drive state (i.e. tension) that individuals will then seek to resolve.

From this point of view, for fear-appealing communication to be persuasive two requirements have to be met; (1) the level of fear induced by communication must be sufficiently high to function as a drive state and (2) recommendations have to be included in the communication as to how to reduce this drive state. Unpleasant emotional tension can be resolved by individuals through either “adaptive responses” (i.e. useful behavioural changes) or through “maladaptive responses”. For example, Leventhal (1970) made a distinction between an internal “fear control” process and an external “danger control” process. Maladaptive behaviours are targeted at controlling the fear response (e.g. through denial) but they often leave the actual threat (e.g. climate change) intact.

Rogers' (1975, 1983) protection motivation model (PMM) has arguably been one of the most applied theories to understanding fear appeals (Witte, 1992). The PMM states that a threat related message will only be effective if (1) it convinces the reader that he or she is seriously threatened (threat appraisal) and (2) actually capable of averting the threat (coping response). In particular, Rogers (1983) postulated that people continue to engage in maladaptive behaviours (e.g. “energy consumption”) if the rewards (convenience) of that behaviour exceed both the perceived severity of the threat (e.g. climate change) and the individual’s perceived susceptibility to that particular threat (low). The intention to protect one’s self then depends on four factors: (1) a threat’s malignancy (2) its probability of occurrence, (3) the effectiveness of a coping response (i.e. response efficacy) and (4) an individual’s ability to perform the response (i.e. self-efficacy).

### **3.4 Scaring People, Does It Work?**

Empirical evidence supporting either Janis (1967) or McGuire’s (1969) model has been lacking (Higbee, 1969; Sutton, 1982). Furthermore Leventhal’s (1970) and Roger’s (1975) models have been criticized for being imprecise (e.g. Witte, 1992). In general, the empirical evidence for the “fear” approach is mixed. While some meta-reviews point out a positive linear relationship between level of fear and a change in behavioural outcomes (Boster & Mongeau, 1984; Sutton, 1982), this does not mean that a curvilinear relationship should be rejected (Meijnders, 1998). More generally, Boster and Mongeau (1984) found that fear appeals are modestly correlated with attitudes and to a lesser extent with intention and behaviour. Overall, it is generally agreed upon that without *efficacy* messaging (i.e. an individual’s perceived capability to avert the threat), fear appeals tend to be backfire (O’Neill and Nicholson-Cole, 2009). Indeed, if anything can be learned from 50 years of research, it is that *strong fear appeals with high efficacy messaging*

produce the highest level of behavioural change whereas *strong fear appeals with low efficacy messaging* produce the most maladaptive responses (Witte, 2000).

However, much of the research on fear appeals has focused on health risks, which are both personal and direct (de Hoog et al., 2005) - two important conditions that are (perceived to be) absent in the context of climate change. Yet, there is some evidence available on the use of fear appeals in the context of climate change. For example, Meijnders et al. (2001a, 2001b) found that moderate fear messages related to global warming induced more systematic processing of the perceived risks as well as more favourable attitudes toward energy conservation (when compared to the low-fear condition). Lowe et al. (2006) carried out a pre/post-test study after individuals had watched the climate change disaster movie "*The Day After Tomorrow*" (Emmerich, 2004). Although a majority of the respondents (67 per cent) were in agreement that everyone needs to do something about climate change, this sense of urgency quickly faded in a focus group meeting a month after the screening.

Yet, very different results were presented by Leiserowitz (2004). In a similar study concerning the same movie, the author found that movie-watchers versus non-watchers showed higher levels of both concern and worry, estimated various impacts on the US more likely and significantly increased their intentions (in all stated categories) to engage in personal action to address climate change (Leiserowitz, 2004). Similarly, Jacobson (2011) used a spatial-econometric analysis to measure increases in the purchase of voluntary carbon offsets within a 10 mile radius of US movie theatres after the release of Al Gore's "*An Inconvenient Truth*" (Guggenheim, 2006). Shortly after its release, purchases of carbon offsets went up by 50 per cent, yet no renewals were recorded in subsequent years.



O'Neill and Nicholson-Cole (2009) conclude that dramatic, sensational, fearful and shocking representations of climate change (both visual and iconic) can successfully capture people's attention and drive a general sense of urgency to the issue (O'Neill & Nicholson-Cole, 2009). Yet, the same researchers also found that while capturing attention and raising concern, fear messaging disengages people from climate change and renders them feeling hopeless and overwhelmed. The authors further mention that catastrophic and fearful representations of climate change are unlikely to motivate a sense of personal engagement and can possibly trigger psychological barriers such as anxiety, apathy, paralysis and denial (Lorenzoni et al., 2007; Moser & Drilling, 2007).

Consistent with these claims, other research has found that fear messaging can have different impacts on different audiences. For example, individuals with strong "just-world" beliefs tend to resort to maladaptive responses (e.g. denial) when faced with fear-messages about global warming, which negatively affects their intention to help reduce climate change (Feinberg & Miller, 2011). The authors recommend that messages should include sufficient information on potential solutions, which is consistent with the idea that a message is more persuasive when negative emotions about one's vulnerability are coupled with positive thoughts about potential solutions (Das, de Wit, & Stroebe, 2003).

All in all, these findings point to one (of several) potential problem(s) that characterize the "fear" approach. To start with, it is likely that fear appeals have a rather short-term effect. In fact, Weber (1997) coined the term "single action bias" to explain the tendency for individuals to only take a single action to reduce a perceived threat and subsequently neglect further steps that would provide incremental protection. For instance, a 2008 poll in the United States indicated that while 28 per cent of Americans thought the environment was getting better, after having elected President Barack Obama in 2009, this number rose to 49 per cent (Silver, 2009). A possible explanation for the

single action bias is that the first measure people take often sufficiently reduces the active level of worry / vulnerability. An additional shortcoming is that fear appeals offer diminishing returns (Hastings et al., 2004). That is, communicators run the risk of desensitising or “emotionally numbing” people to the risks involved, as familiarity with a risk reduces its salience (Fischhoff et al., 1978). Furthermore, the “*finite pool of worry*” hypothesis states that people can only worry about a limited number of problems at any given time. As a result, increased concern for one risk (e.g. economic crisis) might decrease concern for other risks such as climate change (Hansen, Marx, & Weber, 2004).

In conclusion, “fear as a motivator” should be used with caution (Futurra, 2005). While fear messaging can definitely serve a particular function (e.g. capturing attention and breeding concern), it is often difficult to retain such level of interest and arousal as people need a reason to stay engaged and often quickly shift their attention. Furthermore, when using narratives of an impending “catastrophic” and “looming disaster” without promoting actions that can help reduce the threat, fear messages are likely to trigger maladaptive responses and leave people feeling disempowered and disengaged. In the words of O’Neill and Nicholson-Cole (2009): “depicting a state of crisis does not sit comfortably with the suggestion of individual action” (p. 376).

## **4.0 The Social-Normative Approach**

### **4.1 The Homo Sociologicus?**

*“No man is an island, entire of itself; every man is a piece of the continent, a part of the main.”* (John Donne)

In addition to cognitive and experiential processing, human behaviour is also shaped by a wide range of normative factors. In fact, social-psychological research that explores the

effect of social influences on behaviour is pervasive - as it is through social comparison with referent others that people validate the correctness of their opinions and decisions (Festinger, 1954). People derive descriptive and prescriptive social norms from observing others, apply a logic of appropriateness in unfamiliar situations (March, 1994) and unsurprisingly, tend to behave as their friends and peers (Cialdini et al., 1999).

There are many examples of how social factors influence environmental behaviour. For example, people's energy use tends to decrease when they are told that their neighbours are conserving energy as well. People tend to alter their use of energy more generally to conform to the group-norm (e.g. Schultz et al., 2007). Usually a distinction is made between *descriptive* and *prescriptive* social norms. While prescriptive norms contain information about how others think someone *ought* to behave, descriptive norms merely *describe* how others are behaving (Cialdini et al., 1991). When communicating social information it is important to understand the relationship between these two concepts. For example, merely describing that CO<sub>2</sub> emissions are increasing because a lot of people are choosing to fly short distances instead of using alternative modes of transportation (a *descriptive* norm) may have unintended effects if it is not clearly mentioned that this behaviour is in fact undesirable (*prescriptive* norm). In other words, it should be made clear that people *ought* to avoid flying short distances, otherwise the message is easily misread as; "*it's okay because everyone's doing it*".

Another important question is how moral norms are theoretically distinct from social norms. Moral norms refer to the idea that some behaviours are just inherently right or wrong regardless of their personal or social consequences (Manstead, 2000). While there certainly is a strong link between social and moral norms, it is nevertheless possible that a person's moral convictions do not coincide with the expectations that exist in that person's social environment. One way to think of the relationship between these two

concepts is that both cultural and social learning play an important role in acquiring moral beliefs (Krebs & Janicki 2002), as social reference groups deliver standards for what is viewed as right or wrong. It is over time, when people have internalized a social norm that it becomes a (personal) moral norm (Manstead, 2000).

Moral norms are then considered to be the link between internalized (general) values and more specific opinions and expectations about how to behave in a tangible situation (Schwartz, 1977). Thus, even although moral norms may originate from social group norms, once they have become internalised, they exercise influence over an individual's behaviour independently from any immediate social context (Manstead, 2000; van der Linden, 2011). Similarly, Bicchieri (2006) highlights that while social norms are followed conditionally upon the satisfaction of expectations of others, moral norms are followed unconditionally based on internal (emotional) processes.

Moral norms are often assumed to play a central role in explaining pro-environmental behaviour. A particularly influential framework is Stern et al.'s (1999) *Value-Belief-Norm* (VBN) theory. According to the VBN, people's motivation for caring about the environment can be traced back to a specific set of personal values. For example, someone could be aware of the potentially negative consequences of climate change because they wonder how it might affect them personally (i.e. *egoistic values*), how it will affect other humans (*altruistic values*) or how it will affect the earth more generally (*biospheric values*). These values are then thought to influence more specific belief structures about human-environment interactions (a person's ecological worldview) which in turn determines the extent to which people are *aware of (adverse) consequences* (AC) and *ascribe responsibility to their own actions* (AR) – eventually leading to the activation of an individual's moral norm, which, according to the VBN, is thought to be the main driver of pro-environmental behaviour.

## 4.2 Evidence for the Role of Normative Influences on Environmental Behaviour

Empirical evidence for the persuasive power of normative influences on environmental behaviour is growing. A frequently quoted study is that of a conservation experiment on hotel towel reuse. In the experiment, a simple “normative” prompt (i.e. *“75 per cent of guests in this room reuse their towel when asked”*) significantly increased the reuse of towels (Goldstein, Cialdini, & Griskevicius, 2008) - illustrating how the communication of simple social information can induce behavioural change. In fact, a range of other studies that have used social norm manipulations in the context of energy conservation have showed similar positive results (e.g. Dolan & Metcalfe, 2012; Schultz et al., 2007).

In addition to social pressure, moral norms are an equally (if not more) powerful tool for encouraging pro-environmental behaviour (Markowitz & Shariff, 2012). To this extent, a recent field experiment by Bolderdijk et al. (2013) set out to explore what message frame is most successful when asking drivers to pull over to get their tire pressure checked. Results strongly indicated that a moral message frame was most effective (i.e. compared to financial incentives). Similarly, other recent research has found that both moral and social norms are significant predictors of consumer decisions to purchase carbon offsets (Blasch & Farsi, 2012). Yet, there are a number of problems inherent to the “normative” approach. First, observed effect sizes are typically small and short-lived (John et al., 2011). The latter is particularly true for social norms, since they are conditional upon the existence of exogenous social pressure (extrinsic motivation) while moral norms elicit motivation through internal processes (i.e. intrinsic motivation).

A second problem concerns the use of “guilt appeals”. Guilt usually arises as a result of violating some moral or social norm (Baumeister, 1998). In theory, guilt is thought to be a motivator of pro-environmental behaviour because it often leads to a moral obligation to compensate for any caused damages (Bamberg & Möser, 2007).

Studies show that under certain conditions guilt can be effective in changing behaviour (O'Keefe, 2002) and some support is found in the context of climate change. For example, Ferguson and Branscombe (2010) illustrate that feelings of guilt mediated beliefs about global warming and willingness to engage in mitigation behaviours. Truelove (2009) comments however, that similar to “fear appeals”, the associated drawbacks are plentiful. One concern is the risk of eliciting negative emotions (such as anger toward the guilt-inducer), which could potentially undermine the technique's overall effectiveness.

It is also interesting to note that in survey studies, social norms are often identified as one of the weakest predictors of behaviour (e.g. Armitage & Connor, 2001). A potential explanation for this is that it may very well be the case that the effect of social norms on behaviour is systematically underdetected – mainly, because people display a strong tendency to underestimate the extent to which they are subject to social influences (Griskevicius, Cialdini, & Goldstein, 2008). Yet, in a similar manner it can be argued that the effects found in many experimental studies are simply the result of artificially induced social pressure. In fact, it is crucial to understand that in order for social norms to affect behaviour, they must first be activated and made salient (Cialdini et al., 1999).

Unfortunately, strong social norms are generally absent for most pro-social behaviours (van der Linden, 2011). In fact, negative social identities associated with performing “unsustainable” behaviours are currently not very well articulated. Thus, throwing a “few numbers” at people for social comparison purposes is not going to have much effect when there is no negative social identity to leverage in the first place (Corner, 2011). As a result, while social and moral norms may affect behaviour, in order to leverage their full potential, a strong pro-environmental norm must be established first. Several governmental advisory bodies have recently advised the UK government to use more “deep-frames” in their communication. This entails a community-based approach

where the discourse is shifted from “you” to “we” and from “I” to “us”, encouraging the elicitation of moral values, collectivism and social identity (CCCA, 2010). For example, the UK government is currently actively trying to harness the persuasive potential of social norms in their design of large-scale behavioural change campaigns (Cabinet Office, 2011). Yet, at the time of this writing, rigorous empirical evaluations remain elusive.

## **5.0 Towards a new framework for communicating climate change**

### **5.1 An Integrated Understanding: Theories of Dual-Processing in the Brain**

*“Information’s pretty thin stuff unless mixed with experience”*

(Clarence Day)

So far, all three major approaches to public climate change campaigns have been considered in isolation. Yet, cognitive, experiential and normative influences do not affect human behaviour independently of each other - on the contrary, most behaviour is the result of carefully integrated neurological processes. The ancient Greek philosophers Plato and Aristotle long debated the intricacies of the fine line between passion and reason and ever since, a substantial amount of research in social, cognitive and neuropsychology has lend its support for a theory of “dual-processing” in the brain (Pessoa, 2008). Either a distinction is made between *cognitive* and *affective* processing (e.g. Damasio, 1994; Epstein, 1994; LeDoux, 1996; Zajonc, 1998) or between *controlled* and *automated* processes (e.g. Kahneman, 2003; Schneider & Shiffrin; Sloman, 1996).

It is important to realise that these processing systems do not function independently of each other. Instead, they operate in parallel and continuously interact with each other, where higher analytical reasoning may evoke strong (primal) emotions and simple

reflexes can be triggered by higher functioning neocortical processes (Marx et al., 2007; Weber, 2006;). In fact, rational decision making cannot be effective unless it is guided by emotion and affect (Damasio, 1994, 1999), moreover, without emotions, humans are not able to learn effectively at all (Baumeister & Bushman, 2008). While dual-process theories aid conceptual understanding, they often provide an overly simplified understanding of neurological functioning. Cameron, Loewenstein and Prelec (2003) present a more useful categorization of human neural functioning (Table 2.1):

**Table 2.1: Categorisation of Human Neural Functioning**

	<b>Cognitive Processes</b>	<b>Affective Processes</b>
<b>Controlled Processes</b> (e.g. effortful, evoked deliberately, serial)	I	II
<b>Automated Processes</b> (e.g. effortless, reflexive, parallel)	III	IV

*Note:* Adopted from Cameron, Loewenstein and Prelec (2003)

To illustrate how these four quadrants (Table 2.1) operate in relation to everyday consumer behaviour, consider the following example: let's assume that a customer walks into a travel agency and wants to book a well-deserved exotic vacation. Upon entering the store, the customer's attention is immediately drawn to a big fancy flyer displaying the ultimate vacation, including a sunny location, palm trees, white sandy beaches and a breath-taking turquoise sea. The brain's motor cortex will guide that person's arm to reach for the flyer drawing on two processes, namely the *cognitive and automatic* quadrant III



(reaching) and the *affective and automatic* quadrant IV (pleasure and enjoyment). However, at the same time higher level processing might occur in the brain. For example, it could be that this particular person has recently been exposed to a documentary on sustainable tourism and anticipates that going on this holiday would perhaps disappoint important family members who recommended watching the documentary. These processes (*explicit memory*) and anticipation (*planning*) draw on two areas of the brain; the hippocampus and the prefrontal cortex, which are involved in *controlled cognitive* (quadrant I) and *controlled affective* (quadrant 2) processing.

To keep things relatively simple, no social context was made explicit. Yet, it should already become clear from this hypothetical example that in most realistic decision-environments, all four neurological quadrants can potentially be activated (and interact) in a matter of seconds. A clear implication of a more advanced understanding of human behaviour is that in order to make communication efforts more effective, substantial efforts should be directed towards integrating *cognitive, experiential* and *normative* aspects of climate change communication. Particularly, increased cognitive understanding can help make behavioural change more sustainable in the long-term while experiential approaches can help elicit affective associations and facilitate learning and understanding through visualisation of the information presented.

For example, research by Marx, Shome and Weber (2006) indicated that people retain more factual information about climate change when that information is presented in an experiential format. In addition, the overall message should be designed and framed in a context that illustrates that other people are also acting sustainably and that a strong pro-environmental norm is both expected, desired and rewarded. In conclusion, knowing how information is processed and integrated in the brain and subsequently affects behaviour should lead to the understanding that communication designs that take into

account positive interactive feedback loops between, cognitive, experiential and normative processes are likely to be more effective than “either / or” type strategies.

## **5.2 The Pivotal Role of Determinants of Behaviour in Communicating Change**

While the previous section has established that cognitive, experiential and normative processes often operate simultaneously and affect environmental behaviour in an integrative manner, the relative importance (or contribution) of each factor is not always known. To this extent, it is useful to introduce a distinction between *theories of change* and *models of behaviour* (Darnton, 2008; van der Linden, 2013a). While “models of behaviour” aid in understanding specific behaviours by identifying the underlying psychological factors that influence them, “theories of change” show how behaviours can be changed and / or change over time (Darnton, 2008). Thus, while theories of change generally describe more conceptual and generic processes, models of behaviour are diagnostic and help illuminate the psychological determinants that explain and predict a given behaviour. For example, both the role and relative importance of cognitive (knowledge), experiential (affect) and normative (moral norms) factors in predicting and explaining transport behaviours is currently an active area of research (e.g. see Bamberg & Schmidt, 2001, 2003; Bamberg, Hunecke, & Blöbaum, 2007; Steg, 2005).

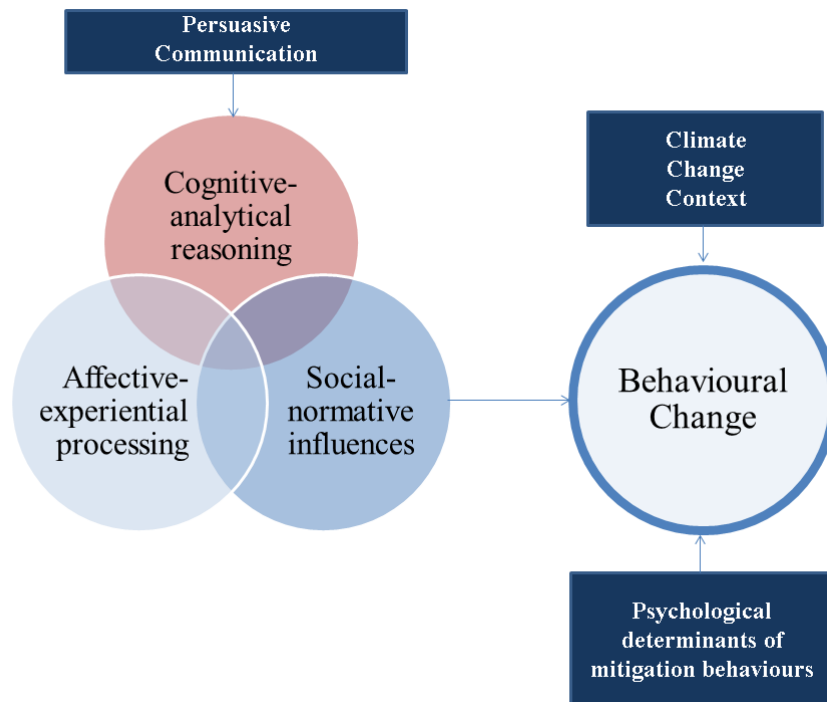
It should be noted that while theories of change and models of behaviour have distinct purposes, they are also highly complementary. In fact, it is argued here that the ineffectiveness of climate change campaigns can, in part, be attributed to the fact that most public climate change interventions pay little to no attention to the psychological determinants of the behaviours that they are trying to change. For example, public campaigns that promote sustainable lifestyles and ‘good environmental conduct’ across the board (e.g. Doyle, 2011) do not take into account the determinants of pro-

environmental behaviour. When campaigns do get specific, for example, in the case of meat consumption (Meat Free Monday, 2010; Peta2, 2008), little attention is paid to the social-psychological determinants of the behaviour under consideration.

In fact, a report by the Government Communication Network (2009) points out that attaining a better understanding of how relevant behaviours are determined and influenced should be considered a prerequisite for the design of effective communication campaigns (GCN 2009). It is important for evaluators to not only look at behavioural outcomes, as it is from studying the psychological determinants of behaviour that we learn why certain interventions were successful or not (Steg & Vlek, 2009). In short, successfully trying to change any given behaviour involves a thorough understanding of all the factors that determine and influence the behaviour under investigation.

### **5.3 A New Framework for Communicating Climate Change**

A conceptual framework to help guide the design of public climate change campaigns is presented in Figure 2.1. The central argument behind the framework is that persuasive communication is only persuasive (i.e. likely to elicit behavioural change) if it is based on an integrated understanding of the psychological processes that underlie and influence pro-environmental behaviour. In order to achieve this, three criteria need to be met; (1) interventions should design *integrative* communication messages that appeal to cognitive, experiential as well as normative dimensions of human behaviour, (2) the *context* and *relevance* of climate change needs to be made explicit and (3) *specific* behaviours should be targeted, paying close attention to the psychological *determinants* of the behaviours that need to be changed.



*Figure 2.1: An Integrated Framework for Public Communication Interventions.*

To illustrate that little of these criteria are typically met in practice, consider the following three illustrative cases. One large-scale climate change information and awareness campaign was conducted in the Netherlands in 1996 and evaluated by Staats et al. (1996). The campaign employed a wide range of media tools, including billboards, posters, television commercials and information pamphlets. The aim of the campaign was to raise knowledge and awareness about the causes, consequences and solutions to climate change. Two strong points of the campaign were the explicit focus on climate change and a link was made between the greenhouse effect, climate change and relevant behaviours. Nevertheless, being one of the earlier campaigns, the intervention was nearly entirely focused on cognitive information and knowledge based factors (although some imagery was used to symbolically illustrate the greenhouse effect). Yet, only marginal focus was applied to “affective/experiential” processes and no attention was paid to “normative” influences. In fact, in their evaluation, Staats et al. (1996) highlight that the

disappointing results of the campaign can be attributed to the fact that little attention was paid to social factors. In addition, no effort was made to study the psychological determinants of the target behaviours.

More than 10 years later, the “Act on Co2” (2009) campaign in the UK featured an advertisement where a little girl is read a scary bedtime story by her father about the potentially horrible consequences of climate change. While the commercial did feature some knowledge/information, the content was predominantly controlled by a “fear frame” - focusing on the negative, scary and threatening consequences of climate change in the form of a cartoon that depicted “climate monsters” and drowning people. The cartoon implied that a “happy ending” is uncertain (hinting that a happy ending is dependent on people changing their behaviour). Falling prey to all the common pitfalls associated with the use of guilt and fear appeals (see section 3.3), the advertisement was not well received by the public as thousands of complaints were submitted to the UK Advertising Standards Authority (Sweney, 2010). The focus of the commercial was predominantly geared towards the affective and experiential domain of human behaviour, neglecting both normative influences on behaviour as well as important informational aspects. While a link between climate change and energy consumption was made explicit, no attention was paid to the psychological determinants of the behaviours in question.

Finally, more recently, the American 'Wasting Water is Weird' (2011) video campaign was released featuring a character called “*Rip*”. In the video, the Rip character visits people that are clearly wasting water (e.g. brushing their teeth with the tap running) and sarcastically illustrates that “they're weird” for wasting water. By trying to create a negative social identity around the notion of wasting water, the campaign fully relies on leveraging normative influences on behaviour. Thus, while zooming in on a particular behaviour (e.g. dishwashing), a major drawback of the campaign is that no attention is

paid to cognitive or experiential processes and no explicit contextual link is made in the videos to climate change. It is important to make the climate change context *explicit*, primarily because if people engage in conservation behaviours for hedonic or cost reasons, they are likely to stop doing so once the behaviour is no longer attractive or cost-effective, whereas environmental motives have proven more robust against such changes (Steg, 2008). Finally, no effort was made to research the psychological determinants of, for example, residential water usage. If research had been conducted, it perhaps would have been more apparent that providing information on alternative courses of action is an important aspect of trying to change behaviours that have a strong habitual component, such as residential water consumption (Gregory & Di Leo, 2003).

In conclusion, climate change campaigns often adopt an “either / or” approach, appealing to only one aspect of human behaviour, thereby failing to consider other important psychological processes. Unsurprisingly then, on the whole, evaluations of past public climate change campaigns have been disappointing at best (O’Neill & Hulme, 2009; Steg, 2008). Figure 2.1 illustrates that in order for communications to be *persuasive*, they should take into account the interrelation between cognitive, experiential and normative influences on behaviour. Recent experimental evidence supports this notion. For example, Dolan and Metcalfe (2012) comment that little is known (empirically) about the interaction between social norms and basic information provision. Based on a large-scale energy conservation study, the authors concluded that, compared to only using a social norm prime, providing information *alongside* social norm messages was key to the success of the behavioural change intervention - nearly doubling the rate of energy conservation (Dolan & Metcalfe, 2012). These findings are corroborated by other recent experimental evidence, which has shown that providing people with information on the negative (environmental) impacts of bottled water consumption is

much more persuasive when preceded by “social proof” that referent others are changing their behaviour as well (van der Linden, 2013b). Similarly, a recent field study by De Groot, Abrahamse and Jones (2013) showed that the *combination* of different normative appeals reduced the use of plastic bags in supermarkets significantly more compared to when the messages were administered individually.

It is no surprise that integrating these theoretical dimensions can help guide the practical design of public climate change interventions. To illustrate, consider that it is well documented that human attitudes encompass both cognitive and affective dimensions (Albarracín et al., 2005), especially in the context of climate change (Lorenzoni et al., 2006). As a result, creating negative attitudes towards climate change draws on the interaction of both cognitive and affective processes. In addition, while knowledge about the potential consequences of climate change has been implicated in achieving behavioural change, this effect is enhanced when knowledge about consequences interacts with a feeling of personal and moral responsibility for those consequences (Bamberg & Möser, 2007; Joireman et al., 2004; Wall, 2005).

While it is important that individuals believe that engaging in the target behaviour is the right thing to do (i.e. *moral norm activation*), this feeling is more easily elicited when people are under the impression that the target behaviour is also being performed by others (i.e. *social norm activation*). Because individual beliefs are often a function of the social group to which an individual belongs, an informational message is expected to be more persuasive if the right in-group source and context is provided (Mackie, Worth, & Asuncion, 1990; Van Knippenberg, Lossie, & Wilke, 1994). In sum, recent research is increasingly starting to validate the importance of exploring interactions between cognitive, experiential and normative influences on behaviour.

## **5.4 Conclusions**

The aim of this paper has been twofold. Firstly, to evaluate the theoretical and empirical evidence for three major approaches to public climate change communication (cognitive, experiential and normative) and secondly to advance a new communication model that is more likely to effectively encourage the behavioural shifts that climate change necessitates. It is concluded that in isolation, cognitive, experiential and normative approaches are unlikely to induce behavioural change. Instead, a new framework for communicating climate change is presented. It is argued that future interventions are more likely to reduce the gap between public communication and behavioural change when such campaigns: (1) effectively integrate cognitive, experiential and normative aspects of human behaviour in their message design (2) make the climate change context explicit and (3) foster a strong link between the behaviours that need to be changed and their psychological determinants.



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### **CHAPTER 3: THE ROLE OF KNOWLEDGE, LEARNING AND MENTAL MODELS IN PUBLIC PERCEPTIONS OF CLIMATE CHANGE RELATED RISKS**

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## **Abstract**

Climate change represents a complex set of challenges, in part because it is marked by risks that are not easily observed and identified – risks that humans have significant difficulty estimating. A large body of research has shown that the construction of human risk perception is a complex, multi-faceted process. Determining viable mitigation and adaptation strategies toward climate change risks therefore necessitates models that appropriately reflect human knowledge systems and learning processes. In learning for a sustainable future, we must look beyond traditional measures of risk variables and obtain a more comprehensive and holistic understanding of risk behaviour. In this chapter, we aim to provide such an interdisciplinary overview. Using practical examples we outline five fundamental processes that help form, shape and guide human perceptions of climate-related risks, namely: (1) cognitive, (2) subconscious, (3) affective (4) socio-cultural and (5) individual factors. We subsequently critically review techniques for measuring risk perception, discuss (current) public risk perceptions of climate change and illuminate the mechanisms by which risk perception can influence public action. A major conclusion is that eliciting effective adaptation and mitigation responses requires greater public understanding of and multi-level engagement with climate change and to this extent, we provide several recommendations for public policy.

## 1.0 Introduction

The scientific consensus on anthropogenic climate change is now unequivocal (Intergovernmental Panel on Climate Change, 2007). As a result, humanity is increasingly faced with the prospect of vastly changing environmental conditions. In light of this fact, there are two broad challenges in learning towards and maintaining a sustainable future. The first relates to attaining a detailed understanding of the effects of changes in Earth's systems, due to geophysical, biological, social, and economic causes. Second is the challenge of enabling effective mitigation and adaptation measures under such changing conditions. In this chapter we aim to address the latter challenge by illuminating the crucial role of risk perception in driving and shaping public responses to climate change.

The apparent disconnect between risk perceptions of climate change and public action is undoubtedly linked to the kind of risk that climate change represents; a so-called “*un-situated*” risk (Hulme, 2009). The term “un-situated” implies that in most people's daily environment, the risks associated with climate change are often not directly observable. Since climate change is a slow, cumulative and largely invisible process, it does not coincide with the way in which humans traditionally perceive threats in their direct environment, making it difficult for people to accurately estimate climate-related risks. Moreover, people's perception of how climate change is likely to impact them personally often seems to differ from their perception of how climate change is likely to affect society as a whole. It is therefore important to develop a better understanding of how individuals construct their knowledge, learn and ultimately make decisions about climate change.

We recognize that the complexities of climate change calls for an integrated approach. Consequently, we take an interdisciplinary perspective in this chapter and aim to present a holistic overview of risk understanding on the individual level. In the first



section, we address the multi-dimensional nature of human risk perception and explain, using practical examples, how perceptions of climate change related risks are constructed. The purpose of the second section is to look at ways of measuring risk perception and to critically discuss how current risk perceptions guide the formation of public responses to climate change. In the last section, we address societal change towards climate change and sustainability more generally and provide several public policy recommendations for eliciting and maintaining effective mitigation and adaptation responses.

## **2.0 Through the Looking-Glass: The Multi-Dimensional Nature of Risk Perception**

While risk perception is an inherently complex process, an extensive review of the literature allows for the identification of at least five different dimensions that underlie, influence and help shape human perceptions of risk<sup>2</sup>. These dimensions include: (1) *cognitive*, (2) *subconscious*, (3) *affective*, (4) *socio-cultural* and (5) *individual factors*.

### **2.1 Reasoning About Risk**

Cognitive scientists have often described the way in which individuals process and organise incoming information as an interrelated network of mental structures. According to *schema theory*, knowledge should therefore be seen as an elaborate network of abstract mental structures that represent an individual's understanding of the external world (Anderson, 1977). More recently, the study of “*mental models*” has gained increased attention. A mental model is a person’s internal, personalized, intuitive and contextual understanding of how something works (Kearney & Kaplan, 1997). It is important to

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<sup>2</sup> These five dimensions constructively build on the “triple stand” model proposed by Hillson and Murray-Webster (2009).

consider how individuals learn, understand, and form mental representations of climate change risks, as mental models have three major functions: (1) they serve as a framework into which people fit new information; (2) they define how individuals approach and solve problems; and perhaps most importantly (3) they help formulate actions and behaviour (Carey, 1986; Morgan et al., 2002).

Unfortunately, a sizable portion of the literature indicates that most people's mental model of climate change contains fundamental flaws and that a more substantial and meaningful understanding of the causes, impacts and solutions to climate change is still lacking (American Psychological Association, 2009; Leiserowitz, 2006; Steg & Vlek, 2009). To highlight the importance of studying people's knowledge and mental models of risk factors, consider that some individuals erroneously perceive a few degrees increase in global average temperature to mean that winters will be less cold and that summers will be more "pleasant" (Meinders, 1998). More generally, such incorrect mental models tend to downplay people's understanding of the potential risks involved and thereby contribute to "wait and see" attitudes (Xiang, 2011).

One reason why people hold such limited understanding of climate change is that its complexity often defies our intuitive understanding of concepts of stock and flow, as thinking about complex systems generally exceeds human cognitive capacity (Simon, 1955). For example, in a set of experiments run by Sterman and Booth Sweeney (2002, 2007) and Sterman (2008), MIT students deduced that a reduction in CO<sub>2</sub> emissions would be followed immediately by a reduction in global mean temperature. While such matching heuristics are effective in daily experiences with simple system dynamics (where inputs and outputs are closely related in time and space), they are inappropriate for complex systems with multiple feedback loops and extended time delays such as climate change modelling (Xiang 2011). Another problem that occurs when trying to

communicate and educate people about the potential consequences of climate change lies in the fact that people tend to process information in a manner that is consistent with their pre-existing beliefs. Selectively attending to evidence that confirms pre-existing beliefs and the re-interpretation or distortion of information to the contrary is generally referred to as “*confirmation bias*” (Lewicka, 1998).

In fact, much information that is retained in an individual’s memory tends to be information that supports pre-existing thoughts and beliefs. Consider two relevant empirical studies that clearly illustrate these concepts: the first study assessed how concerned Democrat and Republican voters were about the risks associated with climate change. Increased levels of concern were indeed associated with increased knowledge levels among Democrats and individuals that expressed trust in the scientific consensus on climate change. Yet, increased knowledge did not lead to more concern among individuals (e.g. Republicans) who were already sceptical about the occurrence of climate change from the outset (Malka, Krosnick, & Langer, 2009).

A second example of the tendency to selectively retain information is illustrated by a case study on farmers in Illinois, USA. Farmers who believed that their region was undergoing climate change recalled temperatures and precipitation levels congruent with those beliefs. Yet, other farmers in the same region who believed in a constant climate recalled weather statistics congruent with those beliefs. In reality, both groups showed an equal amount of error in their recollection of weather statistics (Weber & Sonka, 1994). These cases studies serve to illustrate that the way in which we learn, process information and organise our knowledge strongly influences how we perceive the external world.

However, the idea that human risk perception is predominantly influenced by knowledge and information is a fairly cognitivist point of view. In fact, from a purely cognitive and consequentialist perspective, the concept of “risk” has two sub-

components: (1) *uncertainty* – which relates to the probability or likelihood of a potential danger and (2) an *evaluation* of how much the threat “matters”, (i.e. an estimation of the *impact or severity* of the potential risk (Hillson & Murray-Webster, 2009). Such mental “likelihood/impact” risk assessments require individuals to employ analytical reasoning skills based on the information they have at hand.

The main (economic) model under which risk is appraised in this manner is Expected Utility (EU) theory (Von Neumann & Morgenstern, 1944). From an economist’s viewpoint, a risk preference can be seen as a descriptive label for the shape of a utility function that is assumed to underlie an individual's choices (i.e. a measure of the desirability of a good or service to an individual). Individual utility functions are derived from a set of choices over “risky alternatives”. The shape of a utility function then denotes an individual’s position on a risk continuum (i.e. risk averse, risk neutral or risk seeking). These attitudinal predispositions to risk are often thought to be representative of a general personality trait (Weber et al., 2002).

In practice, such economic models of risk have often been used to estimate individual willingness to pay for public climate change mitigation policies. This is typically done by presenting individuals with a hypothetical set of certain-versus-risky investment choices. For example, Cameron and Gerdes (2007) found that more risk-averse individuals and those who expect the cost of acting now to be preferable to the cost of acting in the future tend to express more support for mitigation policies. Thus, from this point of view, risk is mainly addressed with rational thought, logic, probability and utility maximization (Weber, 2006).

## 2.2 Conversations with the Unconscious

Kahneman and Tversky (1979) have long argued that EU theory fails to predict actual behaviour in many decisions involving risk. In particular, experiments have pointed out that individuals are not consistently classified as risk averse or risk seeking across time and situations (e.g. Shoemaker, 1990) and a wide variety of behavioural phenomena show that people's actual preferences systematically violate the axioms of EU theory (e.g. see Ellsberg, 1961; Slovic, Fischhoff, & Lichtenstein, 1979).

Simon (1955) suggested that the analytical demands of utility maximization generally exceed the cognitive capacity of the typical individual faced with complex decisions. Instead, actual decision-making behaviour, as opposed to a normative model of rational behaviour, involves simplified representations of complex problems and reliance on *heuristics* (rules-of-thumb). We take a "heuristic" to be an expression of fast, intuitive and unconscious information processing. Or, in the words of Gigerenzer (2007): the "*adaptive intelligence of the unconscious*".

To this extent, alternative approaches to EU have been introduced in the field of behavioural economics, most notably "*Prospect Theory*" (PT) (Kahneman & Tversky, 1979). Prospect theory focuses heavily on the framing of risk questions and has identified a large range of heuristics and unconscious "biases" that humans employ when making decisions under uncertainty. Without discussing all of these mechanisms in extensive detail, a particularly interesting and relevant implication of prospect theory is that individuals tend to be risk-averse in what is known as the "*gain domain*" (i.e. when there is something to be gained) and risk-seeking in the "*loss-domain*" (i.e. people are willing to take larger risks if they already have to lose something from the outset). Therefore, if the consequences of climate change can be framed under the loss domain, this might help

explain why individuals and societies are taking more risk (by not changing their behaviour) than what is generally advised by governments and scientists.

In addition, perhaps one of the most frequently quoted biases in explaining risk-taking behaviour is what has become known as “*optimism bias*”: a systematic tendency for individuals to underestimate potential negative outcomes (Weinstein, 1980). Particularly in the context of climate change individuals tend to display an unrealistic sense of optimism; as most people believe that climate change is likely to affect others (e.g. the third world) but not the individual in question (O’Neill & Nicholson-Cole, 2009). In sum, the task environment of climate change is defined by high-level ambiguity, where scientists, policy makers and the public often have to make decisions based on limited and uncertain information. Paired with cognitive constraints such as a low-level discernibility between numeric risks, individuals naturally tend towards heuristics to form a general view of climate change risks.

### **2.3 Feeling at Risk**

Traditionally, most theories of decision making under uncertainty have completely neglected the role of emotions in risk perception (Loewenstein et al., 2001). Yet, it has become increasingly apparent that individuals have a hard time forming risk judgements, when the relevant risk is represented purely as a statistical probability. Mounting evidence from cognitive, social and clinical psychology has indicated that risk perceptions (across domains) are strongly influenced by affective and emotion-driven processes (e.g. Chaiken & Trope, 1999; Slovic, 1996; Weber, 2006). Emotional reactions to risks often diverge from cognitive judgements and when such divergence occurs, emotional influences generally override cognitive deliberation (Loewenstein et al., 2001). Some researchers go as far as stating that the public may not act upon simple

information about probabilities unless this information is given emotional significance (Slovic et al., 2004). These findings are not entirely surprising. The human brain is fast and experienced in mapping cues from the environment (i.e. threats) into affective responses (Weber, 2006). In fact, when responding to immediate environmental threats, instinctive emotions such as *fear* and *anxiety* arise in an evolutionarily older part of the brain known as the “amygdala” (which is the center of the brain's limbic system). The amygdala plays a key role in emotional memory and processing (Davis, 1992). A more subtle form of emotion defined specifically as a positive (like) or negative (dislike) evaluative feeling towards external stimuli is known as “*affect*” (Slovic et al., 2004). An affective response is often a first reaction that guides information processing and judgement (Zajonc, 1980). Particularly, people tend to rely on what is called an “*affective pool*”, which includes all the positive and negative affective associations that someone holds with regard to a risk representation, both consciously and unconsciously (Breakwell, 2010). For example, in one US study negative affect and imagery toward climate change were identified as the strongest predictors of global warming risk perceptions (e.g. Leiserowitz, 2006). Similar results were found in a Swedish study linking risk judgements of climate change to affective evaluations (Sundblad et al., 2007).

It is important to note that different environmental risks can elicit different emotions (Böhm, 2003). For example, while broad and controllable human-caused risks (e.g. industrial pollution) tend to evoke negative emotions and lead to the boycott of the inflicting agent, risks brought about by one's own activities (e.g. car pollution) often invoke ethical emotions such as *guilt* and *shame*. Yet, the most intense emotions associated with ecological risks are so-called *prospective “consequence” based emotions*, such as fear and worry (Böhm, 2003). Overall, these findings highlight the important role of affective and emotion-driven processes in shaping environmental risk perceptions.

## 2.4 A Culture of Risk?

Cultural anthropologist Mary Douglas and political scientist Aaron Wildavsky have criticized existing theories of risk (including economic, cognitive and affective explanations) for neglecting the influence of social and cultural factors in the formation of individual risk perceptions. This criticism is reiterated by Dake (1991): “*An understanding of who fears what and why, requires serious attention to the political, historical, and social context in which risks are framed and debated...mental models of risk are not solely matters of individual cognition but also correspond to worldviews entailing deeply held beliefs and values regarding society, its functioning and its potential fate*” (p.62). The cultural theory of risk (Douglas & Wildavsky, 1982) suggests that individuals and groups deploy different perceptual lenses to arrive at their particular interpretation of the world and proposes that both economic and psychometric approaches ‘depoliticize’ risk and thereby do not accurately reflect an individual’s commitments to competing cultural and political structures.

In short, cultural theory makes a distinction between *social relations* (the interpersonal level) and worldviews (broadly shared values and beliefs). Based on years of anthropological research, Douglas constructed a typology of risk culture, perhaps better known as the “grid-group” system, where these broad (global) competing cultural types are delineated in more detail. These typologies are; “*egalitarianism*”, “*individualism*”, “*hierarchism*” and “*fatalism*”. Their relative position on the group-grid scale is determined by the extent to which individuals feel bounded by feelings of belonging and solidarity (*group*) and the amount of control and structure that people maintain in their social roles (*grid*). While traditionally, the cultural theory of risk has been criticized for lacking empirical testing via recognized social science techniques (e.g. O’Riordan & Jordan, 1999), recent empirical research shows that such presuppositions



about the nature of society do lead people to perceive the same risks in different ways and as a result, cause a divergence in support of different public policies (e.g. Slovic et al., 1998; Steg & Stievers 2000).

For example, egalitarians are likely to show most concern for the environment whereas individualists tend to show least concern (e.g. Leiserowitz, 2006). A likely explanation is that while egalitarians generally perceive nature and the environment as fragile and at risk, most western capitalist societies have propagated an individualist worldview, disconnecting humans from nature by objectifying it as a commodity that can be bought and sold (Doyle, 2011). Another recent initiative is the ‘*cultural-cognition*’ project – a combined effort that seeks to connect cognitivist and cultural theories. The cultural cognition of risk acknowledges that cognitions are shaped and influenced by group-grid worldviews (Kahan, 2012). In addition, the mass media as well as interpersonal interactions play an important role in circulating existing social representations of risk in a given culture. For example, the Social Amplification of Risk Framework (SARF) highlights how risk perceptions are often amplified or attenuated depending on how they are communicated (Kasperson et al., 1988).

Given that, for most people, the popular media is a common source for acquiring information about climate change (e.g. Boykoff & Rajan, 2007; Ungar, 2000), it can significantly influence the public’s perception (e.g. Sampei & Aoyagi-Utsui, 2009; Stamm et al., 2002). To this extent, Steg and Sievers (2000) advise: “*risk communication should be in line with the cultural biases of the target group as people tend to have more trust in risk communication if the message is in line with their cultural biases*”. In short, researchers have also clearly demonstrated the importance of social representations and cultural worldviews in the construction of environmental risk perceptions (e.g. Dake, 1991; Leiserowitz, 2006).

## 2.5 The Risky Individual

Finally, in addition to cognitive, subconscious, affective and socio-cultural considerations, clear individual differences in risk perception have also been noted. For example, research has indicated that there are significant differences in risk perception between men and women (e.g. Finucane et al., 1997). Furthermore, while some studies indicate systematic ethnic and socioeconomic differences in the perception of environmental risks (e.g. Flynn, Slovic, & Mertz, 1994), other recent research has indicated that substantial variation in individual risk behaviour is likely to arise as a result of *genetic* predispositions (Kreek et al., 2005; Kuhnen & Chiao, 2009). In addition, the concept of “*self-efficacy*” (Bandura, 1977) (i.e. an individual’s perception of the capacity to bring about change through his or her own behaviour) has been implicated in explaining variation in risk perception, as lower levels of self-efficacy imply a decreased ability to protect oneself, which tends to be associated with higher levels of perceived personal risk (e.g. Breakwell, 2010; Spence, Poortinga, Butler, & Pidgeon, 2011). Lastly, individual differences in the level of experience and familiarity with a risk also strongly influence perception (Song & Schwarz, 2009; Spence et al., 2011; Weber, 2006).

So far we have discussed five fundamental elements that construct and help shape public risk perceptions of climate change. While each of these elements can be considered independently, we want to stress the interconnected nature of all the aforementioned factors and highlight that environmental risk perception is the result of cognitive, subconscious, emotional, socio-cultural and individual factors. Having discussed the fundamental principles of risk perception, we now turn to reviewing current perceptions of climate change risks and discuss how these perceptions are likely to influence public mitigation and adaptation responses.

### **3.0 Mind the Gap: Risk Perceptions of Climate Change and Public Action**

Direct experience is often thought to strongly influence risk perception (Whitmarsh, 2008), particularly because experiences can invoke strong memorable feelings, possibly making them more dominant in processing (Loewenstein et al., 2001). Yet, if a precondition of risk perception is that humans must be able to perceive a threat or danger in their direct environment, as some perceptual psychologists would argue (e.g. Gibson, 1972), then climate change provides a unique challenge. This is so because climate change is an intangible process that cannot be observed directly. However, the consequences that are likely to be associated with climate change can be observed (e.g. the increased frequency and severity of extreme weather events).

Nonetheless, it remains questionable whether people actually attribute these consequences to climate change (Bickerstaff, 2004). In fact, some individuals may attribute natural disasters to higher powers, spiritual beliefs or other, unrelated factors. In addition, responses to climate change risks address mitigating the threat at hand (e.g. flooding) and not climate change as a broader societal issue. For example, a sensible response to flooding would be to build more robust infrastructures, buy insurance or to take other protective measures to ensure personal safety (i.e. *adaptation* responses). There is no reason to assume that whenever a person's house or property floods, this provides an incentive for the individual to actively diminish his or her carbon footprint.

To illustrate, a recent study in the UK showed that flood victims did not particularly attribute the experienced flooding to climate change (Whitmarsh, 2008); instead, people rather identified local observable causes (e.g. lack of water-course maintenance). Thus, this implies that, while direct (environmental) experience certainly influences risk perceptions and behaviours, differences in perceptual attribution are likely

to determine the nature of the response behaviour. For example, although familiarity with risks has been shown to lower risk perceptions (Weber, 2006), evidence indicates that people living in low-lying coastal areas tend to have a heightened sense of personal risk (Brody et al., 2008).

Still, it has remained relatively unclear whether living in places physically vulnerable to climate change (or having had prior experience with the consequences of climate change) also induces greater preparedness to take *mitigative* action. To this extent, a recent national UK study by Spence et al. (2011) found that past flooding experiences were significantly related to increased preparedness to reduce energy use. In particular, past flooding experiences influenced individual preparedness via risk perception. This is consistent with other research that has highlighted the role of personal risk perceptions in explaining behavioural intentions to address global warming (e.g. Bord, O'Connor, & Fisher, 2000).

These recent findings suggest that risk perceptions seem to be able to elicit both *adaptation* and *mitigation* behaviours. The key take-away is that the effect of risk perception on behaviour is largely mediated by the extent to which individuals *attribute* their risk perceptions to a particular *source* (Figure 3.1). Note that adaptation is likely to occur in both instances (compared to mitigation), as it is often more pressing and less “optional”. A major implication is that if the goal is to stimulate mitigation behaviours, effort must be geared towards creating a strong(er) link between the occurrence of environmental changes and anthropogenic climate change.

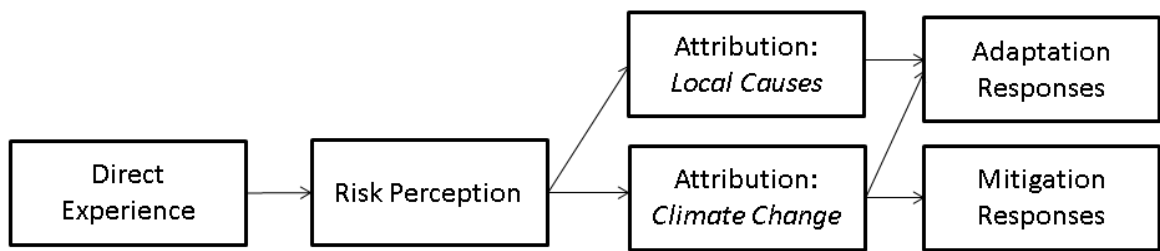


Figure 3.1: Experience, Perception and Attribution of Risk.

Thus far we have discussed instances where people were able to *observe* some of the consequences potentially associated with climate change. But often there is a *disassociation* between the cognitive information that informs individuals that there is in fact a risk to be worried about and the inability for many people to observe or experience this risk in their direct environment (Weber, 2006). Many studies have tried to get a sense of how individuals perceive such seemingly “un-situated” risks. Because there is no one coherent method of how an individual’s “risk perception” is measured, risk perception often represents an index of different constructs.

For example, such measures may include “societal risk factors” or a measure of “general concern”, “perceived seriousness of a threat” (i.e. severity times likelihood estimations) or measures of “personal worry” (cf. Bord, O’Connor, & Fisher, 2000; Leiserowitz, 2007; Staats et al., 1996). In particular, the terms “*concern*”, “*worry*” and “*perceived seriousness*” are often used interchangeably. Yet, the literature often fails to note that these terms have different meanings. For example, it is entirely possible to be generally concerned about an issue without actively worrying about it. Worry is usually considered to be a more active emotional state and a stronger predictor of behaviour than either “concern” or perceived “seriousness” (Leiserowitz, 2007).

To illustrate the impact that such different definitions of “risk perception” can have on outcome measurements, we consider a study that was conducted by GlobeScan, covering 34 countries. The study found that the majority of people in each country believed that climate change was a *somewhat to very serious* problem (GlobeScan, 2000). In 2006, GlobeScan repeated the study and found that the percentage of respondents that believed that climate change was a ‘*very serious threat*’ increased significantly in most countries (GlobeScan, 2006). Similarly, a study done in the UK also indicated that a high percentage (82%) of respondents reported to be *concerned* about climate change (Poortinga et al., 2006). Thus, general concern seems to be well established.

Yet, The Pew Global Attitude Survey (2006) found that, (while varying among countries) *personal* levels of worry about climate change are generally much lower than either perceived seriousness of the issue or general stated concern. It is also questionable whether stated concern reflects the perception that the problem of climate change is urgent or of high priority. For example, while many people are concerned about climate change, they rank it as less important as many other social issues such as terrorism, health care and the economy (Krosnick et al., 2006). This may explain why global climate change remains a relatively low priority compared to other issues of individual concern.

Similar evidence is provided by Poortinga and Pidgeon (2003). Based on a large number of face-to-face interviews, the researchers found that while there was some moderate concern for all risks mentioned in the study (e.g. radioactive waste, genetically modified food), climate change was ranked among the least important issues. Additionally, in a qualitative study conducted by Bedford et al. (2004), respondents reported feeling no immediate need for the implementation of any significant lifestyle changes. Similarly, work by Lowe et al. (2006) also indicated that people did not think climate change would impact their day-to-day life directly. In sum, a review of the

evidence leads to the conclusion that although general concern is expressed, there is also a dominant belief that climate change is a non-urgent and non-personal threat that does not require immediate personal action.

#### **4.0 Conclusion and Policy Implications**

The aim of the current chapter has been to shed light on the role of risk perception in the development of public responses to climate change. We have illustrated that risk perceptions of climate change are formed by five fundamental mechanisms, including; cognitive, subconscious, affective, socio-cultural and individual processes. A major conclusion is that a lack of public understanding is perpetuating incorrect mental representations of climate change. Existing (flawed) mental models downplay the perceived risks and as a result, hinder public action. The creation of viable mitigation and adaptation strategies towards climate change risks therefore requires greater public understanding of the nature of complex system modelling as well as a more holistic understanding of the climate change problem. In fact, O'Neill and Hulme (2009) argue that: *“cognitive engagement is imperative: if individuals do not have an adequate understanding of the issue, any mitigation policy risks being ineffective or even rejected”*.

Yet, as discussed throughout this chapter, cognitive knowledge plays just one part in explaining perceptions and behaviour, while other factors such as heuristics, emotions, socio-cultural norms, given infrastructures and context conditions in which knowledge arises or is situated are in many cases equally relevant to understanding behaviour. For example, while it is known that (affective) experiences with climate-related risks can inspire mitigation behaviours through heightened risk perceptions, this is most likely to occur under the condition that individuals actually (consciously) attribute their perceptual experience with extreme weather to anthropogenic climate change. Thus, a recurring

policy question is how to develop a system that breaches this divide and encourages individuals to take ownership over adaptation and mitigation responses. To this extent, we look ahead and identify two potential approaches that, in the face of accelerating change, can assist policy makers in stimulating the link between public engagement with climate change and learning for a more sustainable future.

In the realm of public policy, “*nudge*” and “*think*” strategies have become popularized (John et al., 2011; Thaler & Sunstein, 2008). To start with the former, “nudging” focuses on minimizing the cost of behavioural change by altering people’s *choice environment* in an attempt to encourage them to act in ways that are more beneficial to both themselves and society as a whole. The “think” approach on the other hand, assumes that individuals can step away from day-to-day life and reflect on a wide range of public policy choices. “Think” suggests that people are “*knowledge hungry*”, “*learn to process new information*” and reach “*new heights of reflection*” (John et al., 2011, p. 19). Thus, think strategies stimulate group participation and encourages the design of democratic institutional platforms that support citizen-lead investigations. This view is in line with the concept of “*post-normal science*”, which supports the idea of an “extended peer community”, where all those that are affected by an issue (e.g. climate change) and prepared to enter into dialogue on it are welcomed to share their knowledge and understanding (Funtowicz & Ravetz, 1991).

While both *nudge* and *think* strategies can be thought of as independent instruments, it is likely that an *integrative* approach will more effectively encourage the adoption of mitigation and adaption behaviours. Such an integrative approach should explore not only traditional but also new, interactive and experiential ways of providing people with information, knowledge and learning opportunities. For example, a number of recent policy-oriented studies on household energy use are highlighting that combining



traditional modes of conveying information (e.g. energy statements) with non-traditional methods, such as providing people with “smart readers” (i.e. *experiential learning*) and / or informing them about the positive energy-saving behaviour of their peers (i.e. “*social nudging*”) stands a greater chance of successfully promoting sustainable behaviours than either strategy alone (e.g. Dolan & Metcalfe, 2011; UK Cabinet Office, 2011).

In conclusion, in the realm of complex risks like climate change, public policies should aim to foster the link between knowledge acquisition, individual and social learning and the implementation of mitigation and adaptation responses. As discussed throughout this chapter, this essentially implies co-production of knowledge and applying the understanding and use of that knowledge to promoting and maintaining more sustainable behavioural and societal changes.

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**CHAPTER 4: THE SOCIAL-PSYCHOLOGICAL  
DETERMINANTS OF CLIMATE CHANGE RISK  
PERCEPTIONS: TOWARDS A COMPREHENSIVE MODEL**

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## **Abstract**

This study seeks to provide a detailed understanding of the social-psychological determinants of climate change risk perceptions. In doing so, the current research advances a climate change risk perception model that integrates socio-demographic, cognitive, experiential and socio-cultural factors. Using a set of highly reliable measures, the conceptual model is tested empirically using a national sample ( $N = 808$ ) of the UK population. Results indicate that the full model is able to explain nearly 70% of the variance in risk perceptions of climate change. Gender, political party, knowledge of the causes, impacts and responses to climate change, descriptive and prescriptive social norms, biospheric values, holistic affect and personal experience with extreme weather events were all identified as significant predictors. Experiential and socio-cultural factors explained significantly more variance in risk perception than either cognitive or socio-demographic characteristics. Results also confirm that the factor-analytic structure of climate change risk perceptions can be conceptualised along two key dimensions, namely: personal and societal risk judgements and that both dimensions have different psychological antecedents. Implications for both theory and risk communication are discussed.

## 1.0 Introduction

While climate change is a complex global hazard that poses significant challenges to societies worldwide (Swim et al., 2011), the extent to which it is publicly viewed as a risk that requires urgent attention varies substantially (cf. Kim & Wolinsky-Nahmias, 2014; Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006; Lorenzoni et al., 2006; Pidgeon, 2012). This is a peculiar but inevitable result of the fact that the nature of human perception allows for a differentiation between real-world threats and the subjective perceptual experience of those threats (Pidgeon, Kasperson, & Slovic, 2003). Indeed, the perception of risk is a mental construct (Sjöberg, 2000a). As Slovic (1992) points out, the notion of “risk” is a human invention and as such, “it does not exist independent of our minds and culture” (p. 690).

Moreover, as an object of risk representation, climate change is relatively unique (Breakwell, 2010). It is unique in the sense that both the magnitude and complexity of the climate change problem are unprecedented in terms of the scale (i.e. global) as well as the time-line involved (i.e. stretching over centuries). Furthermore, because climate change is a slow, cumulative and largely invisible process, it cannot be experienced directly (Weber, 2010) and as such, it is markedly different from the way that our ancestors have traditionally perceived threats in their direct environment (Gifford, 2011; Helgeson, van der Linden, & Chabay, 2012). In other words, human-caused climate change is an evolutionarily “novel” risk (Griskevicius, Cantu, & van Vugt, 2012).

Advancing a more detailed understanding of the psychological factors that drive and shape public risk perceptions of climate change is therefore a pivotal task, especially since an increasing amount of studies are indicating that risk perception is an important predictor of public willingness to help reduce climate change (e.g.

Leiserowitz, 2006; O'Connor, Bord, & Fisher, 1999; Semenza et al., 2008; Spence, Poortinga, Butler, & Pidgeon, 2011; Spence, Poortinga, & Pidgeon, 2012; Tobler, Visschers, & Siegrist, 2012a). In order to get a more systematic overview of the current state of research, a survey of the peer-reviewed literature was conducted using the search terms “risk perception”, “climate change” and “global warming”<sup>3</sup>. Studies were selected based on the relative explanatory power ( $R^2$ ) of the reported models and a detailed overview of the search results is provided in Table 4.1.

A number of conclusions can be drawn from the table. To start with, (a) while a variety of different models and approaches have contributed to explaining risk perceptions of climate change, a more systematic and detailed organisation of key social-psychological determinants is currently lacking, making it difficult for both researchers and practitioners to see the forest for the trees, (b) a majority of the studies have been conducted in the United States and (c) the amount of variance explained ranges between 22% to 55% (with an average of about 40%), leaving substantial room to further develop both the theoretical as well as the empirical explanatory power of current risk perception models.

In addition, it is also worth mentioning that many of the studies listed in Table 4.1 use different measures of risk perception, which makes a comparison of behavioural determinants difficult and therefore some caution should be exercised in making any direct comparisons. For example, whereas some studies used the term “global warming” others used “climate change” or “global climate change” - which could explain some variation in itself (Villar & Krosnick, 2011; Whitmarsh, 2009). In addition, while terms such as perceived “seriousness”, “concern” and “worry” are

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<sup>3</sup> The following databases were used: PsychInfo, Scopus, Google Scholar and Web of Science.

often used synonymously in the literature, they actually mean different things (van der Linden, 2014a). To illustrate, it is possible to be broadly and generally concerned about an issue without actively worrying about it (Leiserowitz, 2007). In fact, climate change is often characterized as a distant psychological risk, both spatially as well as temporally – happening in the “future” to “other” people and places (Spence et al., 2012). To some extent, this characterisation may be a natural consequence of what Weinstein (1989) referred to as; “optimism bias” (i.e. the erroneous belief that others are more likely to be affected by the same risk).

The difference between self vs. other risk comparisons is also nicely captured by the “impersonal impact hypothesis”, which has long suggested a conceptual distinction between societal and personal level risk judgements (Tyler & Cook, 1984). This differentiation is important to consider, as several studies have shown that when asked to assess the threat of climate change for society as a whole, people tend to provide systematically higher ratings than when asked to evaluate climate change as a personal risk (Bord, O’Connor, & Fisher, 2000; Leiserowitz, 2005) - a phenomenon also known as “risk denial” (Sjöberg, 2012).

Surprisingly, risk research has often failed to make this differentiation in the context of climate change. In fact, while occasionally noted (Bord et al., 2000; Roser-Renouf & Nisbet, 2008), no research has examined to what extent risk perceptions of climate change can be viewed empirically as a two-dimensional construct, and more importantly, whether societal and personal risk perceptions have different psychological antecedents - which could have important implications for risk communication (Bord et al., 2000; Leiserowitz, 2005; Sjöberg, 2012). The purpose of the current study is therefore twofold. First, in order to provide a more systematic and theoretically integrated overview of the main social-psychological

determinants of climate change risk perceptions, a new climate change risk perception model is advanced. The explanatory power of the model is subsequently tested empirically using a national sample of the British population and a set of highly reliable measurement constructs.

Second, this study examines whether climate change risk perceptions can be further divided into societal and personal level risk judgements and to what extent these dimensions have different psychological antecedents. The rest of this paper is divided as follows; first, a detailed theoretical discussion of past research is provided, followed by the development of a new conceptual model, an overview of the methodology and a presentation and discussion of the results. Last but certainly not least, limitations are discussed and some suggestions are offered for future research in this area.



**Table 4.1: Overview of Major Risk Perception Studies (ordered by explanatory power)**

<b>Authors</b>	<b>Key Explanatory Variables</b>	<b>Dependent Variable</b>	<b>Sample</b>	<b>Explained Variance</b>
Akerlof et al. (2013)	(a) Personal experience, (b) cultural worldviews (proxy), (c) political ideology, (d) place attachment and (e) socio-demographics.	Local climate change risk (8 items, $\alpha = 0.96$ )	Alger County, Michigan, USA (local) (N = 765)	<b>55%</b>
Spence, Poortinga & Pidgeon (2012)	Psychological distance variables, (a) temporal, (b) spatial and (c) uncertainty.	Risk Perception Index (3 items, $\alpha = 0.83$ )	Great Britain (national) (N = 1822)	<b>54%</b>
Leiserowitz (2006) and Smith & Leiserowitz (2012)	(a) Holistic negative affect, (b) image affect, (c) naysayers, (d) alarmists, (e) political ideology, (f) cultural worldviews (egalitarian/individualist), (g) member of environmental group, (h) newspaper reader and (i) socio-demographics.	Risk Perception Index (9 items, $\alpha = 0.94 / 0.96$ )	USA (national) (N = 673 and N = 1,001)	<b>47%-52%</b>
Kellstedt, Zahran & Vedlitz (2008)	(a) Ecological values (NEP), (b) personal efficacy, (c) self-reported knowledge about climate change, (d) trust in media, (e) trust in experts, (f) confidence in science, (g) political ideology and (h) socio-demographics.	Risk Perception Index (6 items, $\alpha = 0.87$ )	USA (national) (N = 1,093)	<b>43%</b>
Brody, Zahran & Vedlitz (2008)	(a) Physical vulnerability variables, (b) ecological values (NEP), (c) self-efficacy, (d) knowledge, (e) network interest and (f) socio-demographics.	Risk Perception Index (3 items, $\alpha = 0.84$ )	USA (national) (N = 1,093)	<b>42%</b>
Milfont (2012)	(a) Ecological values (NEP), (b) political ideology, (c) self-reported knowledge about climate change, (d) perceived efficacy, (e) trust in media, (f) trust in experts, (g) confidence in science and (h) socio-demographics.	Risk Perception Index (6 items, $\alpha = 0.86$ )	New Zealand (national - 1yr panel) (N = 269)	<b>38%-48%</b>
Menny et al. (2011)	(a) Beliefs about climate change, (b) interest in climate change, (c) knowledge about climate change, (d) mass media influence, (e) personal experience with extreme weather and (f) socio-demographics.	Personal Risk Index (17 items, $\alpha =$ not reported)	Mannheim, Germany (local) (N = 157)	<b>31%</b>
Sundblad, Biel & Gärling (2007)	(a) Knowledge about climate change, (b) worry/affect and (c) socio-demographics.	Risk Perception Index (9 items, $\alpha = 0.91$ )	Sweden (national) (N = 621)	<b>24-26%</b>
Malka, Krosnick & Langer (2009)	(a) Self-reported knowledge, (b) trust in scientists and (c) socio-demographics.	Single-Items (Perceived general and national seriousness)	USA (national) (N = 1,002)	<b>22-25%</b>

## **2.0 The Present Research**

New risk perception models are generally welcomed (Sjöberg, 2002) - especially since “the aim of the work is to find a model which is as fully explanatory as possible” (Sjöberg, 2012, p. 665). Moreover, while existing models often slice risk perception into different dimensions, little explanation is provided as to why people experience risk in these dimensions or while explanations may exist, no coherent effort has been made to piece them together (Wählberg, 2001). The purpose of the current research is exactly this: to provide a new conceptual framework to help organise and integrate different theoretical perspectives and offer a comprehensive overview of key psychological determinants that jointly, explain a substantial amount of the variance in climate change risk perceptions.

While public risk perceptions are clearly complex and multidimensional (Slovic, Fischhoff, & Lichtenstein, 1982) past research has suggested that risk perceptions of climate change are primarily influenced by four key dimensions, namely; *socio-demographic, cognitive, experiential and socio-cultural* factors (Helgeson et al., 2012). The current section expands on this broad conceptual structure by outlining and delineating each of these dimensions in further detail.

### **2.1 Cognitive Dimensions of Risk**

#### *2.1.1 Knowledge about Climate Change*

In order to estimate both, the probability with which global warming is likely to occur and the severity of associated consequences, knowledge of these factors must be acquired first. To this extent, knowledge about climate change is generally

regarded as a cognitive aspect of risk judgements (Sundblad et al., 2007). However, it remains relatively unclear to what extent a cognitive understanding of climate change can explain and predict public risk perceptions. For example, while Brody et al. (2008) find no significant relationship between knowledge and risk perception, both Malka, Krosnick and Langer (2009) and Menny et al. (2011) provide mixed evidence, suggesting that increased knowledge about climate change only leads to higher concern for some groups (e.g. liberals) but not for others (e.g. conservatives). Kellstedt, Zahran and Vedlitz (2008) actually found that knowledge is *negatively* associated with risk perceptions of climate change.

Yet, a growing number of studies report the opposite: that knowledge is in fact a significant and positive predictor of climate change risk perceptions (e.g. Hidalgo & Pisano, 2010; Milfont, 2012; O'Connor et al., 1999; Reser et al., 2012; Sundblad et al., 2007; Tobler et al., 2012a). To some extent, these contradictory findings are attributable to differences in how knowledge about climate change is measured. For example, while some studies use single-item measures of subjective, self-reported knowledge (e.g. Kellstedt et al., 2008; Malka et al., 2009) other studies have tried to objectively determine how much actual knowledge people hold about climate change (e.g. Sundblad et al., 2007; Tobler et al., 2012b).

It is important to note that the way in which “knowledge” is operationalised can bear significantly on the results (Menny et al., 2011; Reser et al., 2012), particularly because self-reported measures tend to be (a) less reliable and (b) confound different types of knowledge. Thus, their use should be avoided (Reser et al., 2012; Roser-Renouf & Nisbet, 2008). In fact, Kaiser and Fuhrer (2003) argue that the role of knowledge often goes undetected because researchers fail to make a conceptual distinction between different forms of knowledge. Accordingly, in line

with other recent research (e.g. Sundblad et al., 2007; Tobler et al., 2012b), the current study aims to provide a more comprehensive and objective assessment by measuring three interrelated and converging subject areas, namely; public knowledge about the *causes*, *impacts* and *responses* to climate change.

## **2.2 Experiential Processes**

### *2.2.1 Affect*

It is now widely recognized that human information processing is guided by emotion and affect (Damasio, 1994; Marx et al., 2007; Zajonc, 1980) and accordingly, both the “*risk-as-feelings*” hypothesis (Loewenstein, Weber, Hsee, & Welch, 2001) and the “*affect-heuristic*” have become influential in describing and understanding public risk perceptions (Finucane, Alhakami, Slovic, & Johnson, 2000; Slovic, Finucane, Peters, & MacGregor, 2004). When a risk judgement is complex and mental resources are limited, relying on a so-called “holistic affective impression” can serve as an efficient heuristic (Slovic et al., 2007). The term “affect” here is meant to indicate a more subtle form of emotion, defined as a positive (like) or negative (dislike) evaluative feeling towards an external stimuli (Slovic et al., 2007). An “affective response” can then be described as a first, associative and automatic reaction that guides information processing and judgement (Zajonc, 1980).

While a number of studies have shown that both *affective imagery* and *holistic affect* are strong and important predictors of climate change risk perceptions (e.g. Leiserowitz, 2006; Smith & Leiserowitz, 2012; Sundblad et al., 2007), others have argued that emotion and affect explain very little variance in risk perception (Sjöberg, 1998a, 2006). In fact, Kobbeltved et al. (2005) report in their study that

they find little support for the “risk as feelings” hypothesis. In addition, Sjöberg (2006) argues that if affect is operationalised as an evaluative measure (like/dislike) - this tends to be closer conceptually to a measure of attitude. Thus, if affect is really operationalised as an attitudinal measure and because the term “emotion” is often mistakenly equated with affect, it is easy to falsely conclude that emotions are an important determinant of risk perception.

Although a fair criticism, Slovic et al. (2007) are careful not to confuse the term emotion with affect and duly acknowledge the similarities between evaluative attitudes and the affect heuristic. In fact, an “attitude” has traditionally been defined as: “the *affect* for or against a psychological object” (Thurstone, 1931, p. 261). Accordingly, no issue is taken here with the conceptual overlap between affect and attitudes more generally, given that it is widely agreed upon that attitudes have a strong “affective” component (Eagly & Chaiken, 1993), especially in the context of climate change (Poortinga et al., 2011). While Wardman (2006) expresses some sentiment for Sjöberg’s argument, he concludes that these definitional issues do not weigh up against converging evidence from across the behavioural sciences in favour of the role of affect in risk perception.

Yet, while Peters and Slovic (2007) conclude that affect is best conceptualised as a global evaluative measure, the current research does note that previous studies have predominantly used single-item measures to assess holistic affect (e.g. Leiserowitz, 2006; Poortinga et al., 2011; Smith & Leiserowitz, 2012) and thus the reliability of such measures cannot be sufficiently assessed. In addition, the present study also argues that when “*holistic affect*” is meant to reflect a global evaluation of the quality of an object, good/bad dimensions are best avoided since

these items are likely to tap into a moral dimension<sup>4</sup> (Manstead, 2000). The current research constructively builds on these issues by using multiple indicators that draw on a range of affective-laden adjectives to establish a clearly formulated and reliable measure of generalised affect.

### 2.2.2 *Personal Experience*

A more direct path to establishing visceral concern relies on personal experience with a threat or hazard (Weber, 2006), as direct experiences can elicit strong emotions, making them more memorable and dominant in processing (Loewenstein et al., 2001). Indeed, people's emotional reactions to risks often depend on the vividness with which negative consequences can be imagined or experienced (Loewenstein et al., 2001; Weber, 2006). However, since climate change cannot be experienced directly (Whitmarsh, 2008), for most people, affective evaluations of global warming are largely influenced by the popular media (Swim et al., 2011).

Yet, while climate change cannot be experienced directly, most people are able to accurately detect changes in local weather patterns (Howe, Markowitz, Ming-Lee, & Leiserowitz, 2013). To this extent, several studies have indicated that heat primes and warmer days influence public perceptions of global warming (e.g. Joireman, Truelove, & Duell, 2010; Zaval, Keenan, Johnson, & Weber, 2014). In addition, people may also experience some of the impacts of climate change (e.g. extreme weather events) – although the nature of this relationship hinges on the assumption that people actually causally attribute their experience with extreme weather events to climate change (Helgeson et al., 2012; Weber, 2010). Yet, an

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<sup>4</sup> Moral emotions such as guilt and regret are conceptually closer aligned with a post-behavioural concept known as *anticipated affect* (van der Pligt et al., 1998).

increasing amount of evidence now suggests that personal experience with extreme weather events does in fact influence risk perceptions of climate change (e.g. Akerlof et al., 2013; Brody et al., 2008; Krosnick et al., 2006; Reser et al., 2012; Spence et al., 2011) - although some exceptions exist (e.g. Whitmarsh, 2008).

It is worth noting that past studies have primarily focused on experience with flooding events (given its saliency as a likely consequence of climate change). Yet, this might not accurately capture an individual's full range of experience with extreme weather and temperatures (e.g. the 2012 UK heat wave). Accordingly, to further build on this research, this study adopts a wider approach to personal experience, measuring a respondent's experience with both flooding as well as other types of extreme weather events (e.g. heat waves, freak storms, droughts etc.).

## **2.3 Socio-Cultural Influences**

### *2.3.1 Culture, Values and Worldviews*

Existing theories of risk perception (including cognitive and affective explanations) have been criticized for “depoliticizing risk” and for neglecting the important role of competing social and cultural structures in shaping individual risk perceptions (Jackson, Allum, & Gaskell, 2006). To this extent, “the cultural theory of risk” (Douglas, 1970; Douglas & Wildavsky, 1982) has become a popular approach to account for cultural differences in risk perception. Cultural theory is based on anthropological research and proposes a conceptual typology of risk culture (i.e. the “grid-group” system), where four broad competing cultural types or “worldviews” are delineated. In short, these include “*egalitarianism*”, “*individualism*”, “*hierarchism*” and “*fatalism*”. The relative position of the cultural types on the group-grid scale is determined by the extent to which individuals

feel bounded by feelings of belonging and solidarity (group) and the amount of control and structure that people maintain in their social roles (grid).

First operationalised empirically by Wildavsky and Dake (1990) recent studies have found a significant relationship between “cultural worldviews” and risk perceptions of climate change (e.g. Akerlof et al., 2013; Kahan et al., 2012; Leiserowitz, 2006; Smith & Leiserowitz, 2012). Yet, others have fiercely criticised its use. For example, Sjöberg (1997, 1998b) and others (e.g. Boholm, 1996; Oltedal, Moen, Klempe, & Rundmo, 2004) have repeatedly argued that cultural worldviews have low explanatory power - even positing that “cultural theory is simply wrong” (Sjöberg, 1998b, p. 150). Others have similarly argued that cultural theory explains little variance, but take a less extreme position and don't dismiss the theory in its entirety (e.g. Marris, Langford, & O'Riordan, 1998) while some continue to support its use (e.g. Slovic & Peters, 1998).

Overall, two main criticisms can be delineated. The first deals with the question of how to operationalise cultural theory empirically while the second relates to whether or not it is appropriate (or even possible) to infer cultural biases from individual-level data. With regard to the latter, existing measures have repeatedly been criticised for lacking construct validity both in terms of scale-reliability as well in terms of discriminant validity between the proposed cultural types (Boholm, 1996; Rippl, 2002; Sjöberg, 1998b). In fact, it's not uncommon for subjects to have high scores on competing scales, which is problematic, since in theory, individuals cannot be characterised by mutually inconsistent worldviews (Kahan, 2012). Yet, even when construct validity is improved, this does not appear to increase the explanatory power of the theory (Rippl, 2002). The second major criticism revolves around the idea that a cultural worldview is simply not an innate psychological tendency that can be inferred from individual-level data (Rippl, 2002). While this paper expresses some support for the idea of a latent “cultural type”,



this does not discount the argument that systematic cultural differences are best measured between countries and not between individuals<sup>5</sup> (Oreg & Katz-Gerro, 2006).

Given the many complications (both theoretical as well as empirical) associated with the cultural theory of risk (Price, Walker, & Boschetti, 2014), the current paper argues that broad value orientations are a more reliable proxy for modeling cultural influences. In order to understand why, some conceptual distinctions need to be made between the terms “values” “culture” and “worldviews”. Values differ from worldviews in two important ways; first, (a) values precede worldviews (Stern, Dietz, & Guagnano, 1995; Stern et al., 1999) and (b) values can be seen as fundamental guiding principles that are more specific and more stable than worldviews (Schwartz & Wolfgang, 1987; Stern, 2000). Yet, cultural worldviews and values tend to overlap conceptually<sup>6</sup> (Corner, Markowitz, & Pidgeon, 2014), given that cultures are essentially comprised of and characterized by their underlying value structures (Hofstede, 2001; Schwartz, 1992).

While sceptical, Sjöberg (2012) argues that the role of values in risk perception has not been explored sufficiently and that more relevant value structures need to be identified. Accordingly, instead of using Schwartz’s (1992) value inventory in its entirety, in the environmental domain, three broad value orientations are considered to be relevant (Stern, Dietz, & Kalof, 1993). These include: (1) *egoistic* values (i.e. maximizing individual outcomes), (2) *socio-altruistic* values (i.e. caring about others) and (3) *biospheric* values (i.e. caring for non-human nature and the biosphere itself). While these value structures tend to be the same in different cultures (Schwartz & Sagiv, 1995), individuals are likely to prioritize them differently (Steg & De Groot, 2012).

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<sup>5</sup> It should be noted however that cultural theory is sometimes (successfully) used to represent preferences for the role of government (e.g. see Akerlof et al., 2013; Price et al., 2014).

<sup>6</sup> To illustrate the conceptual overlap: egalitarian societies tend to be characterised by strong socio-altruistic values whereas egoistic values tend to be more pronounced in individualistic cultures.

In contrast to the cultural typology of risk, the construct validity of broad value orientations has been reliably established in a series of extensive studies across various contexts and cultures (De Groot & Steg, 2007, 2008, 2010; Schultz, 2001; Steg et al., 2011; Steg & De Groot, 2012; Stern & Dietz, 1994). In fact, De Groot, Steg and Poortinga (2013) have recently echoed similar concerns about cultural theory and provide support for the use of broad value orientations in understanding risk perception. A similar view and approach is adopted in the current paper.

### *2.3.2 The Social Construction of Risk*

Inevitably, the way in which people approach and evaluate risks is influenced by other people (Joffe, 2003). In fact, both Social Representations Theory (SRT) developed by Moscovici (1984) and the Social Amplification of Risk Framework (SARF) developed by Kasperson et al. (1988) highlight that interpersonal interactions and the mass media play a crucial role in further circulating existing social representations of risk in a given culture. While the SARF highlights that public risk perceptions are often amplified or attenuated depending on how a risk is communicated, SRT focuses on how the “we” becomes contained in the response of the “I” (Joffe, 2003, p. 60). While certainly useful in their own right (e.g. Smith & Joffe, 2013), both SRT and the SARF framework have been criticised for being rather vague meta-theories (e.g. see Wählberg, 2001; Voelklein & Howarth, 2005). Because both frameworks are more sociological in nature (at least in their level of analysis), it is somewhat unclear how relevant concepts can be readily applied to individual-level data. For example, Renn (2010) acknowledges; “SARF is not a causal theory and does not lead us to identify or quantify the factors that shape and influence the amplification and attenuation processes” (p. 158).

It is surprising that with few exceptions (e.g. Brody et al., 2008), little to no (quantitative) studies have looked at the role of social factors in driving (individual) risk perceptions of climate change. Given that normative factors are likely to influence risk perceptions (Swim et al., 2011; Renn, 2010) the current study adds to this literature by measuring the normative influence of important social referents directly using a *social norms* approach (Cialdini, Kallgren, & Reno, 1991). Social norms are broadly defined as “expectations of how people are supposed to act, think or feel in specific situations” (Popenoe, 1983, p. 598).

In accordance with the “focus theory of normative conduct” (Cialdini et al., 1991), the current study measures both “*descriptive social norms*” (i.e. the extent to which referent others are taking action to help reduce the risk of climate change) as well as “*prescriptive social norms*” (i.e. the extent to which an individual feels socially pressured to view climate change as a risk that requires action). It is hypothesised that normative influences bear significantly on an individual’s risk perception. In other words, the greater the extent to which climate change is viewed as a risk by important social referents (e.g. friends, family etc.), the more it amplifies and intensifies an individual’s own risk perception.

## **2.4 Socio-Demographic Characteristics**

It has been consistently documented that females tend to have higher risk perceptions than males for a wide range of hazards (Slovic, 1999), including climate change (e.g. Brody et al., 2008; O’Connor et al., 1999; Sundblad et al., 2007) – this has also been referred to as the “white-male” effect (Finucane et al., 2000). One possible explanation for this is that women are more aware of environmental risks (Dietz, Stern, & Guagnano, 1998) and experience and create more vivid and intense

affective imageries (Loewenstein et al., 2001). In addition to gender, political ideology is also often identified as a predictor of risk perception (e.g. Leiserowitz, 2006; Malka et al., 2009; Smith & Leiserowitz, 2012), where liberals express more concern about climate change than conservatives. Lastly, it is sometimes assumed that a higher education and socio-economic status provides people with an increased sense of control (and thus lower risk perceptions). While there is some marginal support for this hypothesis (e.g. Akerlof et al., 2013; O'Connor et al., 1999), most studies find little to no correlation between income, age, education and risk perceptions of climate change (e.g. Brody et al., 2008; Milfont, 2012; Sjöberg, 2000b; Sundblad et al., 2007). Given the often inconsistent effect of socio-demographics, they mainly serve as control variables here to assess the net influence of *cognitive*, *experiential* and *socio-cultural* factors on risk perception.

### **3.0 The Climate Change Risk Perception Model (CCRPM)**

Based on the preceding discussion, a conceptual overview of the overarching psychological dimensions and included predictor variables is delineated in Figure 4.1. Risk perceptions of climate change can be described as a function of *cognitive factors* (i.e. knowledge about the causes, impacts and solutions to climate change), *experiential processing* (i.e. affective evaluations and personal experience with extreme weather events) and *socio-cultural influences* (including descriptive and prescriptive social norms as well as egoistic, altruistic and biospheric value orientations) - while controlling for key socio-demographic characteristics. While these dimensions are deemed to be particularly critical in explaining public risk perceptions of climate change, the framework (Figure 4.1) is not meant to provide an ultimate explanation nor is the list of included predictors meant to be exhaustive.

It should also be mentioned that the model's dimensions are not implied to operate independently of each other. On the contrary, on a neurological level, affective and cognitive processing mechanisms typically operate in parallel and continuously interact with each other (Chaiken & Trope, 1999; Marx et al., 2007; van der Linden, 2014b; Weber, 2006). In turn, both cognitive and affective processing mechanisms might be conditioned on a third factor such as cultural differences (Kahan, 2012). The aim of this paper is however not to explore the interrelationship between these dimensions. Instead, the current study seeks to provide a useful framework to (a) help structurally organise key psychological predictors, (b) validate the importance of *cognitive, experiential* and *socio-cultural* factors in their own right and (c) illustrate that jointly they are able to account for most of the variance in risk perceptions of climate change.

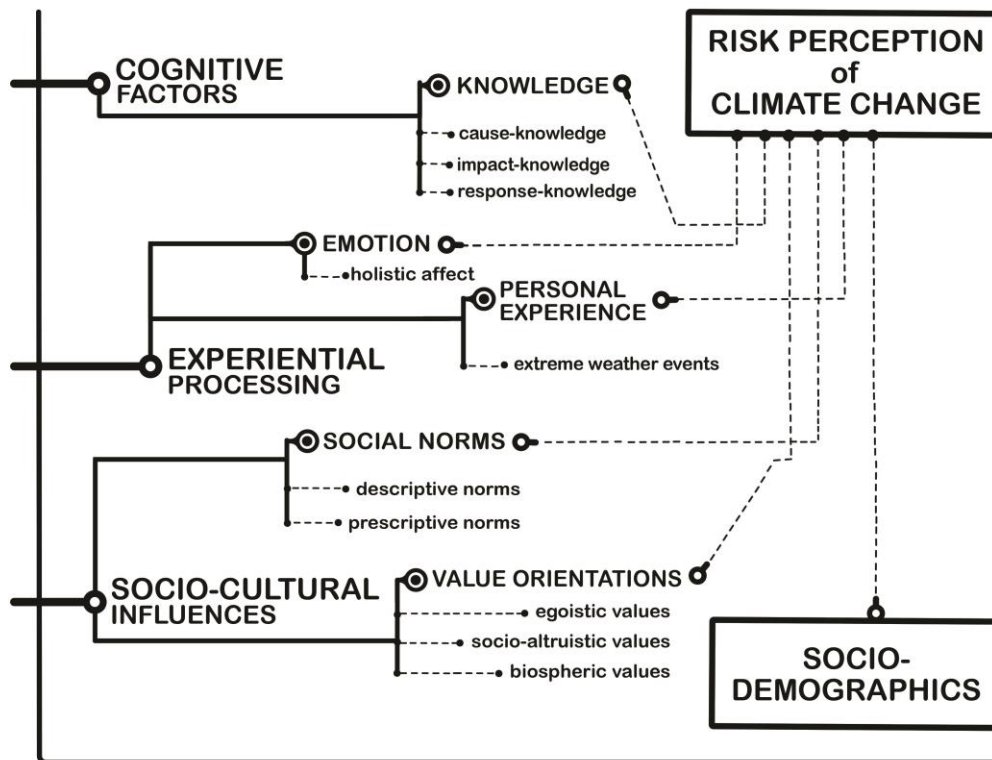


Figure 4.1: The Climate Change Risk Perception Model.

## **4.0 Method**

### **4.1 Participants**

The data set is based on a nationwide sample (N=808) of the population of the United Kingdom (i.e. England, Scotland, Wales and Northern Ireland). The high degree of internet penetration in this country (about 77% of the population) allowed for an online survey via a survey sampling company. A national quota sample<sup>7</sup> (based on gender, age and region) was drawn from a large mixed panel of people who were willing to participate in web-based research for a small (non-monetary) reward. The final sample obtained was composed of 50% male and 50% female respondents. The age of participants ranged between 18 and 65, with a modal age bracket of 35-44.

### **4.2 Materials and Procedure**

During the design stage of the survey instrument, input was obtained from a panel of three academic and professional experts. In addition, to ensure that the survey questions and response categories were clear and unambiguous, a pilot study was conducted at the behavioural research lab of the London School of Economics using a focus group of (N=15) members of the general public. Results of the pilot study were used to refine the questionnaire. The survey was administered online in October 2012, took about 15 to 20 minutes to complete and respondents were assured that their responses remain anonymous. Because the survey was part of larger study designed to explore and investigate a wide range of perceptions, attitudes and behaviours related to climate change, only relevant constructs are reported here.

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<sup>7</sup> Although multi-stage randomisation was employed to select panellists, given the use of a nonprobability (i.e. quota) sample no data was provided (or collected) on response rates.

### 4.3 Measures

#### 4.3.1 Risk Perception

Drawing on items developed by Bord et al. (2000) and Leiserowitz (2006), a total of 8 measures were used to create a holistic assessment of risk perception, covering both spatial and temporal dimensions. The first two questions asked respondents to judge how likely they think it is that they will personally experience threats to their overall well-being as a result of climate change. The same was asked for society as a whole. Three questions asked respondents to evaluate how serious of a threat they think climate change is to the natural environment, the UK and to them personally. Respondents were also asked how serious they would rate current impacts around the world, how concerned they are and how often they worry about climate change. For analysis, three indices were created, a *global/societal* risk perception index ( $\alpha = 0.95$ ), a *personal risk* index ( $\alpha = 0.87$ ) and a *holistic* risk perception index ( $\alpha = 0.96$ ).

#### 4.3.2 Knowledge about Climate Change

Each knowledge scale was assessed with 13 items presented in random order (7 of which were correct statements and 6 were incorrect). The correctness of all statements was based on expert reports (e.g. IPCC) and checked by two academic climate scientists. Responses were dichotomized as either right (1) or wrong (0) and scored and indexed based on the number of *correct* answers (0 - 13) – where more correct answers indicate a higher knowledge score (method adopted from Leiserowitz, Smith and Marlon, 2010). For the *cause*-knowledge scale respondents were asked to what extent each item (e.g. burning fossil fuels) contributes to climate change (i.e. major, minor or no contribution). A reliable scale was obtained for

cause-knowledge ( $\alpha = 0.90$ ). The climate change *consequences / impacts* knowledge scale asked respondents to estimate whether each item (e.g. global sea level) is likely to increase, decrease or not change at all as a result of climate change. Similarly, a reliable scale was created for impact-knowledge ( $\alpha = 0.88$ ). Finally, the *response-behaviours* scale asked respondents to rate how much each item (e.g. conserving energy) is likely to reduce climate change if done worldwide (a lot, a little, not at all). A reliable scale for response-knowledge was obtained as well ( $\alpha = 0.94$ ).

#### 4.3.3 *Holistic Affect*

Following the recommendations of Peters and Slovic (2007) holistic affect was measured using three 7-point bi-polar adjective scales, e.g. ‘I feel that climate change is’ (very unpleasant-pleasant, unfavourable-favourable, negative-positive). A reliable scale was obtained ( $\alpha = 0.85$ ).

#### 4.3.4 *Personal Experience with Extreme Weather Events*

Two questions were used to assess prior experience with extreme weather events. Respondents were asked to recall how often in the last five years they had experienced (a) flooding and (b) other extreme weather events (e.g. severe heat waves, droughts, freak storms etc.) while residing in the United Kingdom. Responses were combined and dichotomized to form an index describing personal experience (0 = no experience, 1 = experience).

#### 4.3.5 *Broad Value Orientations*

Drawing on previous work by Schwartz (1992) and Stern et al. (1999), De Groot and Steg (2007) developed a standardised value scale comprised of four *egoistic, socio-*



*altruistic* and *biospheric* items. The same measures were used here. Respondents were asked to rate the importance of 12 values “as guiding principles in their lives” on a 9 point scale, ranging from -1 *opposed to my values*, 0 *not important* to 7 *extremely important*. Items were randomly ordered. Reliable scales were obtained for egoistic ( $\alpha = 0.79$ ), altruistic ( $\alpha = 0.87$ ) and biospheric ( $\alpha = 0.93$ ) values.

#### 4.3.6 *Social Norms*

##### *Descriptive Norm*

On a 7-point Likert-scale, respondents answered three questions about how *likely* they think it is that important referent others are taking personal action to help tackle climate change. A reliable index was obtained ( $\alpha = 0.97$ ).

##### *Prescriptive (Injunctive) Norm*

Similarly, on a 7-point Likert-Scale, respondents answered four questions about the extent to which they feel socially pressured to personally help reduce the risk of climate change. A reliable index was obtained here as well ( $\alpha = 0.81$ ).

#### 4.3.7 *Socio-Demographic Characteristics*

Lastly, a range of socio-demographic information was collected, including a respondent’s age, gender (female = 1), education, income, religiosity and political party / affiliation. For ease of interpretation, political party and level of education were recoded into binary responses (1 = liberal, 0 = conservative) and (1 = higher and 0 = lower education).

## 5.0 Results

### 5.1 Descriptive Statistics

An overview of the intercorrelations, means and standard deviations of the variables used in this study is provided in Table 4.2.

**Table 4.2: Descriptive Statistics and Intercorrelations**

N = 808	1	2	3	4	5	6	7	8	9	10	11	Mean	SD
1. Biospheric Values	(0.93)											6.22	1.79
2. Egoistic Values	0.23***	(0.79)										4.55	1.45
3. Altruistic Values	0.68***	0.27***	(0.87)									6.76	1.56
4. Cause-Knowledge	0.11**	-0.02	0.04	(0.90)								6.24	1.92
5. Impact-Knowledge	0.27***	-0.01	0.20***	0.51***	(0.88)							7.19	2.52
6. Response-Knowledge	0.22***	0.02	0.17***	0.55***	0.61***	(0.94)						8.03	2.69
7. Descriptive Social Norm	0.35***	0.09**	0.23***	-0.01	0.16***	0.18***	(0.97)					4.21	1.46
8. Prescriptive Social Norm	0.43***	0.14***	0.33***	0.07*	0.27***	0.31***	0.62***	(0.81)				4.52	1.11
9. Affect	0.31***	-0.09**	0.26***	0.22***	0.40***	0.35***	0.20***	0.33***	(0.85)			5.33	1.20
10. Personal Experience	0.13***	0.16***	0.11**	-0.02	0.09*	0.15***	0.17***	0.18***	0.08*	(1.0)		NA	NA
11. Risk Perception	0.54***	0.10**	0.38***	0.09*	0.38***	0.36***	0.51***	0.62***	0.54***	0.22***	(0.96)	4.83	1.36

*Note:* Mean scale reliabilities are provided along the diagonal. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . All variables are coded so that higher values reflect more of the construct.

## 5.2 The Climate Change Risk Perception Model

Using a theory-based approach, hierarchical multiple regression analysis was used to evaluate to what extent cognitive, experiential and socio-cultural dimensions can explain and predict risk perceptions of climate change (Table 4.3). Starting with a baseline model<sup>8</sup>, the influence of relevant socio-demographic characteristics is presented in model 1. Results show that gender, education and political party identification are all significant predictors<sup>9</sup>, explaining a total of 6% of the variance in risk perception ( $F(3, 643) = 15.30, p < 0.001, \text{Adj. } R^2 = 0.06$ ). In other words, being female, higher educated and holding liberal political views is associated with increased risk perceptions of climate change.

Model 2 tested whether cognitive factors explain any additional variance in risk perception while controlling for socio-demographic characteristics. Inspection of the beta weights revealed significant effects for knowledge of the (a) causes, (b) impacts and (c) responses to climate change, explaining an additional 21% of the variance in risk perception ( $F(3, 640) = 58.72, p < 0.001, \text{Adj. } R^2_{\text{change}} = 0.21$ ). Thus, increased knowledge of the causes, impact and solutions to climate change is also associated with higher risk perceptions.

Model 3 explored the influence of experiential processes on risk perception above and beyond the effect of cognitive and socio-demographic factors. Both affect and personal experience with extreme weather events were significant predictors, explaining an additional 25% of the variance in risk perception ( $F(2, 571) = 136.07,$

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<sup>8</sup> About 80% of respondents answered all relevant socio-demographic questions ( $n = 647$ ).

<sup>9</sup> Income, age and religiosity were non-significant predictors and therefore not further reported here.

$p < 0.001$ , Adj.  $R^2_{\text{change}} = 0.25$ ). Thus, personal experience and negative affective evaluations of climate change were both associated with increased risk perceptions.

Model 4 investigated the explanatory power of socio-cultural influences on risk perception in addition to experiential, cognitive and socio-demographic characteristics. Descriptive social norms, prescriptive social norms and biospheric values were all found to be significant predictors, explaining an additional 16% of the variance risk perception ( $F(5, 566) = 58.35, p < 0.001, \text{Adj. } R^2_{\text{change}} = 0.16$ ). The more individuals perceive that others are taking action to help combat the risk of climate change and the more people perceive it is also expected of them, the higher their risk perceptions of climate change. In addition, individuals with stronger biospheric value orientations also tend to view climate change as a greater risk. In contrast, altruistic and egoistic value orientations were non-significant predictors.

In the final (full) model, gender, political party identification, cause-knowledge, impact-knowledge, response-knowledge, holistic affect, personal experience with extreme weather events, descriptive social norms, prescriptive social norms and biospheric value orientations were all identified as significant predictors, accounting for 68% of the variance in climate change risk perceptions ( $F(13, 566) = 93.53, p < 0.001, \text{Adj. } R^2 = 0.68$ )<sup>10</sup>.

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<sup>10</sup> Examination of the collinearity statistics revealed that each predictor fell within acceptable boundaries of tolerance ( $> 0.20$ ) and the VIF coefficient ( $< 5.0$ ), ruling out potential multicollinearity problems (O'Brien, 2007).

**Table 4.3: Climate Change Risk Perception Model (CCRPM) Results**

Independent Variables	Socio-Demographics	Cognitive Factors	Experiential Processes	Socio-Cultural
	Model 1 ( $\beta$ )	Model 2 ( $\beta$ )	Model 3 ( $\beta$ )	Model 4 ( $\beta$ )
Gender	0.14***	0.13***	0.08**	0.05*
Education	0.10***	n.s.	n.s.	n.s.
Political Party	0.20***	0.13***	0.09**	0.06*
Cause Knowledge	-	0.20***	0.19***	0.11***
Impact Knowledge	-	0.31***	0.13***	0.09**
Response Knowledge	-	0.29***	0.17***	0.10**
Affect	-	-	0.54***	0.37***
Personal Experience	-	-	0.11***	0.05*
Descriptive Norm	-	-	-	0.14***
Prescriptive Norm	-	-	-	0.25***
Biospheric Values	-	-	-	0.20***
Altruistic Values	-	-	-	n.s.
Egoistic Values	-	-	-	n.s.
<i>N</i>	647	647	580	580
adj. $R^2$	0.06	0.27	0.52	0.68
$\Delta$ adj.		0.21	0.25	0.16
$F_{\text{change}}$	15.30	58.72	136.07	58.35

*Note:* Dependent variable is holistic risk perception. Entries are standardised beta coefficients;

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$  (n.s. = not significant).

### 5.3 The Relative Importance of Cognitive, Experiential and Socio-Cultural Factors in Explaining Climate Change Risk Perceptions

Zero-order correlations and standardised beta weights are commonly used to judge the relative importance of predictor variables in psychological research (Darlington, 1990). Yet, examining them in isolation can be misleading. Therefore, this paper follows a method developed by Pratt (1987) who advanced a theoretically justified and intuitive way of partitioning explained variance among predictor variables. Pratt defined the relative importance of the  $j$ -th independent variable as the product of two terms: its bivariate correlation with the dependent variable ( $r_j$ ) and its standardised coefficient in the multiple regression ( $\beta_j$ ), where  $\sum_j(\beta_j * r_j) = R^2$ . Using Pratt's (1987) measure, Table 4.4 shows how the adjusted  $R^2$  of the full model is partitioned among all predictor variables as well as for each conceptual dimension as a whole.

A few clear observations are made. First, it becomes evident that overall, *experiential* processes (22.08%) and *socio-cultural* influences (34.40%) contribute the majority (56.48%) of explained variance in climate change risk perceptions, whereas *cognitive* (9.30%) and *socio-demographic* (2.17%) factors (while significant) jointly contribute substantially less (11.47%). Overall, *holistic affect* (20.83%) is the single strongest relative predictor of climate change risk perceptions. It is somewhat surprising that most of the variance contribution in experiential processing can be attributed to affect while direct experience with extreme weather events only contributes marginally (1.30%). Finally, it is interesting to note that *cause-knowledge* (1.02%) contributes somewhat less to the explained variance in risk perception when compared to *impact* (4.39%) and *response-knowledge* (3.94%).

**Table 4.4: Relative Importance of Socio-Demographic, Cognitive, Experiential and Socio-Cultural Influences.**

Independent Variables	Partitioning of Explained Variance
<b>Socio-Demographics</b>	
Gender	0.83%
Political Party	1.34%
<i>Total Variance Explained</i>	<b>2.17%</b>
<b>Cognitive Factors</b>	
Cause-Knowledge	1.02%
Impact-Knowledge	4.34%
Response-Knowledge	3.94%
<i>Total Variance Explained</i>	<b>9.30%</b>
<b>Experiential Processes</b>	
Affect	20.83%
Personal Experience	1.25%
<i>Total Variance Explained</i>	<b>22.08%</b>
<b>Socio-Cultural Influences</b>	
Descriptive Norm	7.10%
Prescriptive Norm	15.10%
Biospheric Values	12.20%
<i>Total Variance Explained</i>	<b>34.40%</b>
<b>Overall Variance Explained</b>	<b>68%</b>

*Note:* Judgements of relative importance of a dimension should not (only) be made in absolute terms but rather in reference to other constructs in the model. *Note:* Simple correlations can be obtained by rewriting  $\sum_j(\beta_j * r_j) = R^2$  so that  $r_j = \left(\frac{R^2 j}{\beta_j}\right)$ .

#### 5.4 Climate Change Risk Perception: A Two Dimensional Construct?

Judged on a scale of 1 to 7, overall risk perceptions of climate change were reasonably high ( $\bar{x} = 4.83$ ,  $SD = 1.36$ ). In order to examine differences in risk judgements in more detail, the eight risk perception items were split into four “*global/societal*” and four perceived “*personal risk*” measures. The difference in mean scores between the two dimensions is highly significant ( $\bar{x} = 6.45 > \bar{x} = 4.44$ ,  $SE_{diff} = 0.03$ ),  $t(807) = 67.88$ ,  $p < 0.001$ ). A confirmatory factor analysis (CFA) was conducted to test the hypothesis that a two-factor (societal and personal) risk perception solution fits the observed (sample) data better than a unidimensional (one-factor) solution. The factor loadings of the societal and personal risk measures are presented in Table 4.5 and are all sufficiently high (ranging from 0.77 to 0.92).

Model fit<sup>11</sup> indices are presented in Table 4.6. It is generally recommended to provide a range of goodness of fit statistics that cover different aspects of model fit. The first statistic in Table 4.6 is the Chi<sup>2</sup> test - where lower values indicate better fit. The CFI and TLI are comparative (relative) fit indices, where a cut off value of 0.95 indicates good fit and  $> 0.95$  excellent fit. The RMSEA and SRMR are absolute fit indices where cut off values between 0.05 and 0.10 indicate a reasonable fit and values  $< 0.05$  excellent fit. AIC and BIC are parsimony fit indices and especially useful for model comparison – lower values indicate better fit. A review of the fit statistics suggests that while a unidimensional structure is acceptable, a two-factor solution provides a significantly better fit to the data (Table 4.6).

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<sup>11</sup> CFI and SRMR are generally preferred (Iacobucci, 2010). For a detailed discussion of goodness of fit statistics and appropriate cut-off value see Hu and Bentler (1999) and McDonald and Ho (2002).



**Table 4.5: Factor Loadings for Societal and Personal Risk Perception Measures.**

<b>Risk Perception Measures</b>	<b>Factor Loadings (Two-Factor Solution)</b>
Societal Risk Perception Measure 1	0.88
Societal Risk Perception Measure 2	0.92
Societal Risk Perception Measure 3	0.93
Societal Risk Perception Measure 4	0.92
Personal Risk Perception Measure 1	0.77
Personal Risk Perception Measure 2	0.91
Personal Risk Perception Measure 3	0.79
Personal Risk Perception Measure 4	0.93

**Table 4.6: Goodness of Fit Statistics for a Two vs. One Factor Solution (CFA)**

Risk Perception (N= 808)	$\chi^2$ (d.f.)	$\Delta\chi^2$	CFI	TLI	RMSEA	SRMR	AIC	BIC
One-Factor Solution (Unidimensional)	345.11 (14)*		0.94	0.91	0.16	0.04	15700	15798
<b>Two-Factor Solution</b>	<b>181.35 (13)*</b>		<b>0.97</b>	<b>0.95</b>	<b>0.11</b>	<b>0.03</b>	<b>15537</b>	<b>15641</b>
		164.76(1)*						

*Note:* \*  $p < 0.001$ . The following measures of fit are reported: Comparative Fit Index (CFI); Tucker Lewis Index (TLI); Root Mean Square Error of Approximation (RMSEA); Standardised Root Mean Square Residual (SRMSR); Akaike Information Criterion (AIC); Bayesian Information Criterion (BIC).

### 5.5 Psychological Antecedents of Societal and Personal Risk Perceptions

Since risk perceptions of climate change can be conceptualised as having a two-dimensional structure, in addition to analyzing holistic risk perception, a logical next step is to examine to what extent cognitive, experiential and socio-cultural factors can explain both societal and personal risk perceptions and whether these two

dimensions have different psychological antecedents. In order to systematically analyse differences in determinants of societal (model 1) and personal (model 2) risk perceptions, two separate regressions were run (Table 4.7) using the same variables that were included in the final regression model in Table 4.3. Results point to three important differences. First, when controlling for all other variables in the regression, knowledge of the causes, impacts and responses to climate change are significant predictors of *societal* risk perception but *not* personal risk perception.

Second, while personal experience is a significant predictor of *personal* risk perception, it does *not* predict *societal* risk perception. Third, while egoistic value orientations are a significant predictor of *personal* risk, they do *not* predict societal risk perception. Gender, political party identification, social norms, biospheric value orientations and affect predicted both personal as well as societal risk perceptions. Comparatively, while socio-demographic, cognitive, experiential and socio-cultural factors jointly explain 56% of the overall variance in personal risk perceptions ( $F(12, 572) = 61.88, p < 0.001, \text{Adj. } R^2 = 0.56$ ), they explain 69% of the variance in societal risk perceptions ( $F(12, 585) = 106.48, p < 0.001, \text{Adj. } R^2 = 0.69$ ).

**Table 4.7: Antecedents of Societal and Personal Risk Perceptions.**

Independent Variables	Societal Risk	Personal Risk
	Model 1 $\beta$	Model 2 $\beta$
Gender	0.05*	0.07**
Political Party	0.06**	0.08**
<b>Cause Knowledge</b>	0.10***	n.s.
<b>Impact Knowledge</b>	0.12***	n.s.
<b>Response Knowledge</b>	0.09***	n.s.
Affect	0.39***	0.29***
<b>Personal Experience</b>	n.s.	0.06*
Descriptive Norm	0.14***	0.16***
Prescriptive Norm	0.23***	0.26***
Biospheric Values	0.22***	0.23***
<b>Egoistic Values</b>	n.s.	0.07*
Altruistic Values	n.s.	n.s.
<i>N</i>	585	585
adj. <i>R</i> <sup>2</sup>	<b>0.69</b>	<b>0.56</b>
F	106.43	61.88

Note: entries are standardised beta coefficients, \*  $p < 0.05$ ,

\*\*  $p < 0.01$ , \*\*\*  $p < 0.001$  (n.s. = not significant).

## **6.0 Discussion**

Public risk perceptions of climate change are clearly complex and multidimensional. The purpose of this paper has been to provide a more systematic and detailed understanding of the social-psychological determinants that underlie risk perceptions of climate change. To this extent, a climate change risk perception model was advanced, combining cognitive, experiential and socio-cultural factors to explain and predict risk perceptions of climate change (while controlling for key socio-demographic factors). Using a national sample, the current study validates the predictive and explanatory power of the model.

### **6.1 Evidence for a Climate Change Risk Perception Model**

It was stated earlier that “*the aim of the work is to find a model which is as fully explanatory as possible*” (Sjöberg, 2012, p. 665). The current research has shown that four conceptual dimensions can be validated empirically: cognitive, experiential, socio-cultural and demographic factors all play a significant role in explaining and predicting holistic risk perceptions of climate change, accounting for more than two-thirds (68%) of the variance - which is substantially more than any published study to date. In fact, in terms of explaining “true variance”, it may very well approximate the ceiling (Sjöberg, 2002). Overall, experiential and socio-cultural processes were most influential, weighing in substantially more than either cognitive or socio-demographic factors in explaining public risk perceptions of climate change. Congruent with the work of Tyler and Cook (1984), this study also provides empirical evidence for a two-dimensional structure (personal vs. societal risk perceptions) and highlights important differences in their psychological antecedents.

### 6.1.2 *Socio-Demographic Characteristics*

In terms of the model's components, socio-demographic factors such as gender and political orientation were found to be significant and consistent predictors of both personal as well as societal risk perceptions of climate change. In particular, females and liberals tend to view climate change as a greater risk, which is consistent with previous research (e.g. Brody et al., 2008; Leiserowitz, 2006; Malka et al., 2009; O'Connor et al., 1999; Sundblad et al., 2007).

While some research has suggested that higher income and higher education should provide people with an increased sense of control and thus lower risk perceptions (e.g. Akerlof et al., 2013; O'Connor et al., 1999), the current research finds little support for this hypothesis, as level of education quickly lost its significance after controlling for knowledge-factors. Moreover, income and age had no significant effect on risk perception - which is also consistent with other recent research (e.g. Kellstedt et al., 2008; Milfont, 2012; Sundblad et al., 2007). Overall, socio-demographics only accounted for a relatively small amount of variance in climate change risk perceptions.

### 6.1.3 *Cognitive Factors*

While a substantial amount of confusion has surrounded the role of knowledge in risk perception (Kellstedt et al., 2008; Malka et al., 2009; Reser et al., 2012; Tobler et al., 2012b), this study distinguishes between three types of knowledge and confirms that knowledge about the (a) *causes*, (b) *impacts* and (c) *responses* to climate change are all *positively* and significantly related to *holistic* risk perceptions of climate change. Thus, people tend to view climate change as a higher risk when

they have knowledge about the causes of climate change, knowledge of what the likely impacts are as well as information about appropriate response behaviours.

Yet, overall, cause-knowledge contributed less to the explained variance than either impact or response knowledge. One possible explanation is that (as opposed to abstract knowledge about cause mechanisms) knowledge about the negative consequences of climate change is likely to elicit more vivid risk perceptions (Weber, 2006). Moreover, upon closer examination it becomes clear that the contribution of knowledge largely stems from its effect on societal risk perception, given that the knowledge items did not explain any variance in *personal* risk perceptions (when controlling for all other variables). It may very well be that since most of the knowledge items were measured on a general level they are likely to correspond more strongly with societal rather than personal risk measures. Yet, this seems to suggest that general knowledge about climate change may not readily map onto a personalized sense of risk.

#### 6.1.4 *Experiential Processes*

While some research has been dismissive of the role of emotion and affect in risk perception (e.g. Sjöberg 2006), the current research finds that holistic *affect* is the single most important predictor of both personal as well as societal risk perceptions of climate change. These results are entirely consistent with research conducted in the US context (e.g. Leiserowitz, 2006; Smith & Leiserowitz, 2012) and provide robust evidence for the role of affect in risk perception. In addition, the current study also provides further support for the growing link between personal experience with extreme weather events and risk perceptions of climate change (e.g. Akerlof et al., 2013; Krosnick et al., 2006; Spence et al., 2011).

While, on average, people who have experienced extreme weather events tend to have significantly higher risk perceptions of climate change, the relative explanatory power of personal experience proved not particularly strong. This finding may be explained by the fact that an explicit (perceptual) link needs to be made salient in order for people to actually causally attribute their experience to climate change (Helgeson et al., 2012; Weber, 2010; Whitmarsh, 2008). For example, other recent research has indicated that personal experience with extreme weather influences beliefs about the reality of climate change (Myers et al., 2012), possibly by helping to reduce its abstract nature, as every day weather is something people are familiar with and can easily relate to (Smith & Joffe, 2013).

Yet, although personal experience correlated significantly with both personal and societal risk perceptions, it remains questionable whether personal experience with extreme weather also breeds concern for society as a whole, given that it was not a significant predictor of societal risk perceptions (after controlling for all other factors). Thus, the role of personal experience with extreme weather (and how it influences risk perceptions) clearly deserves more attention in future research.

#### *6.1.5 Socio-Cultural Influences*

Surprisingly, very little quantitative research has investigated the role of social factors in shaping individual risk perceptions of climate change. The current study focused on assessing normative influence from a social norms perspective. Results indicate that both descriptive and prescriptive social norms show strong associations with risk perceptions of climate change. In other words, the more social referents recognize and act upon the risk of climate change, the more it amplifies and intensifies an individual's risk perception - confirming that social norms

significantly influence perceptions of climate change (Renn, 2010; Swim et al., 2011). Furthermore, in line with other recent research (e.g. De Groot et al., 2013) the current study also supports the inclusion of broad value orientations as important predictors of climate change risk perceptions.

In particular, while biospheric values (i.e. caring about nature and the biosphere) were identified as a strong predictor of both personal as well as societal climate change risk perceptions, social-altruistic values did not predict either. A likely explanation for the non-significant role of altruistic values is that biospheric and altruistic values tend to be strongly and positively correlated. Therefore, in the context of environmental problems, the activation of biospheric values is more salient and hence altruistic values do not add any additional variance, unless both value orientations are in conflict (De Groot & Steg, 2007). The finding that egoistic value orientations predicted *personal* but not societal risk perceptions is non-controversial: self-centred concerns about climate change impacts are unlikely to predict concern for society as a whole. Overall, socio-cultural influences explained most of the variance in risk perception.

## **6.2 Implications for Risk Communication and Future Research**

The present study has important implications for risk communication. First and foremost, because risk perceptions of climate change are influenced by cognitive, experiential as well as socio-cultural factors, risk messages are likely to be more effective when they not only provide people with increased knowledge of the causes, consequences and solutions to climate change, but they should also appeal to affective and experiential processing mechanisms whilst being sensitive to different socio-cultural value orientations. Indeed, public interventions that appeal to multiple



aspects of human behaviour simultaneously are more likely to be successful (van der Linden, 2014a). For example, a strategy that advances public knowledge about climate change (i.e. cognitions) whilst fostering a social norm to view climate change as a hazard that needs to be addressed (i.e. social amplification) is likely to enhance risk perceptions of climate change (Whitmarsh, 2008).

Yet, at the same time, in order to avoid backlash, such messages need to be considerate of and tailored to different cultural and socio-political audiences, especially in countries where political polarisation is high, such as the United States (Hart & Nisbet, 2012; McCright & Dunlap, 2011). In addition, other research has also advocated the potential of experientially based information processing (Marx et al., 2007), potentially through personal or vicarious experience with extreme weather events (Myers et al., 2012). While of course no single weather event can be attributed to climate change, the current study does suggest that making the link between climate change and the rising *frequency* with which extreme weather events are occurring more explicit can indeed be a useful communication strategy.

Nonetheless, it has been argued that this approach could prove problematic in the face of more extreme winters. Yet, recent research by Capstick and Pidgeon (2014) suggests that because the term "climate change" (rather than global warming) has increasingly been used as the predominant frame in the UK, "extremely cold winters" are not necessarily interpreted by the public as evidence against a rise in average global temperatures. A sensible risk communication approach is therefore the suggestion that cold weather extremes are not inconsistent with global warming (Capstick & Pidgeon, 2014).

In line with the "impersonal impact hypothesis" (Tyler & Cook, 1984), risk communication messages should also take into account important differences in

determinants between personal and societal risk perceptions. For example, while increased knowledge of climate change may lead to increased concern for society as a whole, it does not readily translate into a personalized sense of risk. Future research could investigate making knowledge about the causes, impacts and responses to climate change more personally and locally relevant.

Lastly, the current study is of course not without limitations. First, it should be noted that results of the current study are based on a national quota sample of British respondents and thus it remains unclear to what extent results are generalisable to other contexts and cultures. Although, as mentioned, findings of the current study do appear to be strongly aligned with the US context, particularly regarding the importance of experiential and socio-cultural variables in explaining risk perceptions of climate change.

Second, while the aim of the current study was to examine key social-psychological determinants, the list is certainly not exhaustive, as other important factors have also been noted to influence risk perception, such as trust in scientists/experts and exposure to popular media (e.g. Kellstedt et al., 2008; Malka et al., 2009; Slovic, 2006). Future research could also constructively build on the current study by further exploring the interrelated nature of cognitive, experiential and socio-cultural factors in shaping risk perceptions of climate change. Lastly, while designed for the context of climate change, future research may find the psychological framework outlined in this paper equally useful for predicting risk perceptions of other types of (environmental) risks.

## **7.0 Conclusion**

This paper advanced a social-psychological model of climate change risk perceptions. Using a large set of reliable measures, the model was tested on a national sample. Results provide robust evidence for the influence of cognitive, experiential and socio-cultural factors – jointly explaining nearly 70% of the variance in climate change risk perceptions (after controlling for key socio-demographic characteristics). In line with previous research, findings also confirm an empirical distinction between societal and personal risk perceptions and highlight important differences in their psychological antecedents. Taken together, these results suggest that risk perceptions of climate change are complex and multidimensional and that risk communicators should take an integrative approach by appealing to multiple aspects of human judgement and behaviour.

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**CHAPTER 5: ON THE RELATIONSHIP BETWEEN  
PERSONAL EXPERIENCE, AFFECT AND RISK  
PERCEPTION: THE CASE OF CLIMATE CHANGE**

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## **Abstract**

Examining the conceptual relationship between personal experience, affect and risk perception is crucial in improving our understanding of how emotional and cognitive process mechanisms shape public perceptions of climate change. This study is the first to investigate the interrelated nature of these variables by contrasting three prominent social-psychological theories. In the first model, affect is viewed as a fast and associative information processing heuristic that guides perceptions of risk. In the second model, affect is seen as flowing from cognitive appraisals (i.e. affect is thought of as a post-cognitive process). Lastly, a third, dual-process model is advanced that integrates aspects from both theoretical perspectives. Four structural equation models were tested on a national sample ( $N = 808$ ) of the UK population. Results initially provide support for the “cognitive” model, where personal experience with extreme weather is best conceptualised as a predictor of climate change risk perception, and in turn, risk perception a predictor of affect. Yet, closer examination strongly indicates that at the same time, risk perception and affect reciprocally influence each other in a stable feedback system. It is therefore concluded that both theoretical claims are valid and that a dual-process perspective provides a superior fit to the data. Implications for theory and risk communication are discussed.

## 1.0 Introduction

A “risk” is not something that exists “out there”, independent of our minds and culture (Slovic, 1992, p. 119). Indeed, unlike a physical threat or danger, the human notion of “risk” is a mental construct (Sjöberg, 1979), it cannot be sensed - it is only perceived (Fischhoff, Slovic, & Lichtenstein, 1983). Climate change is mostly a statistical concept, referring to the average long-term variability in the earth’s climate (Solomon et al., 2007) and as such, it cannot be experienced directly (Swim et al., 2011). Compared to many other hazards, the threat of climate change is therefore relatively unique: not only because of its scope and breadth (Breakwell, 2010) but also in the sense that it is not directly “situated” in our daily environments (Helgeson, van der Linden, & Chabay, 2012).

Nevertheless, an increasing amount of research has shown that people can (to some extent) accurately detect changes in their local climate and relate this perceptual experience to climate change (e.g. Akerlof et al., 2013; Howe et al., 2013; Joireman, Truelove, & Duell, 2010). Moreover, the rising incidence rate of extreme weather events is now increasingly being associated with climate change (Coumou & Rahmstorf, 2012). In fact, a number of studies have indicated that personal experience with extreme weather events is a significant predictor of climate change risk perceptions (e.g. Akerlof et al., 2013; Brody et al., 2008; Krosnick et al., 2006; Spence et al., 2011).

Personal experience also plays a key role in affective processing, as affective responses are essentially formed through learning and experience (Damasio, 1994). An “*affective*” response is usually defined as a fast, associative and automatic reaction that guides information processing and judgement (Zajonc, 1980). It is often described as a faint whisper of emotion, defined specifically as a positive (like) or

negative (dislike) evaluative feeling towards a stimulus (Slovic et al., 2004). Since affective evaluations of future risks largely depend on the vividness with which negative consequences can be represented mentally (Damasio, 1994; Weber, 2006), it logically follows that personal experience with the impacts of climate change and affective processing are closely interrelated (Marx et al., 2007). However, it is not only direct personal experience and affective processing that go hand in hand. In fact, it is often proposed that any perception (including risk) inevitably contains some affect (Zajonc, 1980). Indeed, negative affect has shown to be an important predictor of climate change risk perceptions (e.g. Leiserowitz, 2006; Smith & Leiserowitz, 2012; Sundblad, Biel, & Gärling, 2007).

Taken together, these research findings raise a number of important and unresolved questions about the relationship between personal experience, affect, and risk perception: does personal experience with extreme weather predict affective judgements? And in turn, do these affective judgements guide public risk perceptions of climate change? Or does personal experience predict risk perception, and in turn, does risk perception predict affect? Alternatively, is it possible that personal experience predicts risk perception and that risk perception and affect simultaneously and reciprocally influence each other?

In short, past research has failed to address the cognition-emotion dilemma in the context of climate change. Doing so is important because more effective public engagement with climate change necessitates risk communication strategies that can better take into account the way in which cognitive and experiential processes shape and influence public perceptions of climate change (Marx et al., 2007). Moreover, as Finucane (2012) notes; *“clarifying the mechanisms by which feelings and cognitions are related and integrated in human judgement and decision making is a critical*

*next step in understanding perceived risk*” (p. 61). As I will illustrate in the next section, the conceptual relationship between personal experience, affect and risk perceptions of climate change can be represented within the frame of three competing social-psychological theories.

## **2.0 The Present Study**

### **2.1 Model 1: Affect as an Information Processing Heuristic**

Much research on affective processing assumes (either implicitly or explicitly) that affect is a *driver* of risk perception (rather than vice versa). For example, Zajonc (1980) unmistakably stated that; “affective judgements are fairly independent of, and precede in time, perceptual and cognitive operations” (p.1). In a similar vein, Slovic et al. (2007) more subtly state that; “the affect heuristic *guides* perceptions of risk” (p. 1343). The notion that people rely on affective cues when making risk judgements is pervasive and based on a substantial amount of experimental as well as clinical research (e.g. Damasio, 1994; Dohle, Keller, & Siegrist, 2010; Fiuncane et al., 2000; Johnson & Tversky, 1983; LeDoux, 1996; Schwartz & Clore, 1983; Zajonc, 1984). The underlying idea is that relying on such heuristics is an evolutionarily adaptive and efficient way of processing information, especially when navigating in a complex, uncertain and dangerous world (Slovic et al., 2007).

Until now (and with good reason), *affect* has mostly been conceptualised as a *predictor* of climate change risk perceptions (e.g. Leiserowitz, 2006; Smith & Leiserowitz, 2012; Sundblad et al., 2007). In line with this view, the hypothesised causal relationship is expected to be unidirectional; where more personal experience with extreme weather leads to the development of negative affective evaluations,

which in turn cultivate higher risk perceptions of climate change. A description of the “affective” model is presented in Figure 5.1.

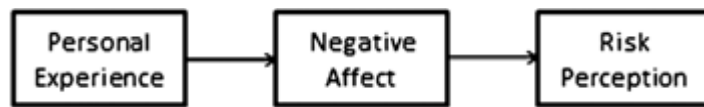


Figure 5.1: Hypothesised Causal Flow Model 1 (the “affective” model).

## 2.2 Model 2: Affect as a Post-Cognitive Process

Other recent experimental research has questioned the extent to which affect can be seen as an associative construct (e.g. Townsend, Spence, & Knowles, 2013) and suggests appraisal theory as a means of understanding the role of emotion in risk perception (e.g. Keller et al., 2012). In fact, diametrically opposed to Zajonc (1980, 1984), Lazarus (1981, 1984) proposed that cognitive processes mediate the relation between environmental situations and specific emotional reactions (i.e. emotions are seen as a post-cognitive process). In order to explain how different people can experience different emotions in identical situations, Lazarus argued that events are first appraised (i.e. perceived and interpreted) in terms of their personal meaning (i.e. how they relate to an individual’s past experiences, personal values and overall well-being). Like information-processing theories, “appraisal theory” has marshaled substantial empirical support (e.g. Roseman, 1984; Scherer, Shorr, & Johnstone 2001; Siemer, Maus, & Gross, 2007). In fact, more generally, Loewenstein et al. (2001) state; “*few would question that cognitive evaluations give rise to affective responses*” (p. 271).

In support of this view, Kobbeltved et al. (2005) report in their (cross-lagged) panel study that; “*it is unlikely that our subjects allowed their affective impressions to guide their risk judgements*” (p. 431). Instead, the authors note that over time, risk

judgements gave rise to negative emotions but not vice versa. Thus, in line with this paradigm (and in contrast to the “affect-heuristic” hypothesis), an alternative causal relationship is one where more personal experience with extreme weather events leads to higher risk perceptions, which in turn, create (more) negative affective evaluations of climate change. A description of the “cognitive” model is presented in Figure 5.2.

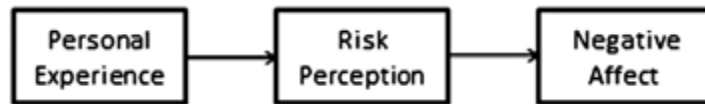


Figure 5.2: Hypothesised Causal Flow Model 2 (the “cognitive” model).

### 2.3 Model 3: A Dual-Processing Perspective: The Case of Climate Change

It is important to recognize, however, that both theoretical perspectives have validity and are not mutually exclusive. For example, although it is now obvious that certain older, subcortical structures in the brain can receive (sensory) information independently of the neocortical structures related to cognition (LeDoux, 1996), when an individual is faced with extreme weather he or she is likely to activate *both* affective processing (e.g. danger) as well as cognitive information about its ontological category (e.g. tornado, climate change). Indeed, humans perceive risk in two fundamental ways, namely; in a cognitive-analytical and experiential-affective manner (Slovic & Peters, 2006). Yet, there is an increasing consensus that the way in which affect functions in relation to cognition is strongly dependent on the context (Lai, Hagoort, & Casasanto, 2012).

In fact, Loewenstein et al. (2001) suggest that when cognitive and emotional reactions diverge, responses are more likely to be guided by affect. Yet, climate change is an evolutionarily novel risk that does *not* represent a clearly observable

physical danger and, thus, there is no environmental cue present to automatically trigger an affective, fear-based fight-flight type response that bypasses cognition completely (Griskevicius, Cantú, & van Vugt, 2012; Weber, 2006). Instead, it is much more likely that when someone personally experiences the likely consequences of climate change (i.e. extreme weather), the individual must first cognitively and causally attribute his or her perceptual experience to climate change (Weber, 2010; Helgeson et al., 2012). At the same time, when this link has been made salient, it is equally likely that negative affective reactions guide and exert a strong influence over risk perceptions. This idea is consistent with neurobiological evidence which suggests that affect can influence cognition and cognition can influence affect (LeDoux, 1989). To this extent, appraisal studies have started to conceptualize the link between emotion and cognition as bi-directional (e.g. Nerb & Spada, 2001) and research is now steadily moving toward a dual-process perspective – emphasising the interplay between cognitive and affective processes (Clore & Ortony, 2000; Gray, 2004; Loewenstein et al., 2001; Pessoa, 2008; Phelps, 2006).

Consistent with this view, the current study presents a dual-process model (Figure 5.3), where more personal experience with extreme weather is expected to predict higher risk perceptions, and while higher risk perceptions in turn predict affect, negative affective evaluations are expected to simultaneously influence and drive higher risk perceptions of climate change. The purpose of the present research is to empirically evaluate the plausibility of all three hypothesised model structures.

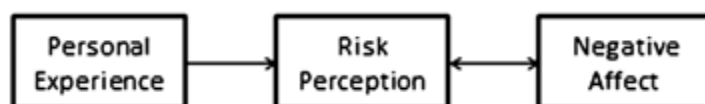


Figure 5.3: Hypothesised Causal Flow Model 3 (the “dual-process” model).



## **3.0 Method**

### **3.1 Sample and Participants**

The data set consists of a national sample ( $N=808$ ) of the population of the United Kingdom. Because the United Kingdom has a high degree of internet users (about 77% of the population), the survey was conducted online via a survey sampling company. A nationally balanced quota sample<sup>12</sup> (based on gender, age and region) was obtained from a large mixed panel of people who were willing to participate in web-based research for a small (symbolic) reward. Multi-stage randomisation was used to select participants from the panel. The sample comprised 50% male and 50% female respondents. The age of participants ranged between 18 and 65, with a modal age bracket of 35-44.

### **3.2 Materials and Procedure**

Because the survey is part of a larger study that aims to explore and investigate a wide range of perceptions, attitudes and behaviours related to climate change, only relevant constructs and results are reported here. The survey instrument was designed with input from a panel of three academic and professional experts. Furthermore, to ensure that the survey questions and response categories were clear and unambiguous, a pilot study was conducted at the behavioural research lab of the London School of Economics and Political Science with a focus group of ( $N=15$ ) members of the general public. Results of the pilot study were used to refine the questionnaire. The survey was administered online in October 2012 and took about 15 to 20 minutes to complete.

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<sup>12</sup> Quotas reflect the 2001 census data for the Great British population.

### 3.3 Measures

#### 3.3.1 Risk Perception

A total of eight measures were used to assess risk perception. Drawing on standardised items developed by O'Connor, Bord and Fisher (1999) and Leiserowitz (2006), all constructs were measured on 7-point (unipolar) Likert-type scales and covered both spatial as well as temporal risk dimensions. The first two questions asked respondents to judge how *likely* they think it is that they will personally experience threats to their overall well-being as a result of climate change. The same was asked for society as a whole. Three questions asked respondents to evaluate how *serious* of a threat they think climate change is to the natural environment, the United Kingdom and to them personally. Respondents were also asked how serious they would rate current impacts around the world and how *concerned* they are about climate change in general. For analysis, a reliable and *holistic* measure of risk perception was created ( $\alpha = 0.96$ ).

#### 3.3.2 Generalised Affect

Peters and Slovic (2007) tested and cross-compared numerous ways of measuring self-reported affect (e.g. through imagery, discrete emotions etc.). The authors found that among all measures, broadly valenced or “holistic” affective evaluations proved to be most reliable. Accordingly, generalised affect was measured with three broadly evaluative bipolar adjective scales, for example ‘I feel that climate change is’ (very unpleasant - pleasant, unfavourable-favourable, negative-positive). A reliable scale was obtained ( $\alpha = 0.85$ ).

### 3.3.3 *Personal Experience with Extreme Weather Events*

Because rising sea levels are one of the most probable consequences of climate change (Solomon et al., 2007), previous research on extreme weather has predominantly focused on flooding events (e.g. Spence et al., 2011; Whitmarsh, 2008). Yet, to account for a potentially wider range of personal experiences with extreme weather, two separate questions were used. Respondents were first asked to recall how often in the last five years they had experienced (a) flooding and (b) other extreme weather events (e.g. severe heat waves, droughts, freak storms etc.) whilst in the United Kingdom. An affirmative response to either question counted towards personal experience. Responses were combined and dichotomized to form an index describing personal experience (0 = no experience, 1 = experience).

### 3.3.4 *Cause Knowledge*

Knowledge about the *causes* of climate change is used in the current study as an auxiliary “instrument” (discussed in more detail in the following section). Measures that try to assess subjective or “self-reported knowledge” with a single item tend to be unreliable (Roser-Renouf & Nisbet, 2008). Therefore, cause knowledge was assessed with 13 items that were presented in random order (7 of which were correct statements and 6 were incorrect). The correctness of all statements was based on expert reports (e.g. IPCC) and checked by two climate scientists. Respondents were asked to what extent each item (e.g. burning fossil fuels) contributes to climate change (i.e. major, minor or no contribution). Following a method developed by Leiserowitz, Smith and Marlon (2010), responses were scored as either right (1) or wrong (0) and indexed (0 - 13) based on the number of *correct* answers, where more correct answers reflect higher knowledge. A reliable scale was obtained ( $\alpha = 0.90$ ).

## 4.0 Results

### 4.1 Overview of Statistical Analyses

All analyses were performed using a latent variable structural equation modelling approach (Bollen, 2005; Ullman & Bentler, 2013).

#### 4.1.1 *Recursive vs. Non-Recursive Structural Equation Models*

The hypothesised relationships of the “cognitive” and “affective” models are estimated with a standard *recursive* (i.e. unidirectional) structural equation approach. However, the dual-process model is estimated using a *non-recursive* (i.e. a bi-directional) structural equation model. Non-recursive structural equation models are more complicated in the sense that both variables (here risk perception and affect) are thought to simultaneously “cause” or influence each other. The problem of simultaneous causation is often addressed with *cross-lagged* models, yet, this is certainly not always appropriate because (a) the assumed “lag” between cause and effect is often unknown (Wong & Law, 1999) and (b) cause does *not* have to precede effect in time (e.g. it is very reasonable to assume that the perception of risk and the experience of negative affect occur simultaneously or at least, in short succession).

In fact, non-recursive structural equation models estimated on cross-sectional data implicitly make a so-called “functional equilibrium” assumption (Schaubroeck, 1990) in order to obtain unbiased regression estimates (Kenny, 1979). The assumption implies that if a causal feedback loop has not fully materialised or stabilised yet, cross-sectional data would not be able to substantiate a synchronous bi-directional relationship. Another important (and often neglected) assumption of non-recursive structural equation models is that they need to be empirically

identified (Kenny, 1979) - which is only truly the case when each endogenous variable in the model has its own *instrument* (i.e. an exogenous variable that influences  $Y_1$  (affect) but not  $Y_2$  (risk) and vice versa). In other words, if two variables are believed to “cause” each other, a third variable (the “instrument”) is needed to partition the variance into endogenous and exogenous components.

For example, in the current study, a valid instrument would be a variable that is significantly correlated with *affect* but not (or only marginally) to risk perception. The instrumental variable approach to causal inference is a powerful but underutilised tool in psychology (Bollen, 2012). In the current study, knowledge about the *causes* of climate change is introduced as an “instrument”. It is argued here that cause-knowledge is a valid instrument because it is both theoretically and empirically related to affect ( $Y_1$ ) but only marginally to risk perception ( $Y_2$ ).

To illustrate, in contrast to knowledge about the *impacts* of climate change (which are often vivid descriptions of a risk event), knowledge about the *physical causes* is expected to share a much weaker theoretical link with risk perception. Particularly, because regardless of whether climate change is seen as a natural or human-caused threat, it remains a risk. Yet, the fact that it is human-caused is likely to trigger strong negative emotional reactions. Indeed, the main perceptual difference between natural and man-made risks often lies in negative affective reactions towards the inflicting agent (Böhm, 2003; Brun, 1992).

#### 4.1.2 Assessment of Model Fit

Model fit is assessed using a range of goodness of fit statistics. The first test statistic reported is the  $\chi^2$  (Chi-square) – for which lower values indicate better fit. The Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI) are comparative

(relative) fit indices where a cut off value of 0.95 indicates good fit and  $> 0.95$  excellent fit. The Root Mean Square Error Approximation (RMSEA) is an absolute fit index that measures lack of fit per degree of freedom, where cut off values between 0.05 and 0.10 indicate reasonable fit and values  $< 0.05$  excellent fit<sup>13</sup>. Nested models (i.e. when a model is simply a less restricted version of the other) are assessed with a Chi-square difference test. Non-nested models are evaluated with parsimony fit indices such as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) where again, lower values indicate better fit. More specifically, a difference of 10 or more provides *very strong* evidence that the model with the more negative values has better fit (Raftery, 1995).

## **4.2 Validating the Measurement Model**

With regard to the measurement model, it is important to first establish sufficient content and construct validity of the measures. As discussed, most of the items used for risk perception and affect are relatively standardised and their usefulness has been established in prior research. Nonetheless, convergent and discriminant validity of the items is assessed using the multitrait-multimethod (MTMT) approach (Campbell & Fiske, 1959) as well as confirmatory factor analysis (CFA) – for which results are presented in Tables 5.1 and 5.2. The factor loadings are provided in Table 5.1 and indicate that all risk perception and affect items load highly on their respective factors, illustrating good *convergent* validity (Farrell & Rudd, 2009). In addition, the MTMT approach suggests that an item should correlate more strongly with all items of the same construct than with measures of other constructs

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<sup>13</sup> For detailed guidelines of goodness of fit statistics in SEM please see McDonald and Ho (2002) and Hu and Bentler (1999) for a good overview.

(Campbell & Fiske, 1959). For example, the items measuring risk perception should correlate more strongly with each other than with the items measuring affect. In other words, the *inter*-correlation between risk perception and affect ( $r = 0.54$ ) should not exceed the value of Cronbach's alpha ( $\alpha = 0.96$ ) since  $\alpha$  is an *intra*-class correlation coefficient. This is clearly the case, as Table 5.2 illustrates. All inter-correlations are well below their mean scale reliabilities<sup>14</sup>, indicating sufficient *discriminant* validity between the measures (Farrell & Rudd, 2009).

**Table 5.1: Factor Loadings and Scale Reliabilities of Measurement Items**

Risk Perception Measures	Factor Loadings	Cronbach's $\alpha$
<i>Risk Perception Index</i>		0.96
Risk Perception Item 1	0.90	
Risk Perception Item 2	0.72	
Risk Perception Item 3	0.86	
Risk Perception Item 4	0.91	
Risk Perception Item 5	0.92	
Risk Perception Item 6	0.86	
Risk Perception Item 7	0.92	
Risk Perception Item 8	0.76	
<i>Generalised Affect Index</i>		0.85
Affect Item 1	0.89	
Affect Item 2	0.91	
Affect Item 3	0.70	

*Note:* All factor loadings are significant at  $p < 0.001$ . Factor loadings can be squared ( $\lambda^2$ ) to obtain the amount of variance that the item explains in the latent construct.

<sup>14</sup> Similarly, the CFA results can be used to prove that the *shared variance* (squared correlation) between each pair of constructs is lower than the *extracted variance* (the average of the squared factor loadings).

**Table 5.2: Descriptive Statistics and Intercorrelations.**

<i>N</i> = 808	Risk Perception	Generalised Affect	Cause-Knowledge	Personal Experience	Mean	Standard Deviation
Risk Perception	(0.96)				4.83	1.36
Generalised Affect	0.54***	(0.86)			5.33	1.20
Cause-Knowledge	0.09*	0.22***	(0.90)		6.24	1.92
Personal Experience	0.22***	0.08*	-0.02	(1.0)	N.A	N.A

*Note:* Measures are coded so that higher scores reflect more of the construct. Reliability scores ( $\alpha$ ) are provided in parentheses along the main diagonal. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

### 4.3 The “Affective” vs. “Cognitive” Model

The structural equation models were estimated using STATA’s (StataCorp, 2013) SEM package<sup>15</sup> and results are presented below in Figures 5.4 and 5.5. The “affective” model is presented first in Figure 5.4, where affect is conceptualised as an antecedent of risk perception (i.e. cognition). Results indicate that both paths, from personal experience to negative affect ( $\beta = 0.10$ ,  $SE = 0.04$ ,  $p < 0.01$ ) and from negative affect to risk perception ( $\beta = 0.67$ ,  $SE = 0.02$ ,  $p < 0.001$ ) are significant. Yet, while personal experience with extreme weather seems to explain very little to no variance in negative affect ( $R^2 = 0.006$ ), negative affect explains a substantial amount of variance in risk perceptions of climate change ( $R^2 = 0.29$ ).

<sup>15</sup> Due to some item non-response (approx. 10%), the model was estimated using a full information maximum likelihood procedure (FIML) – which produces unbiased estimates and is highly recommended (Enders & Bandalos, 2001).



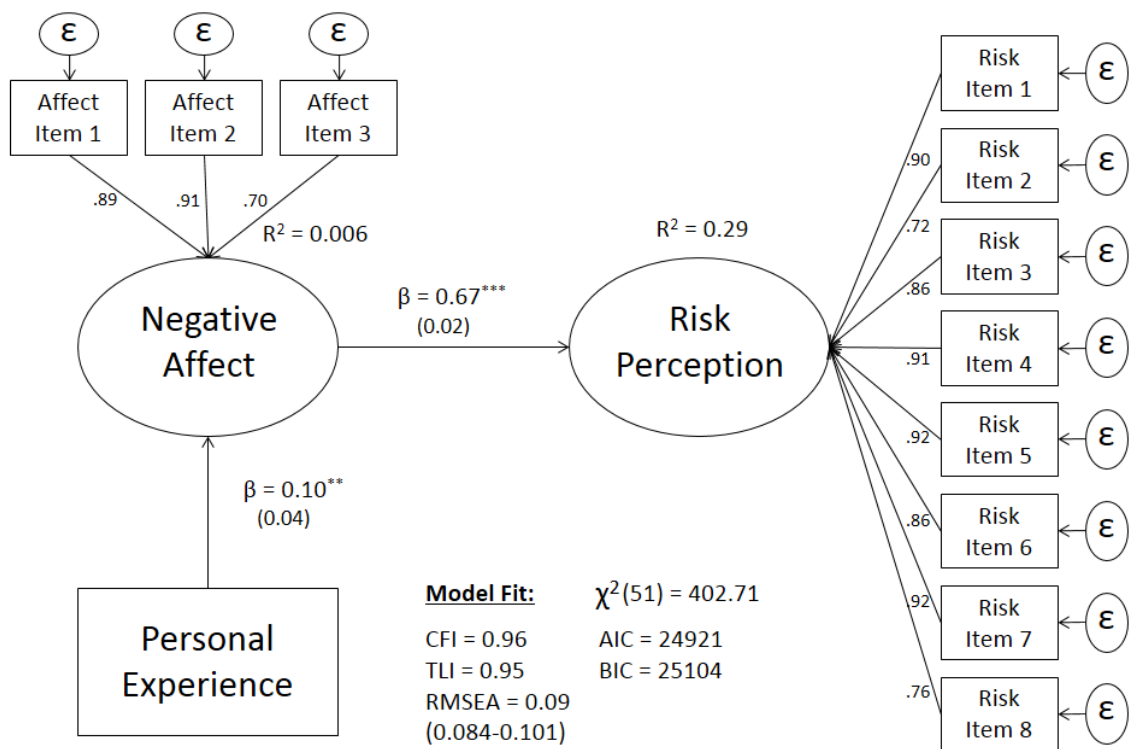


Figure 5.4: Affect as an Information Processing Heuristic (i.e. the “affective” model). Entries are standardised beta coefficients. Only main results are depicted for ease of interpretation, \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

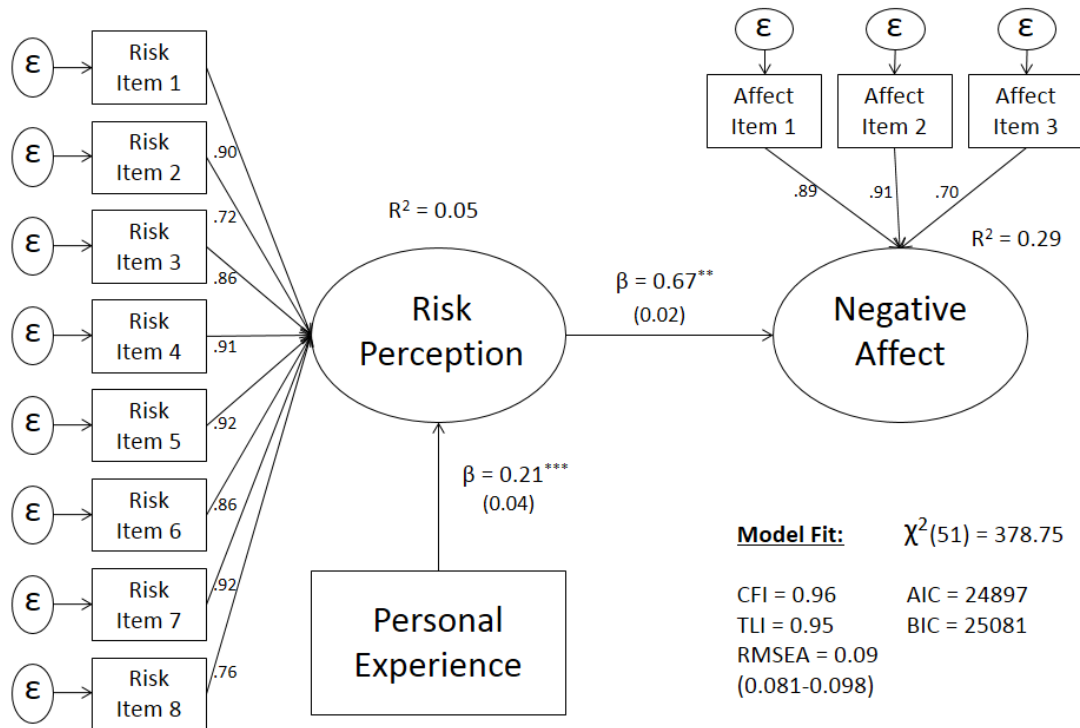


Figure 5.5: Affect as a Post-Cognitive Process (i.e. the “cognitive” model). Entries are standardised beta coefficients. Only main results are depicted for ease of interpretation, \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

In contrast, the “cognitive” model, where risk perception is conceptualised as an antecedent of affect, seems to be better specified in terms of predictive ability - given the magnitude of the personal experience to risk perception path (nearly double) and improved  $R^2 = 0.05$  (Figure 5.5). Moreover, a detailed inspection of the direct and indirect effects (followed by a mediation test) indicates that the impact of personal experience on affect is in fact fully mediated by risk perception ( $z = 5.67$ ,  $SE = 0.05$ ,  $p < 0.001$ ). In terms of overall model fit, the “cognitive” model (Figure 5.5) also has a lower  $\chi^2(51) = 378.75$ ,  $p < 0.001$  than the “affective” model (Figure 5.4)  $\chi^2(51) = 402.71$ ,  $p < 0.001$  - which is preferable. Yet, since these models are

*non-nested* (i.e. one model is not simply a more restricted version of the other), the parsimony fit indices are also compared to further assess model fit. The differences in the Akaike Information Criterion  $\Delta(AIK) = -24$  and the Bayesian Information Criterion  $\Delta(BIC) = -23$  are also strongly in favour of the “cognitive” model. While both models seem to have a reasonable *absolute* fit ( $RMSEA = 0.09$ ), the “cognitive” model is clearly superior in terms of its  $R^2$  and *relative fit* - where personal experience is best conceptualised as a predictor of risk perception, and in turn, risk perception a predictor of affect (i.e. affect is *post-cognitive*).

#### **4.4 A Dual-Process Model of Risk Perception and Affect**

The above *recursive* (i.e. unidirectional) models provide few clues about the potentially interdependent and reciprocal relationship between risk perception and affect. Therefore, a logical next step is to compare the recursive “cognitive” model to a dual-process model where risk perception and affect simultaneously influence each other. Yet, in order to estimate a non-recursive (feedback) model, each of the endogenous variables (risk perception and affect) require an exogenous instrument. As hypothesised in the introduction, without any (conscious) cognitive attribution of the risk event, personal experience with extreme weather seems to have little theoretical connection with affectivity towards climate change. The data supports this hypothesis, given that the influence of personal experience on affect is fully mediated by risk perception. In fact, as Table 5.2 indicates, while personal experience is significantly correlated to risk perception ( $r = 0.22, p < 0.001$ ) it is only marginally related to affect ( $r = 0.08, p < 0.05$ ). Thus, personal experience naturally functions as a viable instrument for risk perception.

The second instrument employed is knowledge about the *causes* of climate change. It was hypothesised that knowledge about the *physical causes* of climate change would share a weak theoretical relationship with risk perception but not with affect. This notion is also supported, as Table 5.2 clearly shows that cause-knowledge is significantly related to affect ( $r = 0.22, p < 0.001$ ) but only marginally to risk perception ( $r = 0.09, p < 0.05$ ). Moreover, the effect of cause-knowledge on risk perception is fully mediated by affect ( $z = 6.10, SE = 0.01, p < 0.001$ ). One potential concern to keep in mind is that if the instruments have differential effects on their corresponding endogenous variables, the variable with the weaker instrument will have a greater disturbance term (Wong & Law, 1999).

The recursive “cognitive” model is estimated first (Figure 5.6) and subsequently compared to the reciprocal (non-recursive) model (Figure 5.7).

A few observations are immediately evident. First, to mitigate concerns about the instruments, their standardised effect on each of the corresponding endogenous variables appears to be equal ( $\beta = 0.17, SE = 0.03, p < 0.001$  vs.  $\beta = 0.18, SE = 0.03, p < 0.001$ ). Second, both of the path coefficients; from risk perception to affect ( $\beta = 0.40, SE = 0.15, p < 0.01$ ) and from affect to risk perception ( $\beta = 0.45, SE = 0.12, p < 0.001$ ) are significant. Third, the overall explained variance ( $R^2 = 0.41$ ) of the reciprocal (dual-process) model is substantially higher than that of the unidirectional model ( $R^2 = 0.09$ ).

In terms of model fit, since the two models are nested (i.e. one is a less restricted version of the other), a Chi-square difference test was performed. The difference in  $\Delta\chi^2(1) = 9.45$  between the two models is significant ( $p < 0.01$ ), indicating that the non-recursive (i.e., reciprocal) model fits the observed variance-covariance matrix better than the unidirectional model. The difference in the

parsimony fit indices,  $\Delta$  AIC (-7) and  $\Delta$  BIC (-3) are equally in favour of the reciprocal model (Figure 5.7). To further examine the plausibility of the bi-directional relationship, the path coefficients between risk perception and affect were constrained to be equal (this adds a degree of freedom as now only one path needs to be estimated - causing the model to be overidentified).

The difference in  $\Delta\chi^2(1) = 2.19$  between the constrained and freely estimated model is not significant, indicating that the two path coefficients are equal. Lastly, the functional equilibrium assumption was tested. A stable model returns an index eigenvalue between 0 and 1. Since the returned value was 0.41, the non-recursive model satisfied the stability condition (Bentler & Freeman, 1983). Overall, these findings strongly point to the conclusion that a non-recursive model (where risk perception and affect reciprocally influence each other) provides a better and more plausible fit to the data than a recursive (i.e. unidirectional) model.

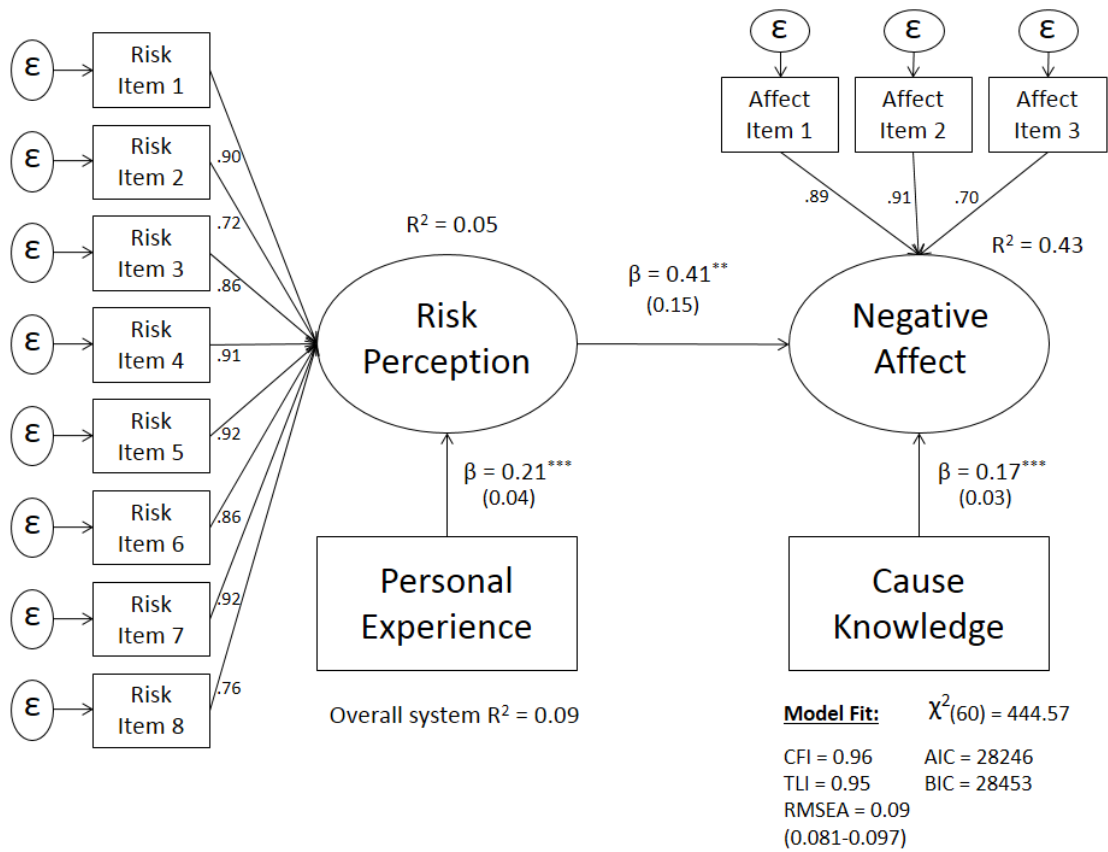


Figure 5.6: Recursive Structural Equation Model. Entries are standardised beta coefficients. Only main results are depicted for ease of interpretation. Endogenous variables covary freely, \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

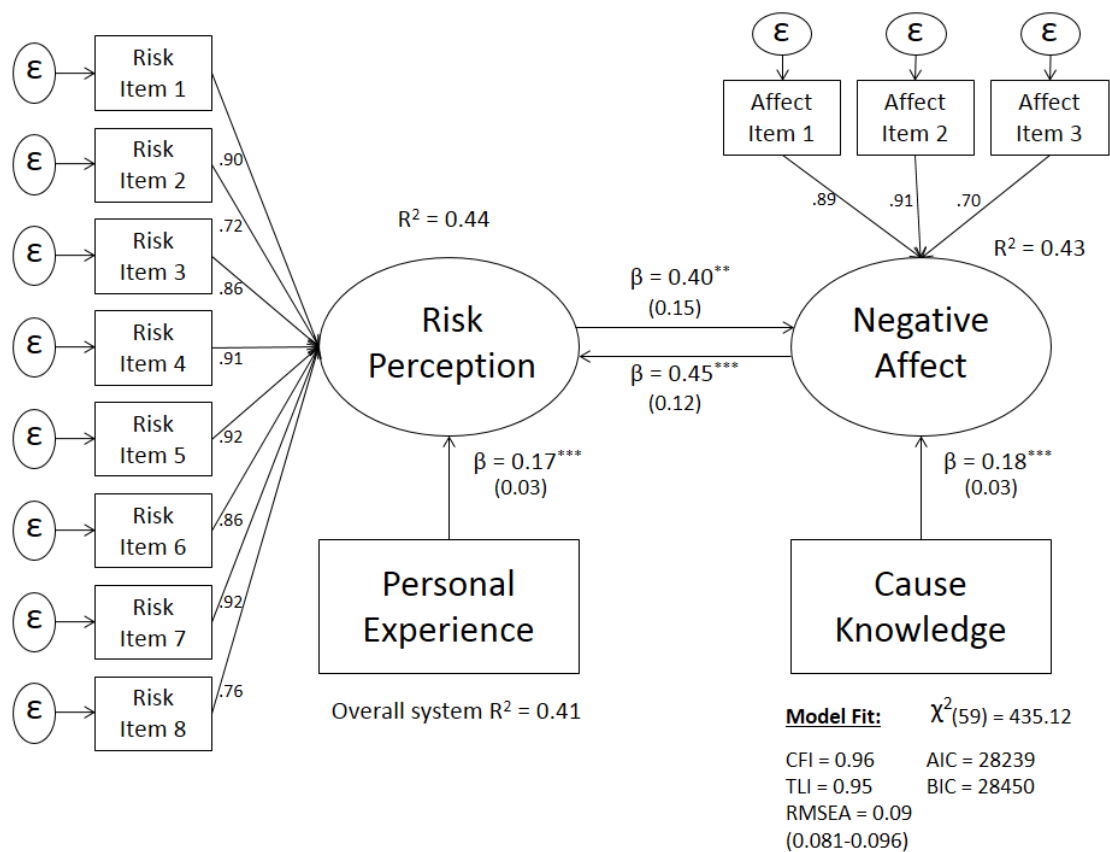


Figure 5.7: Non-Recursive (Dual-Process) Model. Entries are standardised beta coefficients.  $R^2$ 's are Bentler-Raykov squared multiple correlations (Bentler & Raykov, 2000). \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

## 5.0 Discussion

### 5.1 A Causal Tale: Personal Experience with Extreme Weather, Negative Affective Evaluations and Risk Perceptions of Climate Change.

The current study set out to explore the complex and intricate causal relationship between personal experience with extreme weather events, negative affect and risk perceptions of climate change. Using a structural equation modelling approach, three

competing theories were contrasted, namely: (a) the “affective” model (where affect is seen as information-processing heuristic), (b) the “cognitive” model (where affect is viewed as a post-cognitive process) and (c) a “*dual-process*” model that integrates aspects from both theoretical perspectives. Results initially provided support for the post-cognitive specification, where personal experience predicts risk perception and in turn, risk perception predicts (negative) affect. However, further examination of the relationship between risk perception and affect revealed that while personal experience is indeed best conceptualised as a predictor of risk perception, a mutually reinforcing and reciprocal relationship between affect and risk perception provides a significantly better fit to the data than a unidirectional model.

## **5.2 Towards a Dual Processing Perspective**

Previous research has noted that because climate change (as an object) cannot be experienced directly it fails to activate a primal affective/associative risk response (Weber, 2006). In fact, it has been suggested that in order for an individual to develop negative affectivity towards climate change, that individual must first cognitively attribute his or her personal experience with extreme weather to climate change (Helgeson et al., 2012; Weber, 2010). Results of the current study are congruent with this post-cognitive interpretation, as the effect of personal experience with extreme weather events is fully mediated by risk perception. These findings strongly suggest that people first perceive, interpret and appraise risk events in terms of their personal meaning and relevance (at least in the context of climate change). As such, these results are consistent with appraisal theory (e.g. Böhm, 2003; Lazarus, 1984; Nerb & Spada, 2001; Zaalberg et al., 2009; Yang & Kahlor, 2013), other risk perception studies (e.g. Kobbeltved et al., 2005) as well as with recent



research that has provided evidence for a reciprocal relationship between personal experience and belief certainty that climate change is happening (Myers et al., 2012).

It is important to note that these results by no means negate the role of affect as a fast and associative response heuristic that guides information processing and risk judgements, as suggested by Zajonc (1980) and Slovic et al., (2004). In fact, it is very likely that extreme weather events trigger biologically hard-wired affective reactions (e.g. an impending hurricane is likely to stir up negative emotional reactions). Yet, the experienced affect is geared towards the risk object (i.e. the hurricane) and does not necessarily influence perceptions of climate change (unless a conscious link between the extreme weather event and climate change is made salient). However, as this study shows, once this link is established, negative affective reactions appear to be a strong determinant of climate change risk perceptions, where risk perception and affect mutually reinforce each other in a stable feedback system. This is consistent with prior research that has shown that affective judgements of climate change predict cognitive risk perceptions and vice versa (Sundblad et al., 2007).

In conclusion, the current study strongly suggests that (at least in the context of climate change) both theoretical perspectives hold true: affect can be seen as a post-cognitive process as well as an information-processing heuristic that guides perceptions of risk. These findings are entirely consistent with research that has pointed out the interrelated neurological connections between the brain's subcortical and neocortical structures (e.g. LeDoux, 1995; Pessoa, 2008) and provide further evidence for the validity of dual-processing theories that highlight the interplay between cognition and emotion (e.g. Loewenstein et al., 2001; Sloman, 1996).

## 5.2 Implications for Risk Communication

The practical value of this research is evident in that risk perception, and the experiential system in general have been implicated as important determinants of actions to help reduce climate change (e.g. Leiserowitz, 2006; Marx et al., 2007; O'Connor et al., 1999; Semenza et al., 2008; Spence et al., 2011). Results of this study suggest that in order to design effective social-psychological interventions, risk communication messages should take into account the interrelated nature of personal experience, affect and risk perception and the way in which these variables shape perceptions of and beliefs about climate change. Indeed, the interactive engagement of both cognitive and emotional processing mechanisms is key to fostering more public involvement with climate change.

For example, based on the findings of this study and others' (e.g. Capstick & Pidgeon, 2014; Myers et al., 2012), risk communication campaigns should try to emphasise the association between (recent) increases in extreme weather events and climate change. Particularly, because once this link is made salient, a mutually reinforcing relationship between risk perception and affect is established. In addition, results suggest that negative affective evaluations can also be elicited by improving the public's (cognitive) knowledge of the human causes of climate change. In turn, negative affect is then likely to further guide information-seeking behaviour (Yang & Kahlor, 2013). Facilitating the cognition-emotion link is congruent with recent research on climate change communication, which equally suggests that appealing to *both* cognitive and affective processing mechanisms is likely to be a more successful approach (van der Linden, 2014).

### 5.3 Some Final Thoughts on Cognition, Emotion, Causality and Future Research

It is well-known that the cognition vs. emotion debate in psychology is held back by semantics (Kleinginna & Kleinginna, 1985; LeDoux, 1995). In other words, the relationship between cognition and affect, to some extent, depends on how we choose to define these concepts. I should therefore note that the risk perception measures used in this study might not be entirely cognitive and similarly, measures of affect might not be judged as purely emotional either, depending on the reader's definition of these concepts. Yet they don't need to be: the standardised measures used in the current study display sufficient convergent and discriminant validity. Moreover, the purpose of this paper has been to illustrate how these psychological constructs function in relation to each other in the context of climate change. In line with the views of Lai, Hagoort, and Casasanto (2012), future research is advised to move away from discussing semantics and instead focus on exploring the functional relationships between cognitive and experiential constructs in specific contexts.

In addition, I would like to offer a final note on the term "causality" and how it relates to structural equation modelling (SEM). As Pearl (2012) summarized; the critical reader might ask, "*structural equation modelling cannot prove causation so how can it yield results that have a causal interpretation?*" (p. 1). While it is true that no statistical method can in or by itself truly prove "causality", the current study stresses that through a combination of theory and observation, parameters can certainly have a causal interpretation (Iacobucci, 2009; Pearl, 2012) and encourages the view that SEM should be seen as a tool to assess the *plausibility* of different hypothesised causal path relationships (based on how well such theoretical structures fit the observed variance-covariance matrix).

As Fabrigar, Porter, and Norris (2010) state; “*If one model is found to be clearly superior to other models, a researcher might reasonably make the case that certain causal assumptions are more plausible than others for the given dataset*” (p. 222). It is always good to keep in mind that depending on (a) one’s philosophy of causality, (b) the data at hand and (c) the extent to which all the assumptions of a given statistical method are met, “*it will not in general be indisputably clear that an experimental approach accords with all the criteria for causation better than a non-experimental approach*” (Bagozzi, 2010, p. 210).

Human social life is invariably complex and attaining a better understanding of causal relationships necessitates a methodology that is flexible and dynamic enough to model intricate behavioural systems. To this extent, SEM can help researchers offer tentative causal conclusions (Bullock, Harlow, & Mulaik, 1994; Fabrigar et al., 2010; Markus, 2010). The emphasis here is on the term *tentative* and future research could constructively build on the current study by using experimental techniques as well as panel data to further assess the causal structure between personal experience, risk perception and affect and explore how these relationships are likely to function over time as well as how they relate to intention and behaviour.

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**CHAPTER 6: THE SOCIAL-PSYCHOLOGICAL  
DETERMINANTS OF CLIMATE CHANGE MITIGATION  
INTENTIONS AND BEHAVIOURS: A DOMAIN-CONTEXT-  
BEHAVIOUR (DCB) MODEL.**

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## Abstract

This paper advances a domain-context-behaviour (DCB) model. The DCB model structurally organises the social-psychological determinants of a wide range of climate change mitigation behaviours in three causal steps. In particular, psychological motivations are assumed to start with the development of broad pro-environmental/biospheric value orientations (i.e. the domain). These value orientations in turn predict key climate change “context” variables, including; risk perception, response-knowledge and perceived social support. Both values and climate change context variables then feed into a more general intention to act. A central feature of the DCB model is the notion that both mitigation intentions and behaviour-specific determinants are influenced, activated and preceded by a broader and more generally defined orienting intention to help reduce climate change. This general intention influences specific mitigation intentions directly as well as indirectly via behaviour-specific determinants such as attitudes, perceived behavioural control and situational constraints. Lastly, the model suggests that mitigation behaviour is predicted by both mitigation intentions as well as habitual processes. The model is subsequently tested and validated on a national sample of the UK population. The model constructs were surveyed in wave 1 ( $N = 808$ ) and self-reported behaviour was obtained in wave 2 ( $N = 501$ ). Overall, the DCB model explains 66% of the variance in general intentions to help reduce climate change, 57% of the variance in specific mitigation intentions and 35% of the variance in aggregate mitigation behaviour. Interesting and important differences emerge between the determinants of high-cost, high-impact and low-cost, low-impact behavioural changes. Implications for theory and practice are discussed.

## 1.0 Introduction

Addressing climate change is one of the biggest societal challenges of the twenty-first century (Swim et al., 2011). Indeed, multiple lines of evidence now suggest that over 97% of independent climate scientists take the consensus position that global climate change is mainly driven by human activities (e.g. Anderegg et al., 2010; Cook et al., 2013; Doran & Zimmerman, 2009). These activities predominantly refer to behaviours that result in the release of greenhouse gas emissions (GHG) such as carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>). Therefore, in order to help mitigate or reduce climate change, it is pivotal to change existing behaviour and consumption patterns (Gifford, Kormos, & McIntyre, 2011) - for which the collective potential has clearly been demonstrated (e.g. Dietz et al., 2009; Dietz, Stern, & Weber, 2013; Gardner & Stern, 2008). In fact, figures from both the US and the UK indicate that changes in individual lifestyles could reduce national carbon dioxide emissions by as much as 20% to 30% (Dietz et al., 2009; UK Energy Research Centre, 2009).

It is astonishing however, that compared to economic and technological solutions, psychological research remains severely underrepresented in the mitigation debate (Spence & Pidgeon, 2009; Klöckner, 2011; Ernst & Wenzel, 2014). This is especially surprising given that the ultimate goal of applied psychology is to change behaviour in response to a problem (Kaiser, Schultz, & Scheuthle, 2007). Yet, in order to effectively change any behaviour, a grounded understanding of all the determinant factors that shape and influence a behaviour must be established first (Darnton, 2008; Gifford et al., 2011; Klöckner, 2013; van der Linden, 2014). In fact, van der Linden (2013) asks;... *“is it not presumptuous to think that sustainable behavioural change can be achieved without understanding the factors that underlie, drive and differentiate the behaviours under*



*investigation?*” (p. 213). While the psychological determinants of environmental behaviour in general have been actively studied for over thirty years, a specific focus on climate change has been lacking (Roser-Renouf & Nisbet, 2008). Indeed, while there appears to be widespread awareness and concern about climate change (e.g. Bord, O’Connor, & Fisher, 1998; Leiserowitz, 2007; Lorenzoni & Pidgeon, 2006; Pidgeon, 2012), behavioural change has not followed (Whitmarsh, Seyfang, & O’Neill, 2011). Yet, since Gardner and Stern (2009) advanced their short-list of the most “effective” behaviours that individuals can adopt to reduce climate change, research has slowly moved towards a discourse of “*low-carbon lifestyles*” (Whitmarsh, O’Neill, & Lorenzoni, 2011) and “*GHG-mitigating behaviours*” (Gifford et al., 2011). In fact, some initial headway has been made towards mapping the determinants of climate change mitigation intentions and behaviours (e.g. Bord, O’Connor, & Fisher, 2000; Brody, Grover, & Vedlitz, 2012; Ngo et al., 2009; Poortinga, Spence, Demski, & Pidgeon, 2012; Tobler, Visschers, & Siegrist, 2012a; Whitmarsh, 2009; Whitmarsh & O’Neill, 2010).

However, two substantial issues remain. First, most previous work has used extremely broad measures of intention, ranging from very general conceptualisations such as “I plan to take some actions to stop global warming” (e.g. Heath & Gifford, 2006; Hidalgo & Pisano, 2010), to somewhat more specific phrasings such as “I am prepared to greatly reduce my energy use to help tackle climate change” (e.g. Spence, Poortinga, Butler, & Pidgeon, 2011) while only a handful of studies have measured intentions to perform more specific behaviours (e.g. O’Connor, Bord, & Fisher, 1999; O’Neill & Whitmarsh, 2010; Tobler et al., 2012a; Whitmarsh, 2009). Moreover, with a few exceptions (e.g. Semenza et al., 2008; Swim & Becker, 2012; Whitmarsh, 2009), very little research has (systematically) investigated (actual) mitigation behaviour. In addition, existing research has mostly been regional (e.g. Semenza et al., 2008; Tobler et al., 2012;

Whitmarsh, 2009) and has not longitudinally assessed to what extent perceptions and beliefs about climate change in T1 actually predict behavioural changes in T2. A major consequence of the broad-stroke intention approach (coupled with a lack of research on actual behaviour) is that it remains largely unclear what such general intentions actually translate to. This is especially prudent given the noted asymmetry between *impact* and *intent*-oriented research (Stern, 2000; Whitmarsh, 2009), which has indicated that people's intentions often do not correspond with behaviours that actually help reduce climate change. For example, people who report to act pro-environmentally do not necessarily use less energy (Gatersleben, Steg, & Vlek, 2002).

A second important issue is that research in this area has thus far mostly been exploratory. For example, while past studies have focused on the role of climate change relevant norms, beliefs, values and perceptions, the conceptual relationship between these variables and their influence on specific intentions and behaviours remains unclear. As Whitmarsh (2009) states; "*future work should focus on identifying the relationships between relevant theoretical constructs* (p. 22). Accordingly, the current study employs a longitudinal national sample of the UK population to introduce and test an applied model of behaviour that is referred to here as the "*domain-context-behaviour*" (DCB) model. By reliably assessing a large number of relevant behaviours and determinants, the DCB model aims to systematically illuminate the way in which theoretically-relevant constructs shape and influence climate change mitigation intentions and behaviour.

## 2.0 The Present Study: A Domain-Context-Behaviour (DCB) Model

A substantial number of studies have reported significant relationships between (what are referred to here as) “*climate change context*” variables and broad behavioural intentions to tackle climate change<sup>16</sup>. Perhaps the two most salient and theoretically relevant predictors are; *risk perceptions* of climate change (e.g. Brody et al., 2012; Leiserowitz, 2006; O’Connor et al., 1999; Spence, Poortinga, & Pidgeon, 2012; Tobler et al., 2012a) and *knowledge* about climate change (e.g. Bord et al., 2000; Heath & Gifford, 2006; Ngo et al., 2009; O’Connor, Bord, Yamal, & Wiefek, 2002; Truelove & Parks, 2012). Yet, there is a fundamental problem with the way climate change context variables have been conceptualised as individual predictors of climate change mitigation intentions and behaviours. For example, while O’Connor et al. (2002) state that the relationship between risk perception and intention seems “obvious” (p.2), from a social-psychological viewpoint, this relationship is in fact far from obvious.

To illustrate, the Theory of Planned Behaviour (Ajzen, 1991) is one of the most widely applied frameworks for predicting human behaviour (Armitage & Conner, 2001) and suggests that the most proximal antecedent of behaviour is an individual’s intention to perform the behaviour in question (see appendix B for a visual depiction of the TPB). Variables such as risk perception and knowledge are then not considered to be direct predictors of specific intentions, rather, they are seen as background factors or “antecedents” that influence intention only indirectly via more proximal behaviour-specific determinants such as an individual’s attitude toward or perceived sense of control over performing the behaviour (Fishbein & Ajzen, 2010).

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<sup>16</sup> A general intention is defined here as an intention that is *non-specific* with regard to context and time elements (see also Fishbein & Ajzen, 1975).

Moreover, the principle of *measurement correspondence* (Ajzen & Fishbein, 1977) suggests that when predicting behaviour, the criterion variable should be operationalised at the same level of specificity as the explanatory variable. For example, if the explanatory variable is conceptualised at a broad level (e.g. risk perception of climate change), the criterion variable should be assessed on an equally broad and general level (e.g. intention to tackle climate change). However, as mentioned, it is entirely unclear what such broad intentions actually translate to. Alternatively, when risk perceptions of climate change (a broad object) are related to a more specific action (e.g. intention to conserve energy) – evaluative inconsistencies arise (Kaiser, Byrka, & Hartig, 2010). To illustrate, it is likely that the relationship between risk perceptions of climate change and intentions to conserve energy is fully mediated by factors that are conceptually more proximal to the behaviour, such as an individual’s personal attitude toward (or ability to use) less energy. To further illustrate this principle, a visualisation of the “measurement correspondence” problem is presented in Figure 6.1.

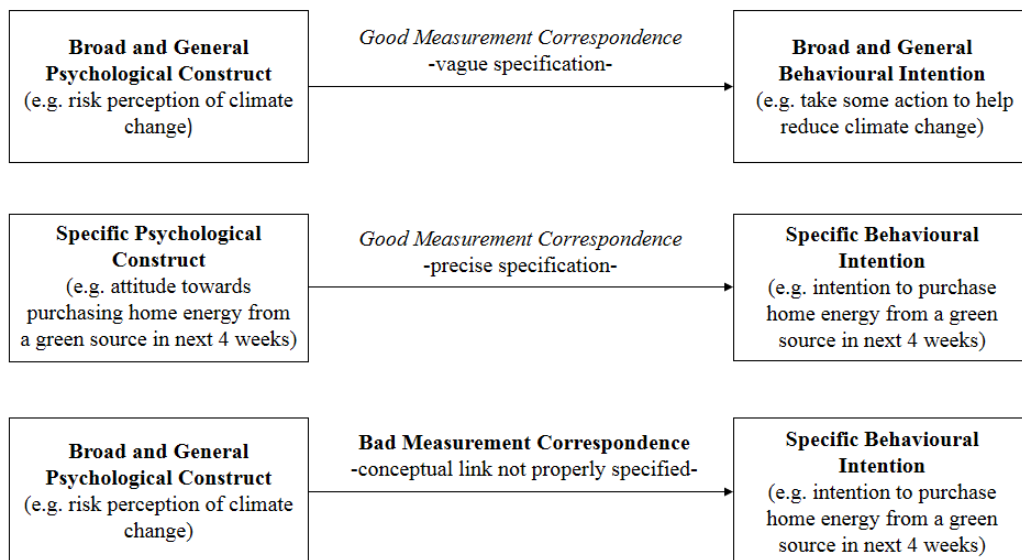


Figure 6.1: The Measurement Correspondence Problem.

While the principle of measurement correspondence is generally well-supported empirically (e.g. Heberlein & Black, 1976; Weigel & Newman, 1976; Weigel, Vernon, & Tognacci, 1974; Vining & Ebreo, 1992), criticism towards overreliance on one particular measurement paradigm has been expressed (e.g. Kaiser, Schultz, & Scheuthle, 2007). Still, there remains substantial confusion about the causal role of broad values and general environmental beliefs in specific mitigation actions. For example, a study by Bamberg (2003) showed that the effect of broad environmental concern on specific behaviour (e.g. inquiring about green energy) was fully mediated by situation-specific cognitions. In addition, Ajzen et al. (2011) reported that general environmental knowledge and attitudes did not explain any variance in energy conservation behaviour after controlling for specific norms, attitudes and intentions to conserve energy. In a similar vein, Whitmarsh and O'Neill (2010) reported that when controlling for behaviour-specific factors, values did not add to the prediction of intentions to perform a specific behaviour (e.g. carbon offsetting). Yet, Stern et al. (1999) argue that values may affect behaviour directly.

With regard to beliefs about climate change, Poortinga et al. (2012) report that the effect of broad values on low-carbon behaviours was fully mediated by more specific beliefs, concerns and norms about climate change. While Vainio and Paloniemi (2013) also argue that the relationship between general values and mitigation behaviour is mediated by belief in climate change, Price, Walker and Boschetti (2014) argue the opposite: that the effect of values on carbon-relevant behaviour is mostly direct and only weakly mediated by specific beliefs about climate change. Results from both Whitmarsh (2009) and Whitmarsh and O'Neill (2010) indicate that risk perceptions of and knowledge about climate change do not seem to significantly predict behaviour.

The present study argues that the relationship between environmental values, climate change “context” variables and specific mitigation intentions and behaviours has

been obscured by the fact that, with a few exceptions (e.g. Ajzen et al., 2011; Whitmarsh & O'Neill, 2010) studies often do not measure (actual) behaviour and when they do, often fail to control for the effect of behaviour-specific determinants. Moreover, thus far, the literature has mostly mapped the psychological determinants of climate change mitigation behaviours in a largely exploratory fashion (Whitmarsh, 2009), without much regard for existing behavioural models and with little theorising as to how these variables are conceptually related to (a) one another and (b) intention and behaviour.

Indeed, how are broad and general environmental values, more detailed beliefs and perceptions about climate change and behaviour-specific determinants conceptually related to both each other as well as to specific mitigation intentions and behaviours? To answer this question, the present study introduces a *domain-context-behaviour* model (DCB). The DCB proposes a linear causal progression from the most “distant” antecedents (i.e. domain-relevant variables), to (mediating) context-variables to ultimately the most proximal predictors of individual action (i.e. behaviour-specific variables). In particular, it is suggested that climate change context variables share no direct relationship with specific mitigation intentions and behaviour (hypothesis 1). Instead, context variables are assumed to be conceptually related to an individual’s broad and general intention to help reduce climate change (hypothesis 2). It is assumed that this general intention then activates and directs motivation and attention towards more specific mitigation intentions (hypothesis 3).

One major objective of the current study is to identify how broad value orientations and beliefs about climate change influence more specifically defined intentions and behaviours (in terms of both context and time-elements). In fact, it is crucial for applied researchers to be specific and to identify to what extent these constructs play a role - not only in broadly or vaguely defined terms, but also in people’s

day-to-day life. Are existing cognitions, norms and emotions about the environment and climate change predictive of individual action in the short-term, and if so, how?

A key feature of the DCB model is the notion that general intentions serve as a situation-invariant (psychological) “orienting” mechanism, mediating the relationship between climate change context variables and specific mitigation intentions. One way to think about this metaphorically is that general intentions are very much like the earth’s climate –an invisible and long-term background condition, whereas specific intentions and behaviours are more like the weather, concrete manifestations of a more general state<sup>17</sup>. The notion that general intentions (i.e. free of context and time elements) can prime, activate and predict situation-specific intentions is theoretically coherent (Ajzen, personal communication) and in line with other work which has suggested that specific intentions are likely to be conditional upon the existence of a more global antecedent intention (Warshaw, 1980). However, recognizing that human (mitigation) behaviour is the product of both intentional and unintentional (i.e. automated) processes (Barr, Gilg, & Ford, 2005; Triandis, 1977), the DCB model suggests that mitigation behaviour is ultimately a function of both intention and habit. A more detailed explanation of the DCB model’s main components is provided below.

## **2.1. The Domain: Environmental Value Structures**

Climate change is inevitably intertwined with and part of a much broader domain that encompasses a wide range of environmental problems and behaviours. While often ignored, in order to assess the overall relevance of specific climate change context variables, it is important to demonstrate their explanatory power above and beyond an individual’s general pro-environmental values. While some past studies have controlled

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<sup>17</sup> I would like to thank Anthony Leiserowitz for bringing this metaphor to my attention.

for broad environmental worldviews (e.g. O'Connor et al., 1999; Whitmarsh, 2008), they have often relied on shortened versions of the New Environmental Paradigm (NEP) scale (Dunlap & Van Liere, 2008). This is problematic in the sense that such measures are limited to only one dimension (i.e. environmental values) and do not account for the fact that humans have multidimensional and competing value structures (Steg et al., 2011; Tsirogianni & Gaskell, 2011).

Values are usually defined as broad and stable situation-transcending goals that serve as guiding principles in a person's life (Rokeach, 1973; Schwartz, 1992; Tsirogianni & Gaskell, 2011). As such, values generally affect behaviour indirectly (e.g. De Groot & Steg, 2009; Eagly & Chaiken, 1993; Nordlund & Garvill, 2002; Poortinga et al., 2012; Schultz et al., 2005; Stern et al., 1999). While values have sometimes shown to affect behaviour directly, this only tends to occur when studies fail to control for behaviour-specific factors (De Groot & Thøgersen, 2013). In line with Stern et al.'s (1999) Value-Belief-Norm (VBN) theory (see appendix B), the DCB model starts the causal flow with general value orientations. Particularly because (a) broad value structures precede and are more fundamental than worldviews (Schwartz & Wolfgang, 1987; Stern et al., 1999) and (b) changes in a person's fundamental value orientations are likely to cause a shift in a wide range of perceptions, beliefs, attitudes and behaviours (De Groot & Steg, 2009).

In the environmental domain, the validity of three broad value structures has recently been thoroughly established across cultures and contexts (e.g. see De Groot & Steg, 2007, 2008; Schultz, 2001; Schultz et al., 2005; Stern, Dietz, & Kalof, 1993). These distinct, fundamental value structures include; *biospheric* values (i.e. caring for nature and the environment itself), *altruistic* values (i.e. caring for others) and *egoistic* values (i.e. caring for one's self) and will be adopted in the current study accordingly.



Although value structures tend to be same in different cultures (Schwartz & Sagiv, 1995), people tend to prioritize them differently (De Groot & Thøgersen, 2013). It is hypothesised that biospheric, altruistic and egoistic value orientations influence an individual's risk perception of climate change, an individual's knowledge about the causes, consequences and solutions to climate change as well as the extent to which an individual associates with other people who intend to help reduce climate change. This conceptualisation is in line with the idea that values shape human perception, influence the cognitive accessibility of relevant knowledge and shape the way that people attend to and select information (Stern & Dietz, 1994; De Groot & Thøgersen, 2013). While values are taken here as the fundamental starting point of the development of psychological motivations, one may of course in turn ask; where do values come from? Values are believed to derive from the socialisation process (Stern & Dietz, 1994; Schwartz, 1994). Yet, the present study hypothesises that the influence of socio-demographic variables on voluntary mitigation behaviour is fully mediated by psychological processes (which is a common assumption, e.g. see Abrahamse & Steg, 2011; Diamantopoulos et al., 2003).

## **2.2 The Context: Climate Change**

As an object of risk representation, climate change is as unique as it is complex (Breakwell, 2010). It is complex in the sense that, psychologically, public risk perceptions of climate change have shown to be multidimensional (Helgeson, van der Linden, & Chabay, 2012; Leiserowitz, 2006; Spence et al., 2012). Climate change is unique not only in terms of its global scope but also in terms of its “un-situated” nature. For example, while people may be able to accurately perceive changes in local weather patterns (Howe, Markowitz, Ming-Lee, & Leiserowitz, 2013), climate change in and of itself cannot be experienced directly (Whitmarsh, 2008). It is not a type of risk for which humans have

evolved a biologically hard-wired response (Griskevicius, Cantú, & van Vugt, 2012; Weber, 2006). In fact, climate change has been characterised as a psychologically distant risk, both temporally as well as spatially (Spence et al., 2012).

Yet, the complex and multidimensional nature of climate change risk perceptions poses challenges for accurate assessment, as the way in which perceived risk is measured can bear significantly on the outcome (Helgeson et al., 2012). To illustrate, different terms (e.g. concern, worry, perceived seriousness) are often used synonymously while they may have differential effects on behaviour. For example, “worry” is a specific emotional state and generally a stronger motivator of behaviour than general concern or perceived seriousness (Leiserowitz, 2007). In short, it is relatively easy to misrepresent the role of perceived risk in behaviour. Accordingly, in line with other recent research that has adopted the use of more “holistic” risk assessments (e.g. Smith & Leiserowitz, 2012; Spence et al., 2012), this study uses a measure of perceived risk that taps into a combination of spatial, temporal, cognitive and emotional risk dimensions.

In addition to risk perception, a significant amount of studies have indicated that knowledge about the causes of climate change is a key determinant of climate change mitigation intentions (e.g. Bord et al., 2000; Hidalgo & Pisano, 2010; O’Connor et al., 1999; O’Connor et al., 2002; Whitmarsh, 2009). Indeed, lack of basic knowledge about climate change (particularly solutions) has been noted as an important barrier to engagement (e.g. Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Semenza et al., 2008).

Yet, the effect of knowledge on behaviour may have been systematically underestimated due to the fact that studies often fail to include and differentiate various forms of knowledge that affect behaviour in a convergent manner (Kaiser & Fuhrer, 2003). Moreover, it is now clear that so-called subjective or “self-reported” knowledge measures tend to be unreliable (Roser-Renouf & Nisbet, 2008). Instead, recent research is

increasingly encouraging the use of objective knowledge measures that make a conceptual distinction between knowledge about the *causes* (physical mechanisms), *consequences* (impacts) and *solutions* (action) to climate change (e.g. Sundblad, Biel, & Gärling; Tobler et al., 2012b). In line with these suggestions, the present study employs an objective knowledge measure that covers all three major dimensions to provide an accurate assessment of the role of knowledge in mitigation intentions and behaviours.

Last but certainly not least is the notion of “social knowledge”. Social knowledge refers to and consists mostly of normative beliefs about the motives and intentions of others (Deutsch & Gerard, 1955; Kaiser & Fuhrer, 2003). It is important to include a social norm measure, as people take social cues from observing others (Festinger, 1954) and tend to behave like their friends and peers (Cialdini, Kallgren, & Reno, 1991). For example, social norms have shown to influence energy consumption (Midden & Ritsema, 1983), particularly, people tend to adjust their energy use to conform to the group norm (Schultz et al., 2007). Yet, on the whole, social factors have been neglected in research on climate change mitigation behaviour (Griskevicius, Cialdini, & Goldstein, 2008; Tobler et al., 2012a). Accordingly, in this study, social knowledge is conceptualised as a *descriptive social norm* (i.e. beliefs about what referent others are doing to help tackle climate change), particularly because the behaviour of others provides information that people are likely to use in deciding their own course of action (Cialdini et al., 1991).

### **2.3 The Behaviour: Situation-Specific Influences**

It is important to note that in contrast to the Theory of Planned Behaviour (Ajzen, 1991), Stern et al.’s (1999) Value-Belief-Norm (VBN) theory assumes that the most proximal antecedent of pro-environmental behaviour is not intention but rather, a person’s *moral norm* (i.e. a feeling of personal obligation) – this notion is largely based on Schwartz’s

(1977) Norm-Activation Model (Schwartz, 1977). While initially tempting, most comparative empirical evaluations find that intentions are psychologically closer to behaviour than a person's moral norm (even in the environmental domain) and as such, an individual's "intention" is better situated as an antecedent of behaviour than an individual's moral norm (e.g. see Bamberg & Schmidt, 2003; Kaiser, Hübner, & Bogner, 2005; Klöckner & Blobaum, 2010)<sup>18</sup>. In fact, moral norms are better conceptualised as a predictor of intention rather than behaviour (Bamberg & Möser, 2007; Nordlund & Garvill, 2003; van der Linden, 2011). Consistent with this notion, mitigation intentions are conceptualised as the most proximal antecedent of behaviour in the DCB model.

In turn, mitigation intentions are assumed to be predicted by behaviour-specific determinants. In fact, the attitude-behaviour relationship is perhaps one of the most widely discussed topics in social psychology (Ajzen, 2001; Eagly & Chaiken, 1993) and its importance in theories of environmental behaviour has not gone unnoticed (e.g. Hansla et al., 2008; Hines, Hungerford, & Tomera, 1986; Kaiser, Wölfing, & Fuhrer, 1999; Newhouse, 1990) – although some behaviour models that claim comprehensive coverage have failed to include attitudinal measures (e.g. Klöckner & Blobaum, 2010). As discussed, a weak attitude-behaviour relationship tends to arise particularly when there is a mismatch in the level of correspondence between the two constructs (Ajzen & Fishbein, 1977; Rajecki, 1982). In the DCB model, a key determinant of *specific* mitigation intentions is therefore an individual's attitude toward *specific* mitigation behaviours.

The popularity of the attitude construct is perhaps rivaled only by the notion of an individual's sense of perceived control over performing a behaviour (Ajzen, 1991). Perceived control in this sense is somewhat related to Bandura's (1977) concept of "self-

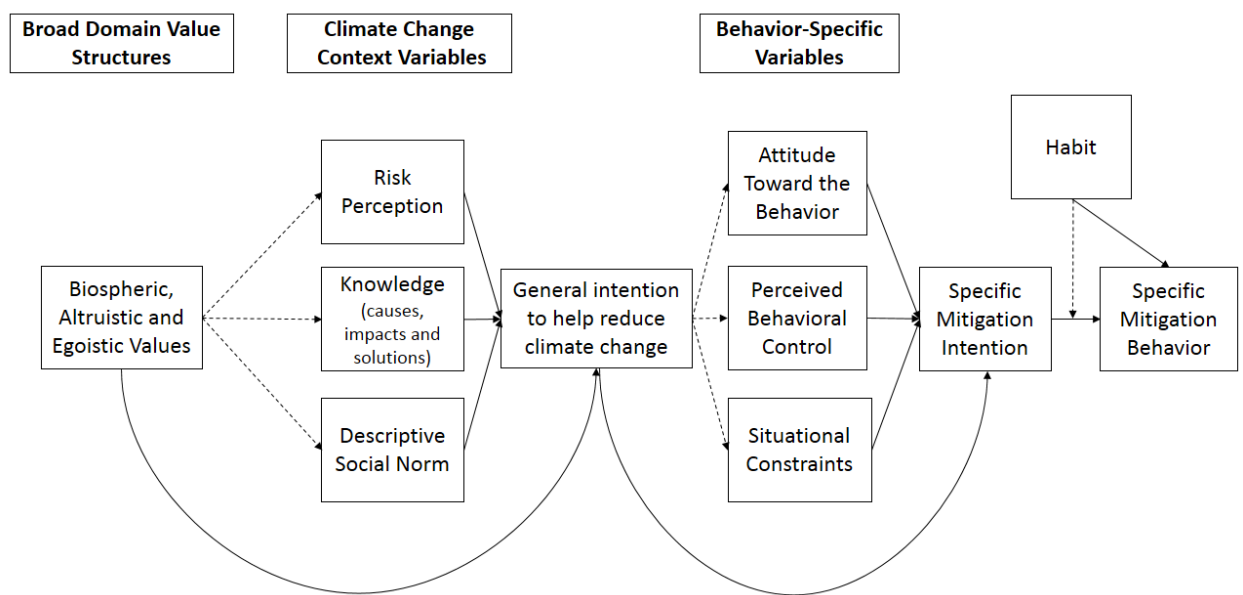
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<sup>18</sup> This does however not imply that mitigation behaviour cannot successfully be predicted from a personal (moral) norm, on the contrary (e.g. see Nordlund & Garvill, 2002; Poortinga et al., 2012).

efficacy” (i.e. an individual’s perceived ability to produce the required change). Yet, without strictly defining whether the locus of control is external or internal, perceived control can be seen as a global evaluation of the amount of volitional control that someone has over performing an action (Fishbein & Ajzen, 2010). In the TPB, perceived behavioural control (PBC) is used as a proxy for “actual” control. Given that intentions are unlikely to materialise into behaviour when people have little control over implementing the desired change (e.g. driving less if driving is a mandatory aspect of one’s job), the main idea behind the inclusion of the PBC construct was to reduce the notorious intention-behaviour gap (Ajzen & Madden, 1986; Sheeran, 2002).

Yet, some notable criticism has been expressed with regard to only measuring (conscious) intentions and people’s perceived sense of control, as other situational constraints often prevent people from carrying out their intentions (e.g. Klöckner & Blobaum, 2010; Ölander & Thøgersen, 1995; Steg & Vlek, 2009; Tobler et al., 2012a; Triandis, 1977). Therefore, to better account for the influence of “situational” barriers on behaviour (e.g. cost, time, inconvenience), the present study also includes a comprehensive measure of “situational constraints” as well as “habit”. Unsustainable habits are pervasive in consumer lifestyles and need to be considered in modelling behaviour (Biel, 2003). Habits are generally defined as learned sequences of acts that have become automatic responses to specific contextual cues as a result of some rewarding consequence (Ouellete & Wood, 1998; Verplanken & Aarts, 1999). Overall, when habit strength for a behaviour increases, it is less likely to be guided by intentions (Triandis, 1977; Verplanken et al., 1998). Congruent with the Theory of Interpersonal Behaviour (see appendix B), it is therefore expected that habitual processes not only predict behaviour but also moderate the intention-behaviour relationship.

A quick note is offered here on the various moderation hypotheses that can be postulated with regard to “contextual” factors and the intention-behaviour relationship. Both perceived control and situational constraints are not assumed to be direct predictors or moderators of behaviour in the DCB model. The reason for this is that when aggregating actions cross-behaviourally and cross-situationally (as is done here), the situation-specific (unique) variance between behaviours is canceled out (Epstein, 1983). Thus, while playing an important role in the formation of psychological intent, these factors are not assumed to affect behaviour directly (Kaiser & Gutscher, 2003). A visual depiction of the domain-context-behaviour (DCB) model is provided below in Figure 6.2.



*Figure 6.2: The Domain-Context-Behaviour Model (DCB). Note: Broad value structures influence general intentions to help reduce climate change directly as well as indirectly via climate change context variables. General intentions influence specific mitigation intentions directly as well as indirectly via behaviour-specific determinants (by creating more favourable attitudes, more perceived control and less perceived situational constraints). In turn, specific intentions and habit jointly predict mitigation behaviour.*

### **3.0 Climate Change Mitigation Intentions and Behaviour**

Drawing on a growing amount of research (e.g. Defra, 2008; Gardner & Stern, 2008; Leiserowitz et al., 2009; Tobler et al., 2012a; Truelove, 2009; Whitmarsh, 2009) and results of a UK focus group (N = 15) study, the current paper presents a comprehensive climate change mitigation scale that is comprised of 21 behavioural items. Together, these items represent a specific assortment of “effective” mitigation behaviours, representing all major categories, both direct (e.g. home energy conservation) as well as often neglected but important indirect behaviours such as meat consumption (e.g. de Boer, Schösler, & Boersema, 2012) and air travel (Cohen & Higham, 2011).

#### **3.1 One To Bind Them All?**

The current study takes note of the fact that treating climate change “mitigation” actions as a homogenous and undifferentiated class of behaviours (i.e. a unidimensional construct) might come at the expense of overlooking important differences in determinants between behaviours (Lindenberg & Steg, 2007; Whitmarsh & O’Neill, 2010; Tobler et al., 2012a). For this reason, some scholars have expressed support for the alternative; theorising each behaviour separately (e.g. Balderjahn, 1988; Gatersleben, 2013; McKenzie-Mohr et al., 1995; Pickett, Kangun, & Grove, 1993; Stern, 2000).

It seems highly unlikely however, that the psychological determinants of different mitigation behaviours share little to no commonalities between them, in fact, they tend to be significantly correlated (Ölander & Thøgersen, 2006; Price et al., 2014; Tobler et al., 2012a). Moreover, addressing urgent large-scale problems such as climate change one behaviour at a time has been referred to as “too slow, inefficient and inconsequential” (Kaiser & Wilson, 2004; Thøgersen, 1999). There are many benefits (both conceptual as

well as empirical) to treating climate change mitigation behaviours as a homogenous construct. First, collapsing different behaviours into a single index cancels out the effect of situation-specific ambiguities, which is useful when trying to identify broad patterns (Epstein, 1983; Kaiser, 1998; Kaiser et al., 2007). Moreover, finding a common set of antecedents for a common set of mitigation behaviours would help reduce complexity and increase the impact of environmental psychology in the mitigation debate (Klößner, 2013). It would also allow interventionists to change multiple behaviours simultaneously by targeting only a key number of determinants (Steg & Vlek, 2009).

Nonetheless, it must still be recognized that certain behaviours (e.g. switching off lights) are categorically different from other behaviours (e.g. purchasing a fuel-efficient car) – not only at the conceptual level but also in terms of their psychological determinants (Truelove, 2009). In the words of Stern (2000); “*a distinction between behavioural types is not only conceptually coherent, but statistically reliable and psychologically meaningful*” (p. 410). In particular, a distinction is often made between *curtailment* and *efficiency* behaviours (Stern & Gardner, 1981). While the former refers to routine behaviours that reduce consumption (e.g. switching off lights) the latter is concerned with one-off choices that result in the adoption of more efficient technology (e.g. purchasing a fuel-efficient car). It is often noted that curtailment behaviours are overrepresented in the literature because people are more likely to implement simple, low-impact changes (Gatersleben et al., 2002; Gifford et al., 2011) and accordingly, pro-environmental intentions are often thought to be more predictive of low-cost than high-cost changes (Diekmann & Preisendörfer, 2003; Steg & Vlek, 2009).

The present study therefore recognises the importance of also studying the behavioural determinants of people’s intention to perform high-impact changes. In fact, perhaps the single most debated and impactful dimension along which behavioural



changes can be distinguished is the low-cost, low-impact and high-cost, high-impact curve<sup>19</sup>, especially in terms of their psychological antecedents (e.g. Diekmann & Preisendörfer, 2003; Gatersleben et al., 2002; Gifford et al., 2011; Guagnano, Stern, & Dietz, 1995; Roser-Renouf & Nisbet, 2008; Schultz & Oskamp, 1996; Whitmarsh, 2009). Accordingly, the current study measures intentions to implement easier, low-impact changes (e.g. hang-drying clothes) as well as intentions to implement more costly, high-impact changes (e.g. purchasing green energy) so that neither category is underrepresented and differences in determinants can be systematically assessed.

## **4.0 Method**

### **4.1 Sample and Participants**

The data set is based on a national quota sample ( $N = 808$ ) of the population of the United Kingdom<sup>20</sup>. Quotas were based on gender, age and region. The survey was administered (longitudinally) in two waves. In the first wave,  $N = 808$  responses were collected and  $N = 501$  (or 72%) of panel members responded in the second wave, four weeks later. The high degree of internet penetration in the UK (about 77% of the population) allowed for an online survey via a survey sampling company. Multi-stage randomisation was used to select participants from a large mixed panel of people who were willing to participate in web-based research for a small (non-monetary) reward. The final sample is comprised of 50% male and 50% female respondents. The age of participants ranges between 18 and 65 with a modal age bracket of 35-44.

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<sup>19</sup> This distinction works well as a general rule, exceptions (e.g. low-cost, high-impact) of course exist.

<sup>20</sup> The United Kingdom includes England, Scotland, Wales and Northern Ireland. Quotas reflect the 2001 Census data for the Great British population.

## 4.2 Materials and Procedure

Because the survey was part of a larger study on climate change perceptions and behaviours, only relevant constructs are reported here. The survey instrument was designed with the input from a panel of three academic and professional experts. Furthermore, in keeping with recommendations to avoid common method bias (Podsakoff et al., 2003), anonymity of responses was assured, questions were positioned so to avoid priming effects and whenever possible, items were presented in random order. Furthermore, because respondents evaluated a large number of behavioural items at a time, the response scales of the predictor variables (e.g. attitude, PBC) were varied from that of the behavioural measures. Psychological separation of measurement between intention and behaviour was achieved with a longitudinal design.

In addition, as suggested by Leiserowitz (personal communication), to account for the fact that certain actions may not be relevant<sup>21</sup> (e.g. reducing meat consumption if you are a vegetarian) or the fact that some people might not be able to accurately reflect on their knowledge, for all relevant questions, a “not applicable” or “don’t know” option was provided as well. Finally, to ensure that the survey questions and response categories were clear and unambiguous, a pilot study was conducted with ( $N = 15$ ) members of the general public at the behavioural research lab of the London School of Economics and Political Science. Results of the pilot study were used to fine tune the questionnaire.

The first wave (T1) of the survey was administered online in October 2012, took about 15 to 20 minutes to complete and measured all constructs except for self-reported behaviour. The second wave (T2) took place four weeks later. During the follow up, the

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<sup>21</sup> It is important to note that if a respondent does not intend to perform a certain behaviour because it is not relevant to his or her situation, this will not affect the intention-behaviour relationship - which is of main interest here (as intention and behaviour would both = N/A).

survey was sent out again to all panel members and respondents were asked to report on their actual behaviour. A time period of four weeks was chosen as an appropriate “temporal sequence” for three reasons; (a) to reduce cognitive accessibility of responses to previous answers (Podsakoff et al., 2003), (b) to strike a good balance between allowing enough time, on average, for psychological dispositions such as intentions to materialise into behaviour but (c) not to the extent that the time lapsed will significantly “erode” the potential cause-effect relationship (Ajzen & Madden, 1986; Ajzen, 2011) or to the extent that it becomes too difficult for respondents to accurately reflect on their behaviour (Gaskell, Wright, & O’Muircheartaigh, 2000).

### **4.3 Measures**

#### *4.3.1 Biospheric, Altruistic and Egoistic Values*

Based on previous work by Schwartz (1992) and Stern et al. (1994), De Groot and Steg (2007, 2008) advanced a standardised scale for measuring *egoistic*, *altruistic* and *biospheric* values. All value orientations are measured with four items each and the same measures were adopted here. In total, respondents were asked to rate and consider the importance of 12 values “as guiding principles in their lives” on a 9 point scale, ranging from -1 *opposed to my values*, 0 *not important* to 7 *extremely important*. Items were randomly ordered and reliable scales were obtained for egoistic ( $\alpha = 0.79$ ), altruistic ( $\alpha = 0.87$ ) and biospheric ( $\alpha = 0.93$ ) values.

#### *4.3.2 Risk Perception*

Drawing on items previously developed by O’Connor et al. (1999) and Leiserowitz (2006), a total of 8 measures were used to assess risk perception (all 7-point Likert-

type scales). The items measured spatial, temporal, cognitive as well as emotional dimensions of perceived risk. The first question asked respondents to judge how likely they think it is that they will personally experience threats to their overall well-being as a result of climate change. The same was asked for society as a whole. Three questions asked respondents to evaluate how serious of a threat they think climate change is to the United Kingdom, the natural environment and to them personally. Respondents were also asked how serious they would rate current impacts around the world, how concerned they are in general and how often they personally worry about climate change. For analysis, a *holistic* measure of risk perception was created ( $\alpha = 0.96$ ).

#### 4.3.3 Knowledge about Climate Change

Three scales were used to assess a respondent's knowledge about the causes, consequences and solutions to climate change. Each knowledge scale consisted of 13 items that were presented in random order (7 of which were correct statements and 6 were incorrect). The correctness of all statements was based on expert reports (e.g. IPCC) and checked by two academic climate scientists. Responses were dichotomized as either right (1) or wrong (0) and indexed based on the number of *correct* answers (0 – 13) – where more correct answers indicate a higher knowledge score (method adopted from Leiserowitz, Smith & Marlon, 2010).

For *cause*-knowledge, respondents were asked to what extent each item (e.g. burning fossil fuels) contributes to climate change (i.e. major, minor or no contribution). A reliable scale was obtained ( $\alpha = 0.90$ ). The knowledge scale for climate change *impacts* asked respondents to estimate whether each item (e.g. global sea level) is likely to increase, decrease or not change at all as a result of climate

change. Similarly, a reliable scale was obtained ( $\alpha = 0.88$ ). Lastly, the knowledge of *response* behaviours scale asked respondents to rate how much each item (e.g. conserving energy) is likely to reduce climate change if done worldwide (a lot, a little, not at all). A reliable scale was obtained here as well ( $\alpha = 0.94$ ).

#### 4.3.4 *Descriptive Social Norm*

On a 7-point scale, respondents answered three questions about how likely they think it is that important referent others are taking personal action to help tackle climate change (e.g. “*most people who are important to me, are personally doing something to help reduce climate change*”). A reliable index was created ( $\alpha = 0.97$ ).

#### 4.3.5 *Attitude Toward the Behaviour*

Attitude toward the behaviour was assessed on a 7-point bipolar scale by asking respondents how they would evaluate (*favourable-unfavourable*) performing each of the 21 mitigation behaviours. A reliable scale was formed ( $\alpha = 0.91$ ).

#### 4.3.6 *Perceived Behavioural Control*

Similarly, perceived control over the behaviour was assessed on a 7-point Likert scale (strongly disagree – strongly agree). For each of the 21 behavioural items, the respondent was presented with the following statement; “*If I wanted to do so, I firmly believe that I have the ability to...*” (e.g. insulate my home or apartment). A reliable scale was formed ( $\alpha = 0.94$ ).

#### 4.3.7 *Situational Constraints*

Respondents were presented with the following statement; “For each of the behaviours listed below, please tick ALL barriers that are relevant to your situation”. For each of the 21 behaviours, respondents could tick; “*I can’t afford it*”, “*I don’t have the time*”, “*Decision is not entirely up to me*”, “*I don’t know how to*”, “*Too inconvenient*”, “*Other reason*” or “*No barriers apply*”. An index of situational constraints was created by summing and averaging the number of perceived barriers (if any) for each behaviour. The more barriers listed, the higher the score. A reliable index was created ( $\alpha = 0.89$ ).

#### 4.3.8 *Habit*

Behavioural frequency is often used as a proxy for habit (e.g. Whitmarsh & O’Neill, 2010), yet, the formation of “habit” has shown to be independent of the frequency with which a behaviour is performed (Verplanken, 2006). Thus, recognizing that “past behaviour” is not a good indicator of habit (Ajzen, 1991), this study followed the suggestions of Verplanken and Orbell (2003) to focus on the unconscious and automated nature of habits. On a 7-point scale (strongly disagree – strongly agree), respondents were asked; “*for each behaviour, please indicate the extent to which you agree that the behaviour has become automatic to you, that is, something you do on a routine basis, without consciously thinking about it*” A reliable scale was obtained ( $\alpha = 0.87$ ).

#### 4.3.9 *General Intention*

Given the relatively straightforward nature of broad intentions, following previous literature (e.g. Heath & Gifford, 2006; Hidalgo & Pisano, 2010; Spence et al., 2011), three general statements (7-point Likert scale) were used to measure a respondent’s

general intention to address climate change (e.g. “*I intend to change my behaviour to help reduce climate change*”). A reliable scale was achieved ( $\alpha = 0.85$ ).

#### 4.4.0 *Specific Mitigation Intentions*

Specific intentions were measured as follows; “*considering the next four weeks, to what extent do you intend to adopt the following behaviours? In the next four weeks, I intend to* (e.g. only run the dishwasher when there is a full load). Response format was a 7-point scale (very unlikely – very likely). Intentions were summed and averaged to form a reliable index describing mitigation intentions ( $\alpha = 0.92$ ).

#### 4.4.1 *Specific Mitigation Behaviour*

Four weeks later, respondents were re-contacted and presented with the same behavioural items. On a 7-point scale, respondents were asked to report (to the best of their knowledge) how often they performed each of the 21 behaviours in the last four weeks (never – very frequently)<sup>22</sup>. A reliable mitigation behaviour index was formed ( $\alpha = 0.91$ ).

#### 4.4.2 *Socio-Demographics*

A range of socio-demographic characteristics were measured as well, including; gender, age, education, political affiliation and level of income.

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<sup>22</sup> Out of the 21 items, there were a few one-off efficiency behaviours for which it seemed somewhat unusual to perform them frequently in 4 weeks (e.g. purchasing a fuel-efficient car) – in this case, respondents were instructed to tick either “very frequently” (for yes) or “never” (for no).

## 5.0 Results

### 5.1 Overview of Statistical Analyses

A structural equation modelling (SEM) approach (Ullman & Bentler, 2013) was adopted to evaluate the fit and hypothesised (mediated) path relationships of the *domain-context-behaviour* (DCB) model. In essence, SEM can be seen as a combination and natural extension of both confirmatory factor analysis (CFA) and multiple regression. Yet, compared to standard regression or (manifest) path models, a structural equation modelling approach offers numerous benefits, including; more efficient (i.e. simultaneous) estimation of complex multivariate relationships, the ability to represent *latent* (i.e. unobserved) constructs as well as the ability to estimate and account for *measurement error* (Iacobucci, 2009). However, since it has been noted that the sampling distribution of “mediated” (i.e. indirect) effects may be slightly skewed or leptokurtic (rather than multivariate normal), the present study uses a bootstrapping method to resample the data (1000 times) when estimating indirect effects, as recommended by Preacher and Hayes (2008) and Hayes (2009)<sup>23</sup>.

#### 5.1.2 Assessment of Model Fit

In line with the suggestions of Hu and Bentler (1999) and McDonald and Ho (2002), the following goodness of fit indices are reported<sup>24</sup>;  $\chi^2$  (df), CFI (Comparative Fit Index) and the RMSEA (Root Mean Square Error Approximation). While the CFI compares the null model (i.e. no assumed correlations between the observed

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<sup>23</sup> Although this is unlikely to be a concern for the current study, given its relatively large sample size.

<sup>24</sup> The Standardised Root Mean Square Residual (SRMR) is not used in the current study as it cannot reliably be computed (due to missing data).



variables) to the model of theoretical interest, the RMSEA is an absolute fit index that measures lack of fit per degree of freedom. For the CFI, a cut off value of 0.95 indicates good fit and  $> 0.95$  excellent fit whereas for the RMSEA, cut off values between 0.05 and 0.10 indicate reasonable fit and values  $< 0.05$  excellent fit. In addition, because of the fact that for larger sample sizes, the Chi2 ( $\chi^2$ ) test is nearly always rejected, as a rule of thumb,  $\chi^2$  to degrees of freedom (df) ratios that range anywhere between 2 to 5 generally indicate good fit.

### *5.1.3 Missing Data*

Missing data is a common problem in SEM and any model estimation should be accompanied by an account of how missing data was handled (McDonald & Ho, 2002; Schreiber et al., 2006). Unfortunately, a ubiquitous characteristic of longitudinal designs is the so-called drop-out rate (also known as “attrition”). In the present study, the attrition rate between stated intention (wave 1) and self-reported behaviour (wave 2) was about 38%. Fortunately, attrition tends to only marginally affect the composition of the sample (Chang & Krosnick, 2009). Yet, in order to learn more about the nature of the missing data, Little’s Missing-Completely-at-Random (MCAR) test was implemented (Little, 1988). The null hypothesis (that the data is missing completely at random) was rejected. In other words, either the data is Missing-at-Random (MAR) or Missing-Not-at-Random (MNAR). To further explore the data, several logistic regressions were run with ‘missingness’ as the dependent variable. Missingness was not associated with socio-demographic characteristics. In fact, only one significant predictor of missingness could be identified, namely; “general intention”. Those with higher intentions to help reduce climate change were somewhat less likely to report on their behaviour in wave 2 (perhaps because despite good intent, they didn’t actually change their behaviour). When data is

not MCAR or when the attrition rate is substantial, listwise deletion (i.e. only using observations for which full data is available) has shown to be a biased approach, inflating standard errors and greatly reducing power (Allison, 2003; Graham, 2009; Wothke, 2000). In contrast, full information maximum likelihood (FIML) procedures use the full sample variance-covariance matrix (observed data) to fill in the unobserved (missing) data. FIML has consistently shown to be superior to traditional methods and is therefore regarded as an efficient and unbiased method for estimating structural equation models with missing data, especially when correlated variables that may determine missingness (e.g. general intention) are included in the model (e.g. Allison, 2003; Collins, Schafer, & Kam, 2001; Enders & Bandalos, 2001; Graham, 2009; McDonald & Ho, 2002; Schafer & Graham, 2002). This study therefore implemented the FIML procedure accordingly.

## **5.2. Descriptive Statistics**

An overview of the climate change mitigation scale items along with their mean scores and standard deviations is provided in Table 6.1. It becomes clear from the table that the public is willing to implement easy, low cost changes (e.g. maintaining correct car tire pressure, switching off electronics etc.) but this willingness steadily declines for more inconvenient, high-cost changes (e.g. flying less, purchasing a fuel-efficient car etc.). The full sample correlation matrix used for the analysis is provided in Table 6.2. With regard to convergent and discriminant validity of the measurement model, an item should generally correlate more strongly with all items of the same construct than with measures of other constructs (Campbell & Fiske, 1959). In other words, the “within” (intra-class) correlation coefficient given along the main diagonal (Cronbach’s  $\alpha$ ) should always exceed the “between” (inter)-correlations among the respective variables, which as Table 6.2 shows, is clearly the case (note: the same result can be obtained from the CFA).

**Table 6.1: Climate Change Mitigation Scale Items Ranked By Mean Response Score.**

<b>(N = 808) Mitigation Intention Scale</b>	<b>Mean</b>	<b>SD</b>
<b>(1 = Very unlikely 7 = Very likely)</b>		
1. Maintain correct tire pressure on my car	5.96	1.47
2. Only run the dishwasher when there's a full load	5.83	1.68
3. Use a clothesline instead of a tumble dryer, when drying wet clothes	5.49	1.93
4. Alter my driving (i.e. avoiding sudden accelerations and stops)	5.41	1.74
5. Unplug (or shut down) electronics completely when not using them	5.39	1.76
6. Replace ordinary (non-saving) light bulbs with energy-saving (CFC) bulbs	5.32	1.89
7. Use energy-efficiency as a selection criterion when buying new appliances	5.18	1.84
8. Turn off my car when idle for longer than 30 seconds (except in traffic)	5.13	1.94
9. Turn down my heating/thermostat by 2 degrees	4.96	1.95
10. Reduce my shower time to 5 minutes maximum	4.82	1.99
11. Buy more locally grown and produced foods	4.59	1.81
12. Reduce my driving by walking or biking more	4.33	2.16
13. Use more public transportation (e.g. train, bus) instead of driving	3.91	2.26
14. Reduce the number of miles that I fly	3.84	2.19
15. Insulate my home or apartment	3.59	2.28
16. Buy/consume less meat	3.57	2.03
17. Buy carbon offsets when booking an airline ticket (whenever possible)	3.52	2.20
18. Reduce my driving, by sharing car rides	3.48	2.18
19. Switch from single glazed to double glazed windows	3.43	2.34
20. Purchase home energy from a green source (e.g. wind or solar power)	2.83	2.02
21. Purchase a more fuel-efficient car	2.55	2.10

**Table 6.2: Intercorrelation Matrix and Descriptive Statistics**

N = 808	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	M	SD
1. BIO	(0.93)															6.22	1.79
2. EGO	<b>0.23</b>	(0.79)														4.55	1.45
3. SOC	<b>0.68</b>	<b>0.27</b>	(0.87)													6.76	1.56
4. RP	<b>0.54</b>	<b>0.10</b>	<b>0.38</b>	(0.96)												4.83	1.36
5. CK	<b>0.11</b>	-0.02	0.04	<b>0.09</b>	(0.90)											6.24	1.92
6. IK	<b>0.27</b>	-0.01	<b>0.20</b>	<b>0.38</b>	<b>0.52</b>	(0.88)										7.19	2.52
7. RN	<b>0.22</b>	0.02	<b>0.17</b>	<b>0.36</b>	<b>0.55</b>	<b>0.61</b>	(0.94)									8.03	2.69
8. DN	<b>0.35</b>	<b>0.09</b>	<b>0.23</b>	<b>0.51</b>	-0.01	<b>0.16</b>	<b>0.18</b>	(0.97)								4.21	1.46
9. ATT	<b>0.49</b>	0.05	<b>0.37</b>	<b>0.57</b>	<b>0.07</b>	<b>0.25</b>	<b>0.26</b>	<b>0.49</b>	(0.91)							5.02	1.17
10. PBC	<b>0.35</b>	<b>0.20</b>	<b>0.27</b>	<b>0.46</b>	0.04	<b>0.19</b>	<b>0.21</b>	<b>0.45</b>	<b>0.59</b>	(0.94)						4.68	1.22
11. SC	<b>-0.21</b>	0.02	<b>-0.18</b>	<b>-0.20</b>	0.01	<b>-0.10</b>	-0.14	<b>-0.24</b>	<b>-0.33</b>	<b>-0.31</b>	(0.89)					10.60	6.56
12. GI	<b>0.49</b>	<b>0.13</b>	<b>0.33</b>	<b>0.67</b>	0.04	<b>0.28</b>	<b>0.35</b>	<b>0.61</b>	<b>0.63</b>	<b>0.58</b>	<b>-0.24</b>	(0.85)				4.63	1.48
13. MI	<b>0.34</b>	<b>0.14</b>	<b>0.28</b>	<b>0.37</b>	-0.06	<b>0.12</b>	<b>0.17</b>	<b>0.39</b>	<b>0.66</b>	<b>0.61</b>	<b>-0.37</b>	<b>0.60</b>	(0.92)			4.43	1.37
14. HAB	<b>-0.19</b>	<b>0.21</b>	<b>-0.11</b>	<b>-0.16</b>	<b>-0.07</b>	-0.13	<b>-0.13</b>	<b>-0.13</b>	<b>-0.29</b>	<b>-0.11</b>	<b>0.27</b>	<b>-0.13</b>	<b>-0.20</b>	(0.87)		3.36	1.15
15. MB	<b>0.31</b>	<b>0.12</b>	<b>0.24</b>	<b>0.29</b>	0.01	<b>0.09</b>	<b>0.11</b>	<b>0.33</b>	<b>0.53</b>	<b>0.38</b>	<b>-0.18</b>	<b>0.40</b>	<b>0.57</b>	<b>-0.21</b>	(0.92)	3.89	1.35

*Note:* Significant correlations ( $p < 0.05$ ) are highlighted in bold. BIO = biospheric values, EGO = egoistic values, SOC = socio-altruistic values, RP = risk perception, CK = cause-knowledge, IK = impact-knowledge, RN = response-knowledge, DN = descriptive norm, ATT = attitude, PBC = perceived behavioural control, SC = situational constraints, GI = general intention, MI = mitigation intention, HAB = habit, MB = mitigation behaviour.

### 5.3. The Domain-Context-Behaviour Model (DCB)

The structural model was estimated using STATA's (StataCorp, 2013) SEM package. Although the initial model provided an adequate fit to the data;  $\chi^2 = 627.46$ ;  $df = 214$ ,  $p < 0.001$ , CFI = 0.95, RMSEA = 0.06 (90% CI: 0.054-0.062),  $\chi^2 / df = 2.93$ , a few post-hoc adjustments were made to the initial model. Particularly, contrary to the competing value structure hypothesis, egoistic and altruistic values did not significantly add to the model above and beyond the effect of biospheric value orientations, as their path relationships were insignificant. Similarly, both cause and impact-knowledge did not add any variance in addition to response-knowledge, as their path relationships were equally insignificant. The notion that theoretical models should not be adjusted post-hoc is somewhat contrived, as any theory should be updated in light of contradicting empirical evidence. Indeed, a few modifications are generally deemed acceptable (McDonald & Ho, 2002). If fit for a theoretical model is completely rejected, than substantial post hoc adjustments of course no longer provide a confirmation of the original model but rather reflect a model that is mostly "data-driven" (Bullock, Harlow, & Mulaik, 2009). However, this is certainly not the case in the present study.

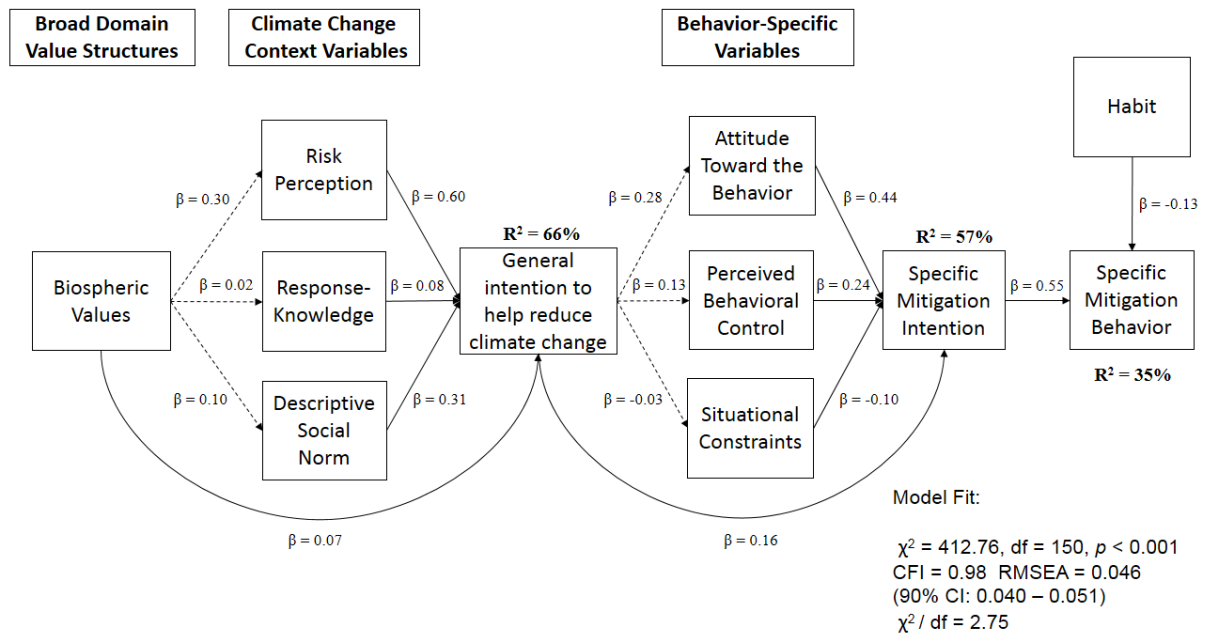
Moreover, SEM can be used for both confirmatory as well as more exploratory purposes (Jöreskog, 1993). There are generally three main concerns when it comes to model modifications; (1) the extent to which modifications are stable / generalizable to other samples (i.e. changes that do not merely capitalize on sampling variability), (2) the number of sequential modifications made and (3) the interpretability of the adjustments (MacCallum, Roznowski, & Necowitz, 1992). With regard to the first point, given the relatively large and representative nature of this study it is unlikely that these modifications capitalize on particularities of the sample. Moreover, only a small number of modifications were made once without making any major conceptual changes to the

model. While the purpose of the current study is mostly confirmatory, there must be some room for exploration, as the context of climate change is unique and theoretical (model) development in this area has been lacking (Roser-Renouf & Nisbet, 2008; Whitmarsh, 2009). Moreover, the purpose of the modifications here is not to drastically improve model fit but rather to avoid making the model unnecessarily complex (i.e. to arrive at the most parsimonious solution).

Freeing the insignificant parameters results in a model with good fit,  $\chi^2 = 412.76$ ;  $df = 150$ ,  $p < 0.001$ , CFI = 0.98, RMSEA = 0.046 (90% CI: 0.041 – 0.052),  $\chi^2 / df = 2.75$ . All of the remaining hypothesised path relationships were supported (Table 6.3) and an overview of the final model is presented in Figure 6.3. Although biospheric values have a small *direct* effect on general intentions to help reduce climate change, most of the effect (approx. 85%) is *mediated* by the climate change context variables; risk perception, response-knowledge and descriptive social norms. Furthermore, while descriptive social norms, response-knowledge and risk perception are all significant predictors of general intentions to help reduce climate change, risk perception is clearly the strongest relative determinant. Together, values and climate change context variables explain ( $R^2 = 66\%$ ) of the variance in general intentions.

In turn, while general intentions have a significant direct impact on specific mitigation intentions, they also have a substantial indirect effect through the behaviour-specific determinants; attitudes, perceived behavioural control and situational constraints. More specifically, about 1/3<sup>rd</sup> of the total effect of general intent on specific mitigation intentions is *direct*, while roughly 2/3<sup>rd</sup>s of the effect is *mediated* by behaviour-specific variables. Thus, forming a broad intention to help reduce climate change results in stronger intentions to perform specific mitigation behaviours directly, as well as indirectly by creating more favourable attitudes toward mitigation behaviours, more perceived

control over taking specific actions and by reducing the amount of perceived situational constraints. General intentions and behaviour-specific variables explain ( $R^2 = 57\%$ ) of the variation in specific mitigation intentions. Lastly, mitigation intentions and habits both significantly predicted mitigation behaviour. Yet, while the presence of habit has a clear negative influence on mitigation behaviour, a moderation (i.e. interaction effect) between intention and habit could not be substantiated. Mitigation intentions and habit jointly explain ( $R^2 = 35\%$ ) of the variance in aggregate mitigation behaviour.



*Figure 6.3:* The Domain-Context-Behaviour (DCB) Model. *Note:* Visual depiction of results. All values are standardised beta coefficients and significant at  $p < 0.01$ . For ease of interpretation, only the structural model is displayed. Dotted lines represent indirect effects.

**Table 6.3: SEM Parameters Full DCB Model**

Path Relationships Full			
Model	$\beta$	S.E.	<i>p</i>
BIO -> GI via RP	0.30	0.02	<0.001
BIO -> GI via RN	0.02	0.01	<0.01
BIO -> GI via DN	0.10	0.01	<0.001
BIO -> GI	0.07	0.02	<0.001
RP -> GI	0.60	0.03	<0.001
RK -> GI	0.08	0.01	<0.001
DN -> GI	0.31	0.02	<0.001
GI -> MI via ATT	0.28	0.03	<0.001
GI -> MI via PBC	0.13	0.02	<0.001
GI -> MI via SC	-0.03	0.01	<0.001
GI -> MI	0.16	0.03	<0.001
ATT -> MI	0.44	0.04	<0.001
PBC -> MI	0.24	0.03	<0.001
SC -> MI	-0.10	0.01	<0.001
MI -> BEH	0.55	0.04	<0.001
HAB -> BEH	-0.13	0.04	<0.01
MI*HAB -> BEH	0.05	0.03	n.s.

*Note:* BIO = Biospheric Values, RP = Risk Perception, RK = Response Knowledge, DN = Descriptive Norm, GI = General Intention, ATT= Attitude, PBC = Perceived Behavioural Control, SC = Situational Constraints, MI = Mitigation Intention, BEH = Behaviour, HAB = Habit.

#### **5.4. Psychological Determinants of High vs. Low Cost Behavioural Changes**

As mentioned in section 3.1, the most crucial and practical dimension along which behavioural changes can be distinguished is the low-cost, low-impact, high-cost, high



impact curve. While some scholars have predominantly scaled behaviours according to their difficulty level (e.g. Kaiser, 1998; Kaiser, Wölfing, & Führer, 1999), more recent research has highlighted that the perceived barriers to performing climate change mitigation behaviours are clearly multidimensional (e.g. Semenza et al., 2008; Tobler et al., 2012a). It is important to note that while researchers often have a priori beliefs about what behaviours should fall into these categories, it is (or ought to be) to some extent, an empirical question (i.e. what is perceived as costly or inconvenient by some might seem inexpensive and convenient to others, depending on one's personal circumstances).

To explore the dimensionality of the scale, a principal component analysis (PCA) with an oblique oblimin rotation was performed<sup>25</sup>. A two-component solution explained 50% of the variance (Table A.1), which is fair given that past research has used three components to explain the same amount of variance (e.g. Tobler et al., 2012a). Although some of the individual loadings might appear relatively low ( $< 0.25$ ), they provide a sharp contrast between the components. The possibility of a third components was also explored. The third component had an eigenvalue of 1.57, which according to the Kaiser criterion ( $> 1$ ) could be considered, however, the third component added little explained variance and a three-factor solution had no clear interpretation - which is an important consideration (Fabrigar et al., 1999). The rotated 2-factor solution did have a clear interpretation (see appendix A). Particularly, the items that loaded on the first (low-cost, low impact) component correspond nearly exactly with the first 11 behaviours of the mitigation scale presented in Table 6.1 (i.e. behaviours people are most likely to perform). The latter 10 behaviours loaded on the second component (high-cost, high impact). This relationship is presented visually in Figure 6.4. Intentions to mitigate more

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<sup>25</sup> An oblique rotation assumes that the components are correlated (as is common in social science). If the components are uncorrelated, then oblique will simply return an orthogonal rotation (Costello & Osborne, 2005).

or less steadily decline when moving from relatively low-cost to more high-cost behavioural changes. While the upper quadrant indicates that the public is likely to make “low cost” changes (behaviours 1 to 11), this readiness levels off into “unlikely” for more “high-cost” changes (12 to 21). At the intersection the letter *A* is used to denote what is referred to here as “*the point of ambivalence*”. The PCA highlighted that items 12 and 18 (driving less) load potentially well on both components. While it may be tempting to suggest that a “neutral” disposition warrants grouping in the “low-cost” category, the opposite is argued here.

In fact, when looking at the most commonly reported barriers for the identified “high-cost, high-impact” changes (Table 6.4), items 12 and 18 (driving less) are associated with substantial barriers, most notably; “inconvenience”. Thus, while behaviours that border the neutral end of the scale might not be cost-prohibitive, people are unlikely to perform them because of the inconvenience factor associated with mobility-restrictions. Indeed, the finding that driving and flying less is perceived as highly inconvenient has been noted before (e.g. Tobler et al., 2012a; Whitmarsh et al., 2011). While the high/low cost categorization produced by the PCA closely matches the ranking of mitigation intentions, to check whether the grouping also made sense from a perceived barrier perspective, a *t*-test was performed. The test indicated that people indeed perceive, on average, significantly more barriers for high-impact than low-impact behaviours ( $M = 6.61$ ,  $SE = 0.13$ ) vs. ( $M = 3.97$ ,  $SE = 0.12$ ),  $t(807) = 26.24$ ,  $p < 0.001$ <sup>26</sup>. Reliability scores for both the “low cost, low impact” scale ( $\alpha = 0.87$ ) and the “high, cost, high impact” scale ( $\alpha = 0.90$ ) were good.

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<sup>26</sup> Although high and low-cost intentions significantly differ in terms of perceived constraints, the correlation between the two behavior classes is positive and significant ( $r = 0.65$ ,  $p < 0.001$ ).

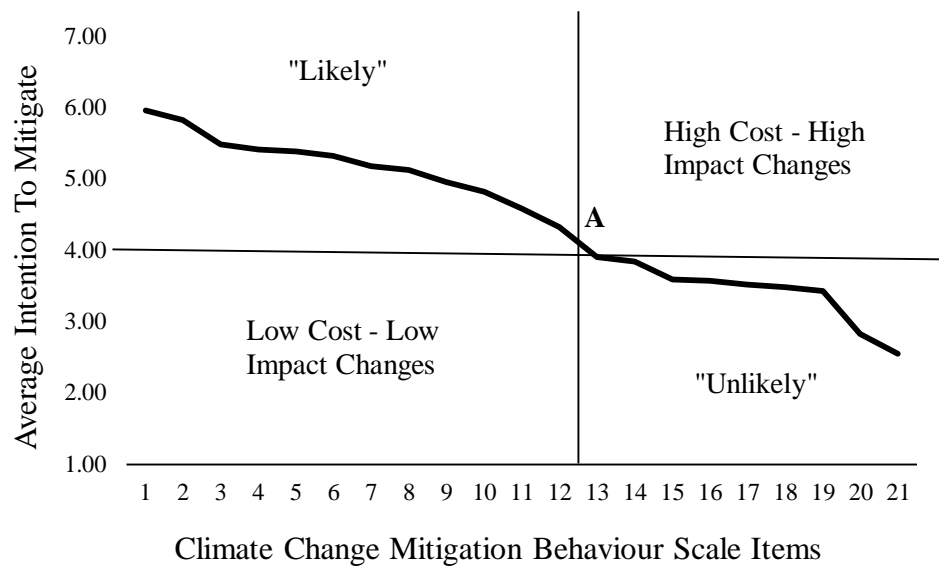


Figure 6.4: Graphical Representation of Mitigation Intentions. Note: “A” indicates the point of “ambivalence”.

Table 6.4: Perceived Situational Constraints for High-Cost, High-Impact Changes

Perceived Situational Constraints for High-Cost / High Impact Changes	Can't Afford It	Don't have the time	Decision is not entirely up to me	I don't know how to	Too Inconvenient	Other Reason
1. Reduce my driving by walking or biking more	2.7%	13.1%	8.3%	4.4%	<b>38.1%</b>	33.4%
2. Use more public transport (e.g. train) instead of driving	12.9%	11.5%	6.3%	3.9%	<b>44.4%</b>	21.0%
3. Reduce the number of miles that I fly	6.1%	2.7%	20.0%	7.9%	23.6%	39.7%
4. Insulate my home or apartment	26.7%	3.0%	30.7%	6.5%	6.3%	26.8%
5. Buy/consume less meat	2.4%	1.2%	30.0%	8.0%	24.6%	33.8%
6. Buy carbon offsets when booking an airline ticket (whenever possible)	41.0%	1.3%	9.3%	18.4%	7.4%	22.6%
7. Reduce driving, by sharing car rides	2.0%	5.0%	15.0%	6.8%	<b>39.8%</b>	31.4%
8. Switch from single glazed to double glazed windows	28.9%	1.8%	26.9%	3.9%	5.30%	33.2%
9. Purchase home energy from a green source (e.g. wind or solar power)	41.0%	3.0%	21.1%	15.0%	10.2%	9.8%
10. Purchase a more fuel-efficient car	58.0%	0.9%	11.8%	3.9%	6.7%	18.7%

The Domain-Context-Behaviour model was subsequently tested separately for each domain and results are displayed in Figures 6.5 and 6.6. The fit of both the high-cost, high-impact;  $\chi^2 = 381.26$ ;  $df = 150$ ,  $p < 0.001$ , CFI = 0.98, RMSEA = 0.04 (90% CI: 0.038 – 0.049),  $\chi^2 / df = 2.54$  and low-cost, low-impact model was good;  $\chi^2 = 427.25$ ;  $df = 150$ ,  $p < 0.001$ , CFI = 0.98, RMSEA = 0.048 (90% CI: 0.043 – 0.053),  $\chi^2 / df = 2.85$ . There were a number of notable differences between the two models. In particular, while general intentions to help reduce climate change are a significant direct and indirect predictor of low-cost mitigation intentions they are *not* a significant *direct* predictor of intentions to implement more high-cost changes.

Furthermore, while situational constraints are a significant predictor of high-cost changes they are not a significant predictor of low-cost changes. In addition, while the presence of habit had a significant and negative impact on low-cost behaviours, habit did not have a significant influence on high-cost behaviours. The path relationships of the two models are provided in Tables 6.5 and 6.6. Overall, attitude-intention congruence is slightly stronger for low-cost than high-cost changes. In addition, the DCB model explained somewhat more variance in low-cost than in high-cost mitigation intentions ( $R^2 = 53\%$  vs.  $44\%$ ). Lastly, although somewhat unexpected, the strength of the intention-behaviour relationship is practically identical for both models ( $R^2 = 36\%$  vs.  $35\%$ ).

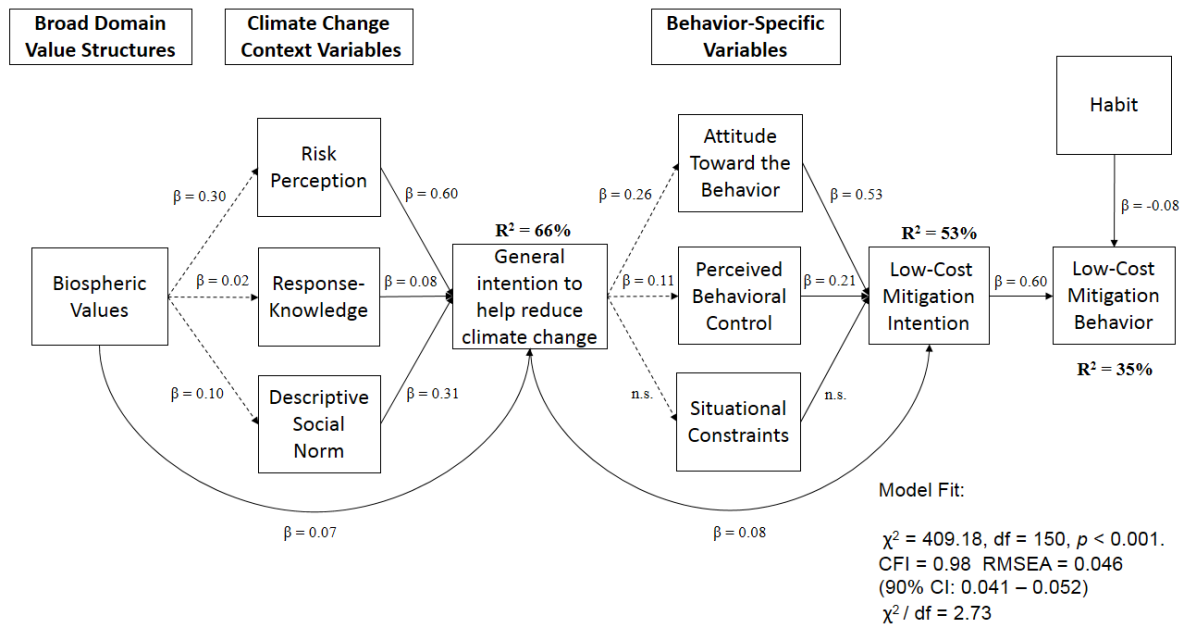


Figure 6.5: Domain-Context-Behaviour Model Results for Low-Cost, Low Impact Behaviours. Note: All values are standardised beta coefficients and significant at  $p < 0.05$ .

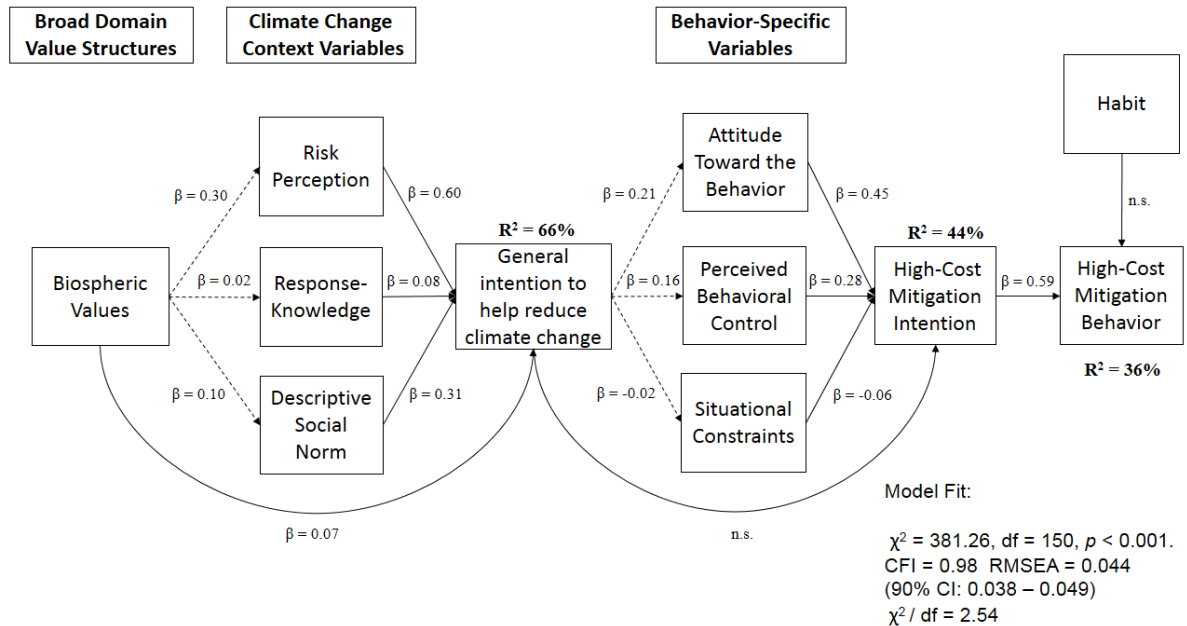


Figure 6.6: Domain-Context-Behaviour Model Results for High-Cost, High-Impact Behaviours. Note: All values are standardised beta coefficients and significant at  $p < 0.05$ .

**Table 6.5: Parameters Low-Cost Model**

Path Relationships	$\beta$	S.E.	$p$
Low-Cost Model			
BIO -> GI via RP	0.30	0.02	<0.001
BIO -> GI via RN	0.02	0.01	<0.01
BIO -> GI via DN	0.10	0.01	<0.001
BIO -> GI	0.07	0.02	<0.001
RP -> GI	0.60	0.03	<0.001
RK -> GI	0.08	0.01	<0.001
DN -> GI	0.31	0.02	<0.001
GI -> MI via ATT	0.26	0.03	<0.001
GI -> MI via PBC	0.11	0.02	<0.001
GI -> MI via SC	-0.01	0.02	n.s.
GI -> MI	0.08	0.03	<0.001
ATT -> MI	0.53	0.04	<0.001
PBC -> MI	0.21	0.04	<0.001
SC -> MI	-0.02	0.01	n.s.
MI -> BEH	0.60	0.01	<0.001
HAB -> BEH	-0.08	0.04	<0.05

**Table 6.6: Parameters High-Cost Model**

Path Relationships	$\beta$	S.E.	$p$
High-Cost Model			
BIO -> GI via RP	0.30	0.02	<0.001
BIO -> GI via RN	0.02	0.01	<0.01
BIO -> GI via DN	0.10	0.01	<0.001
BIO -> GI	0.07	0.02	<0.001
RP -> GI	0.60	0.03	<0.001
RK -> GI	0.08	0.01	<0.001
DN -> GI	0.31	0.02	<0.001
GI -> MI via ATT	0.21	0.02	<0.001
GI -> MI via PBC	0.16	0.02	<0.001
GI -> MI via SC	0.02	0.01	<0.05
GI -> MI	0.01	0.04	n.s.
ATT -> MI	0.45	0.02	<0.001
PBC -> MI	0.28	0.04	<0.001
SC -> MI	-0.06	0.01	<0.05
MI -> BEH	0.59	0.03	<0.001
HAB -> BEH	0.07	0.04	n.s.

## 5.5 Socio-Demographics & Non-Trivial Competing Model Structures

It is important for any psychological theory to demonstrate its explanatory power above and beyond the effect of socio-demographic factors. To this extent, additional analyses indicated that as hypothesised, jointly, socio-demographic variables explain a small ( $R^2 = 7\%$ ) amount of variance in general intentions and only a fraction of the variance in specific mitigation intentions ( $R^2 = 2\%$ ). In fact, while females, liberals and higher educated individuals all tend to have significantly stronger intentions to help reduce

climate change, their effect on intention is fully mediated by domain and context-relevant variables (see Table A.2). The DCB model was also estimated *net* of the effect of socio-demographic variables, as expected, differences in parameters were negligible.

In addition to controlling for socio-demographic characteristics, it may be argued that other model-specifications fit the data equally well (MacCallum et al., 1993). For example, additional *direct* path relationships can be specified between the climate change context variables and specific mitigation intentions or between general intentions and mitigation behaviour. Yet, these direct paths are however not significant (i.e. the relationships are fully mediated by the intervening variables as specified by the DCB model) and adding such paths does not improve model fit. Thus, climate change context variables do not influence specific mitigation intentions directly (controlling for general intentions and behaviour-specific determinants) and general intentions do not influence behaviour directly (controlling for specific intentions and habit).

In addition to testing the DCB model against alternative mediation hypotheses, the Theory of Planned Behaviour (Ajzen, 1991) can also easily be constructed from the current data (by removing habit, situational constraints and all other antecedent variables). Social descriptive norms can serve as a proxy for the TPB's "subjective norm". While social norms were operationalised at a general level (and hence not specific to any behaviour) this shouldn't bear too much on the results given that subjective norms are usually the TPB's weakest component (Armitage & Connor, 2001), especially when predicting pro-social behaviours (e.g. van der Linden, 2011). According to the TPB, attitude, perceived behavioural control and subjective norms would predict mitigation intentions, and in turn, intentions alone would predict mitigation behaviour. In terms of model fit, the TPB also provides an adequate fit to the data;  $\chi^2 = 36.26$ ;  $df = 11$ ,  $p < 0.001$ , CFI = 0.99, RMSEA = 0.05 (90% CI: 0.035 – 0.073),  $\chi^2/df = 3.30$ .

A comparative overview of model fit for the TPB vs. DCB is provided in Table 6.7. While the TPB is more parsimonious, the objective of the DCB model is different, namely; to provide a comprehensive explanatory account of how psychological intentions to perform specific mitigation behaviours are ultimately formed. Such an explanation necessitates a more complex model that structurally organises the psychological antecedents of behaviour-specific determinants in a theoretically coherent manner.

**Table 6.7: Comparison of Model Fit: TPB vs. DCB.**

<b>Model Fit: TPB vs DCB (N = 808)</b>						
	$\chi^2$	(df)	( <i>p</i> )	CFI	RMSEA (90% CI)	$\chi^2 / df$
<b>TPB</b>						
Full Model	36.26	11	<i>p</i> < 0.001	0.99	0.053 (0.035-0.073)	3.30
High-Cost Behaviour Model	34.24	11	<i>p</i> < 0.001	0.99	0.052 (0.033-0.073)	3.11
Low-Cost Behaviour Model	48.53	11	<i>p</i> < 0.001	0.99	0.069 (0.050-0.089)	4.41
<b>DCB</b>						
Full Model	412.76	150	<i>p</i> < 0.001	0.98	0.046 (0.040-0.051)	2.75
High-Cost Behaviour Model	381.26	150	<i>p</i> < 0.001	0.98	0.044 (0.038-0.049)	2.54
Low-Cost Behaviour Model	409.18	150	<i>p</i> < 0.001	0.98	0.046 (0.041-0.052)	2.73



## 6.0 Discussion

### 6.1 The Domain-Context-Behaviour Model

The purpose of the current study has been to move towards a more coherent psychology of climate change mitigation behaviour by introducing and validating the domain-context-behaviour model (DCB). The DCB model is the first to advance a psychologically coherent explanation of how general environmental values (*the domain*), more distinct norms, beliefs, perceptions and feelings about climate change (*the context*) and situation-specific determinants (*the behaviour*) are conceptually related to both each other as well as to voluntary mitigation intentions and behaviours.

With a few exceptions, the present study was able to validate the overall conceptual structure of the model, as the DCB provided a good fit to the data and nearly all hypothesised path relationships were supported empirically. In particular, while biospheric value orientations significantly predicted all climate change context variables (i.e. risk perceptions, response-knowledge and social descriptive norms), they appear to be especially important in predicting risk perceptions of climate change, which is congruent with other recent research that has highlighted the role of biospheric values in environmental risk perceptions (e.g. de Groot, Steg, & Poortinga, 2013). In turn, risk perceptions of climate change were identified as a crucial determinant of general intentions to help reduce climate change - which is also consistent with prior research (e.g. Hidalgo & Pisano, 2010; Spence et al., 2012). In addition, this study adds that descriptive social norms are also a significant determinant of general intentions to act, which is in line with the results of Kormos, Gifford, and Brown (2014), who recently demonstrated the usefulness of descriptive social norm messages in promoting low-

carbon behaviours such as reducing personal car use. Last but certainly not least, the finding that broad environmental values and climate change cognitions, perceptions and norms do not affect specific mitigation intentions and behaviours directly also constructively builds on previous research in this area (e.g. Ajzen et al., 2011; Bamberg, 2003; Poortinga et al., 2012; Whitmarsh & O'Neill, 2010 ). In particular, the present study further expands on this by introducing and validating the notion that general intentions to help reduce climate change function as a broad psychological “orienting” mechanism - activating specific mitigation intentions directly as well as indirectly by creating more favourable attitudes toward performing mitigation behaviours, by fostering a stronger sense of perceived control over performing the behaviour and by reducing the amount of perceived situational constraints. With regard to the latter, the present study recognizes a need to pay closer attention to the importance of situational barriers to change (Steg & Vlek, 2009) and shows, in line with other recent research (e.g. Klöckner & Blobaum, 2010; Tobler et al., 2012a) that a multidimensional “situational constraints” measure significantly improves behaviour-specific predictions.

Finally, consistent with other integrated models of environmental behaviour (e.g. Bamberg & Schmidt, 2003; Klöckner & Blobaum, 2010, Klöckner, 2013) the present study finds that both (conscious) intentions and (unconscious) habitual processes significantly predict mitigation behaviour. Overall, the amount of variance that the final DCB model is able to explain in general intentions to help reduce climate change ( $R^2 = 66\%$ ), specific mitigation intentions ( $R^2 = 57\%$ ) and mitigation behaviour ( $R^2 = 35\%$ ) is very respectable, especially in comparison to previous studies and meta-analyses, where more complex models of behaviour generally explain between 40% to 50% of the variance in intention and 25% to 30% of the variance in behaviour (cf. Armitage & Conner, 2001; Bamberg & Möser, 2007; Klöckner, 2013; Sheeran, 2002).

It should be noted that some initial modifications were made to the conceptual model that warrants some further discussion here. In particular, in contrast to the competing value structure hypothesis (De Groot & Steg, 2008; Stern & Dietz, 1994), egoistic and altruistic value orientations did not significantly impact any of the climate change context variables above and beyond the effect of biospheric values. In terms of egoistic values, this is clearly due to the fact that they share a weak correlation with all of the climate change context variables. With regard to the role of altruistic values, they tend to be strongly and positively correlated with biospheric value orientations and it is likely that (at least in the environmental domain), unless they are in conflict, altruistic values add little extra variance (De Groot & Steg, 2007; Stern & Dietz, 1994). While the present study does not reject the idea of competing value structures, in the current sample and context, biospheric values alone appear to offer a sufficient explanation.

Furthermore, the utility of both cause and impact-knowledge in predicting general intentions to help reduce climate change was statistically negligible above and beyond the effect of response knowledge. While these results may run contrary to the findings of some previous research (e.g. Bord et al., 2000; O'Connor et al., 1999), it is important to note that these studies did not control for the effect of different types knowledge on intention. For example, other studies have only found a weak effect (Whitmarsh, 2009; Whitmarsh & O'Neill, 2010) or no effect at all (e.g. Heath & Gifford, 2006), especially in comparison to response-knowledge (Truelove & Barnes, 2012). It is not suggested here that other types of knowledge are not important, as different types of knowledge tend to converge (Kaiser & Fuhrer, 2003). In fact, all three knowledge measures used in this study are significantly and positively correlated with each other. However, in terms intentions to address climate change, knowledge of *response*-strategies clearly seems to be most instrumental. Finally, while habit had a negative effect on mitigation behaviour,

an often suggested interaction-effect with intention (e.g. Triandis, 1977) could not be substantiated. This is not unusual however, as hypotheses concerning factors that moderate the intention-behaviour relationship have not proven to be consistent (Klößner & Blobaum, 2010; Fishbein & Ajzen, 2010) and deserve further clarification.

## **6.2 The Psychological Determinants of Low Impact vs. High-Impact Behavioural Changes**

Consistent with prior research (e.g. Diekmann & Preisendörfer, 2003; Gifford et al., 2011; Tobler et al., 2012a; Whitmarsh, 2009), the present study confirms the notion that the public is significantly less willing to implement more high-cost, high-impact behaviour changes. To investigate potential differences in psychological determinants, the explanatory power of the DCB model was tested on both behavioural categories. Although model fit for each sub-dimension was good and both behaviour categories share important common psychological antecedents, some important differences still emerged.

First, a generalised motivation to help reduce climate change does not seem to weigh in as strongly for high-cost behaviours, particularly because situational barriers tend to be more salient for high-impact changes. In turn, while situational constraints are of little concern for low-cost changes, low-cost behaviours tend to be subject to unsustainable habitual patterns. These results are relatively intuitive; situational constraints are less relevant for most low-cost, low-impact behaviours (e.g. reducing shower times etc.) but very relevant for more high-cost behaviours (e.g. purchasing a more fuel-efficient car). Similarly, most low-cost behaviours (e.g. leaving the lights on) are entrenched in habit while this is arguably less relevant for more high-cost behaviours (e.g. flying long distances). Moreover, the conceptual relationship between general intent, behaviour-specific variables and mitigation intentions was somewhat stronger for the

low-cost model than for the high-cost model. Accordingly, the low-cost DCB model accounted for more of the variance in intention ( $R^2 = 53\%$  vs.  $44\%$ ). While overall, these findings are congruent with the hypothesis that psychological motivations tend to be somewhat more predictive of low-cost changes (Diekmann & Preisendörfer, 2003; Gatersleben et al., 2002; Steg & Vlek, 2009), an important aspect that previous studies have overlooked is the finding that the stability of the intention-behaviour relationship proved identical for both high-cost and low-cost actions - which is promising in the sense that high-impact mitigation intentions are equally (un)likely to translate into action as low-impact intentions. Moreover, both types of changes are significantly and positively correlated and appear to share a “common motivational roots”.

### **6.3 The DCB, Other Behavioural Models and Future Research**

While this study found that females, higher educated and liberal individuals tend to have stronger mitigation intentions, congruent with other models of behaviour prediction, the DCB model assumed (and illustrated) that the effect of socio-demographic factors on intention and behaviour is fully mediated by psychological explanations. These findings are consistent with other recent work (e.g. Poortinga et al., 2012) as well as with more general surveys of the literature, which indicate that the influence of socio-demographic characteristics on pro-environmental behaviour is usually quite weak (Diamantopoulos et al., 2003). One potential explanation for this phenomenon is that psychological intentions to *reduce* climate change are voluntary in nature and thus psychologically “flexible” whereas actual consumption or energy use is more constrained by socio-economic factors (Abrahamse & Steg, 2011).

In comparison to the DCB, the TPB provided an equally good fit to the data. Yet, it is important to highlight the distinct but complementary features of the DCB. For

example, one of the main strengths of the DCB model lies in its ability to provide a more comprehensive and evolutionary account of the formation of an individual's psychological intention to "mitigate". Moreover, the DCB model provides an overarching causal framework to help systematically organise predictors of climate change mitigation intentions and behaviours in a theoretically coherent and psychologically meaningful manner. The model is also more organic in the sense that it allows researchers and practitioners to choose at which point in the causal chain they wish to intervene.

Overall, the current study offers many notable benefits and improvements over previous research. For example, the high reliability of the included constructs and relatively large and balanced nature of the sample provide more confidence in the fact that the DCB model is generalisable to other samples and populations as well. Moreover, the present study measured a wide range of self-reported behaviours in addition to stated intention, which is a substantial improvement over existing research (e.g. Brody et al., 2012; O'Connor et al., 1999; Poortinga et al., 2012; Spence et al., 2011). Lastly, instead of assessing past behaviour and intention cross-sectionally, the longitudinal design of the study allows for stronger causality claims (Bullock et al., 1994).

Yet, in spite of these benefits, the current study is certainly not without limitations. First, there was substantial attrition between the first and second wave of the survey (although subsequent missing data analyses provided little reason to suspect that any systematic bias resulted from this attrition). A second limitation is that the national quotas are ultimately based on a panel of respondents who volunteer to participate in online survey research and as such, the sampling procedure does not constitute a randomized probability sample. Having said this, national quota samples obtained from large online panels are often deemed sufficiently representative (Berrens et al., 2003).

A third obvious limitation of this study is the self-reported nature of the data. A common criticism is that people tend to somewhat overestimate and inaccurately recall their own pro-environmental intentions and behaviour (e.g. Chao & Lam, 2009; Gifford et al., 2011). While to some extent, this may be true, it has been noted that the effect of social desirability bias on self-reported environmental behaviour tends to be negligible (Milfont, 2009). Moreover, when aiming to discern broad relationships for a large number of behaviours, objective measurements are often not feasible (Tobler et al., 2012a) if not practically impossible (Fishbein & Ajzen, 2010). Still, it could be the case that the very act of measuring “intent” might increase an individual’s probability to actually perform the target behaviour, which would inflate the observed intention-behaviour relationship (Morwitz & Fitzsimons, 2004).

Another limitation is that the sole focus of this study was geared towards (direct) mitigation activities and hence the present study did not measure other important behaviours such as *policy support* (e.g. Leiserowitz, 2006; Tobler et al., 2012a) or *adaptation* behaviour (e.g. Zaalberg et al., 2009). In addition, the DCB model has only been tested and validated within the context of a specific Western culture (i.e. the UK). Future research could overcome some of these limitations and constructively build on the current study by examining the DCB model in other contexts and cultures as well as within the frame of an experimental approach.

In addition, while the amount of variance that the DCB model is able to account for is relatively high, there are arguably other domain, context and behaviour-specific variables that may be added to improve the predictive validity of the model. For example, recent research has explored the role of pro-environmental identities and moral norms in mitigation behaviour (e.g. Poortinga et al., 2012; van den Werf, Steg, & Keizer, 2013; Whitmarsh & O’Neill, 2010). Lastly, the present study acknowledges that changes in

behavioural patterns are most effective in conjunction with larger socio-political shifts that facilitate and promote a low-carbon society. Thus, while it is pivotal to change existing public attitudes and perceptions, in order to enable widespread lifestyle changes, structural, contextual and institutional barriers to public engagement need to be alleviated as well (Lorenzoni et al., 2007; Stern, 2000).

#### **6.4 Implications for Public Communication & Behavioural Change**

In practical terms, the causal chain proposed by the model allows interventions to be designed at every stage of the process (domain, context, behaviour). Particularly, the DCB model suggests that in order to stimulate the development of a general intention to act, public communication campaigns should try to take an integrative approach and; (a) foster biospheric values, (b) increase risk perceptions of climate change, (c) enhance knowledge of individual response-strategies while (d) promoting and leveraging social norms to address climate change. This general intention is then likely to activate and motivate more specific (low and high-impact) mitigation intentions, especially when situational and contextual factors are conducive to implementing the intended change.

While it is often argued that communication strategies have their limits, the present study does highlight that certain situational (e.g. time, ability, convenience) and contextual (e.g. habit) barriers are (at least partly) psychological in nature and thus, they may very well be influenced by persuasive communication messages that can produce changes in relevant knowledge, norms, values and attitudes. For example, the more motivated an individual is to take action (normatively, cognitively as well as emotionally), the lower the number of perceived situational constraints and the higher the sense of perceived control over performing the behaviour. In addition, while it is well-known that unsustainable habits are resistant to change, people still need to be made



cognisant of their behaviour and alternative courses of action need to be mentally accessible. Similarly, in terms of possible domain-interventions, it is often argued that deep-seated fundamental values are relatively stable throughout a person's life (Schwartz, 1992). Yet, specific value-priorities are, to some extent, also situationally constructed (Gifford & Howes, 2009) and thus one potential strategy could be to increase the saliency of biospheric values in specific contexts without explicitly infringing on other important value structures such as egoistic motivations (De Groot & Steg, 2009) – a strategy which has the potential to make people more inclined to act on their values (Bolderdijk, Gorsira, Keizer, & Steg, 2013). Lastly, a much needed example of an integrative approach to public communication is the need to strike a careful balance between creating a sense of urgency and risk on one hand, and the importance of providing sufficient knowledge about how to effectively respond to the risk of climate change on the other, particularly via the adoption of specific mitigation and adaption behaviours (van der Linden, 2014).

## **6.5 Conclusion**

This study introduced and validated a domain-context-behaviour (DCB) model.

The major theoretical and practical contribution of the model lies in its ability to provide a comprehensive and psychologically coherent account of how broad environmental values and more specific norms, perceptions and beliefs about climate change ultimately influence climate change mitigation intentions and behaviours. In particular, the DCB model suggests that the common motivational roots that underlies a wide variety of “mitigation” behaviours is a general orienting intention to help reduce climate change. Overall, the DCB model can help inform and improve behavioural change interventions and as such, increase the relevance of environmental psychology in the mitigation debate.

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**CHAPTER 7: GENERAL DISCUSSION AND  
CONCLUSION**

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## 7.1 Summary of Findings and Contribution of Thesis

The central contribution of this thesis has been to advance a more comprehensive, theoretically informed and systematic social-psychological account of how people feel, think about and perceive the risk of climate change on one hand, and subsequently act on their perceptions, values, attitudes and intentions on the other.

### 7.1.1 *Theoretical Advances and Contribution to Literature*

A persistent theme throughout this thesis has been the notion that human behaviour in the context of climate change is complex and multi-determined and best understood by combining and integrating three key dimensions, namely; *cognitive* (e.g. knowledge), *experiential* (e.g. affect, personal experience) and *socio-cultural* (e.g. norms, values) factors. This theme is explicitly reflected in chapter 2, where I provide a survey of existing literature and conclude that popular approaches to public climate change communication and behavioural change have been relatively unidimensional, often appealing to only one aspect of human behaviour whilst neglecting other key factors.

To this extent, a broad and practical typology is offered to describe the evolution of public climate change interventions, including the traditional “*cognitive-analytical*” type (which is largely focused on knowledge acquisition, education and information provision), the “*affective-experiential*” type (which predominantly relies on eliciting negative emotions through the use of fear and guilt appeals) and lastly, the “*social-normative*” type (an approach which primarily focuses on creating and leveraging the persuasive appeal of social norms and negative/positive social identities).

Highlighting that part of the limited success of past interventions is due to failing to recognize that human behaviour is multi-determined by cognitive, experiential and socio-cultural factors, a novel framework for communicating climate change is advanced.

The framework is novel for a number of reasons. First, because it strongly advocates an integrative approach to behavioural change, where public campaigns and appeals should be designed in such a manner that they effectively combine all three (cognitive, experiential and socio-cultural) dimensions. In addition, there is a large gap between practitioners who focus on designing behavioural change interventions and those scholars who are concerned with advancing a more diagnostic understanding of the determinant factors that explain and predict a given behaviour. To this extent, another major theme and contribution of this thesis is reflected in an effort to combine these two approaches. For example, the model suggests that climate change communication efforts should pay close attention to the psychological determinants of the mitigation behaviours that the campaign is trying to change.

Chapter 3 specifically reviews the risk perception and risk communication literature and highlights that different paradigms and approaches currently exist to understanding public risk perception. Moreover, while there has been much debate about the relative explanatory power of one paradigm over another (e.g. Sjöberg, 2002), they have largely remained disintegrated and disconnected from each other (Wåhlberg, 2001). This is not to say that more recent attempts to combine theoretical approaches have not been made (e.g. see Leiserowitz, 2006; Jackson, Allum, & Gaskell, 2006; Pidgeon, Kasperson, & Slovic, 2003), yet this thesis makes a distinct contribution to the literature by specifically advancing a more comprehensive and integrated social-psychological model of risk perception, where cognitive, experiential, and socio-cultural factors are combined to explain and predict risk perceptions of climate change. Tested on a national sample of the UK population, the study reported in chapter 4 provides strong empirical evidence for both the validity of each of these dimensions on their own as well for the combined explanatory power of the model as a whole.

In particular, knowledge about the causes, impacts and solutions to climate change, negative affective evaluations, personal experience with extreme weather events, biospheric values, social norms (both descriptive and prescriptive) and key socio-demographics (gender, political orientation and education) all explained and predicted holistic risk perceptions of climate change, jointly accounting for nearly 70% of the variance – which (to the best of my knowledge) is more than any published study to date has been able to explain. Thus, one major contribution of this thesis is its ability to provide a systematic, integrative and more comprehensive explanatory account of the major psychological dimensions that influence public risk perceptions of climate change. In doing so, the current thesis highlights that when it comes to explaining risk perceptions of climate change, experiential and socio-cultural factors weigh in substantially more than cognitive or socio-demographic factors. In fact, generalised (negative) *affect* is identified as the single most important determinant of risk perception.

Another important contribution of this thesis revolves around exploring and empirically validating risk perception as a two-dimensional construct. Indeed, holistic risk perceptions can be conceptualised as having two underlying dimensions; societal and personal risk judgements – a conceptual distinction which has been proposed before (e.g. Tyler & Cook, 1984; Weinstein, 1989) but has not received much attention in the climate change context. Yet, the psychological level at which people construe representations of a risk is important to consider (Spence et al., 2012). For example, results from the national survey suggest that people are significantly more likely to see climate change as a societal rather than a personal risk, a finding which is very much consistent with similar studies conducted in both the UK and the US (e.g. Leiserowitz, 2006; Leiserowitz et al., 2013; Spence et al., 2012). Yet, while this is an important finding, the more interesting question is what determines societal and personal risk judgements. This thesis makes a novel



contribution by highlighting some fundamental differences between the psychological determinants of societal and personal risk perceptions. For example, broad knowledge about the causes, impacts and solutions to climate change predicted societal but not personal risk perceptions. In addition, personal experience with extreme weather was a significant predictor of personal but not societal risk perception. Similarly, while egoistic values were a significant predictor of personal risk, they did not predict societal risk perceptions. Common antecedents of both personal and societal risk perception included affect, biospheric values and social norms (as well as gender and political party).

In addition to mapping and validating the key social-psychological dimensions that underlie risk perceptions of climate change, another major contribution of this thesis is a first attempt to explore the psychological relationship between personal experiences with extreme weather, negative affect and risk perceptions of climate change. In chapter 5 I illustrate, using a theory-based approach, that the complex interrelationship between personal experiences with extreme weather events, the formation of negative affective evaluations and risk perceptions of climate change can be situated within the cognition-emotion debate. Thus far, the literature has only conceptually indicated on a broad level that cognitive and affective judgements of climate change are intertwined (e.g. Marx et al., 2007; Sundblad et al., 2007), but no attempt has been made to explore how these constructs actually function in relation to each other in the context of climate change.

In particular, three dominant social-psychological theories were compared. In the first model, affect is seen as an “information-processing” heuristic that guides and predicts risk perception (Slovic et al., 2007; Zajonc, 1980). In the second model, congruent with appraisal theory (Lazarus, 1984), affect is regarded as a post-cognitive concept, where instead, risk perception is conceptualised as a predictor of affect. In the third model, a dual-process perspective is advanced which integrates both theories and

suggests that experiential and cognitive processes operate in parallel (i.e. affect is thought to be both; predicted by – as well as influence risk perception at the same time).

Drawing on the “*risk-attribution hypothesis*” presented in chapter 3, it is suggested that personal experience with extreme weather only leads to negative affective evaluations if people consciously attribute their experience to climate change. Using a structural equation modelling approach the hypothesised causal path relationships of all three models were compared. Results provide support for the aforementioned hypothesis in that the relationship between personal experience and affect is fully mediated by risk perception (i.e. cognitive / perceptual awareness of the risk). Yet, closer examination reveals that at the same time, once negative affective evaluations of climate change are formed, affect also functions as an important determinant of risk perception. In short, results from chapter 5 provide strong support for a theory of dual-processing, validating both theoretical perspectives and emphasizing the interplay between cognition and affect in shaping public responses to climate change (Marx et al., 2007) – which is considered a significant contribution to the risk perception literature (Finucane, 2012).

Last but certainly not least, chapter 6 introduces a domain-context-behaviour (DCB) model. Until recently, much of the work on the social-psychological determinants of climate change mitigation behaviour has been mostly exploratory, unsystematic, intention-only and often non-representative (e.g. see Brody et al., 2012; Whitmarsh, 2009; Truelove, 2009; Tobler et al., 2012). In particular, the literature is characterized by substantial confusion over the role of environmental values and beliefs and perceptions about climate change in shaping specific mitigation intentions and behaviours. The DCB is a behavioural model that provides a novel and theoretically coherent explanatory account of how these variables are conceptually related to both each other as well as to a wide range of mitigation intentions and behaviours.

Specifically, the DCB model suggests that general environmental value orientations (i.e. the domain) influence specific beliefs and perceptions about climate change (i.e. the context). Both values and climate change specific norms and cognitions subsequently influence a more broad and general intention to help reduce climate change. This general intention is free of specific time and context elements and works as a situation-invariant (psychological) orienting mechanism, activating and influencing specific intentions to perform mitigation behaviours directly as well as indirectly via more proximal behaviour-specific determinants. According to the DCB, mitigation intentions and habitual processes jointly predict mitigation behaviour.

Following a few initial modifications, results from a structural equation modelling approach provide empirical support for the conceptual structure of the DCB model. In particular, biospheric value orientations (the domain) were found to influence general intentions directly as well as indirectly via risk perceptions, response-knowledge and social descriptive norms (the context). These results are in line with the idea that general value orientations shape human perception, influence the cognitive accessibility of relevant knowledge and determine the way that people attend to and select information (Stern & Dietz, 1994; De Groot & Thøgersen, 2013). Jointly the domain and context variables explain 66% of the variance in general intentions. General intent in turn predicted specific mitigation intentions directly as well as indirectly via the behaviour-specific determinants (attitudes, perceived control and situational constraints). General intention and behaviour-specific variables together accounted for 57% of the variance in specific mitigation intentions. Specific intentions and habit jointly predicted mitigation behaviour, accounting for 35% of the variance. Overall, the explanatory power of the DCB model is very respectable, especially in comparison to prior research and existing models (e.g. Bamberg & Möser, 2007; Klöckner, 2013; Whitmarsh & O'Neill, 2010).

Another major contribution of this thesis follows from analyzing differences in determinants between low-cost, low-impact and high-cost, high-impact behavioural changes, as much of the literature has predominantly been concerned with the former (Gifford et al., 2011). Overall, consistent with other recent work (e.g. Whitmarsh et al., 2011), results of the national survey highlight that compared to low-cost actions, the UK public is still significantly less engaged with and less willing to adopt more high-cost changes (e.g. purchase green energy) and a multitude of barriers are perceived to doing so. Furthermore, while common psychological antecedents could be identified that underlie engagement in both types of behaviours, a general motivation to act appeared less influential in predicting high-cost behaviours, a finding which is also congruent with prior research (e.g. Diekmann & Preisendörfer, 2003; Steg & Vlek, 2009).

Although the DCB model provided a good fit for both behavioural categories, some notable differences emerged. While situational constraints were predictive of high-cost intentions they were not predictive of low-cost intentions. Similarly, while habitual processes were predictive of low-cost intentions, habit was not a significant predictor of high-cost intentions. Overall, two important and promising findings are that low and high cost behavioural changes are significantly and positively correlated ( $r = 0.65$ ), which could provide some (albeit indirect) support for the existence of potential spill-over effects (Thøgersen, 1999; Whitmarsh & O'Neill, 2010). In addition, another important finding is that the stability of the intention-behaviour relationship is approximately equal for both high and low impact changes. This is promising in the sense that intentions to perform high-cost changes are not necessarily less likely to materialise into action.

Lastly, compared to existing behavioural models such as the Theory of Planned Behaviour (Ajzen, 1991), the DCB model performs (at least) equally well (if not better) but also provides a more comprehensive and systematic explanatory account of a wide

range of important climate change mitigation behaviours. It does so specifically by illustrating, in a theoretically coherent manner, how relatively distant domain and context variables ultimately influence more proximal determinants of behaviour.

### *7.1.2 Methodological Contributions*

This thesis also makes a number of important methodological contributions. First, the mitigation behaviour scale was specifically designed to be relevant to the context of climate change, comprising a wide range of impactful curtailment and efficiency behaviours. Secondly, a large number of highly reliable psychological constructs were measured so that their relative influence could be assessed simultaneously in a systematic manner. For example, instead of using “quick and dirty” measures of self-reported knowledge, an objective measure was implemented that differentiates between three important forms of knowledge (i.e. knowledge about the causes, impacts and solutions to climate change). Doing so is important because results are likely to be conflated when only subjective or partial knowledge levels are controlled for (Kaiser & Fuhrer, 2003; Roser-Renouf & Nisbet, 2008). In addition, past research has often used very different and inconsistent measures of risk perception (Leiserowitz, 2007), including single-item questions (e.g. Whitmarsh & O’Neill, 2010). Congruent with the approach of Leiserowitz et al. (2013) and Spence et al. (2012), this thesis used a total of 8 items to measure temporal, spatial, cognitive and emotional dimensions of perceived risk - allowing for a more comprehensive assessment.

With regard to predicting mitigation behaviour, next to a measure of perceived control, contextual factors were taken more effectively into account by using a multidimensional measure of perceived barriers / situational constraints, which builds constructively on previous research (e.g. see Klöckner & Blobaum, 2010; Steg & Vlek,

2009; Tobler et al., 2012). Furthermore, while past research (e.g. Poortinga et al., 2011; Smith & Leiserowitz, 2012) has often relied on single-item measures of “holistic affect”, this thesis used several indicators to represent global affective evaluations without conflating the measure with a moral judgement (good/bad). The present research also adds to the literature by taking the influence of normative factors on perceptions and behaviour more widely into account through a social norms approach (Tobler et al., 2012). Similarly, in terms of habit, although still self-reported, the current research goes beyond simple measures of past behavioural frequency, as habit has shown to be independent of the frequency with which a behaviour is performed (Verplanken, 2006).

In addition, two other significant methodological contributions are made. First, the current research not only measured self-reported behaviour in addition to intention but also as part of a longitudinal design, allowing for greater confidence in causal claims (Bullock et al., 1994). Thus, in contrast to correlating belief-measures with past behaviour at the same point in time (e.g. Semenza et al., 2008; Whitmarsh, 2009), this thesis investigated how predictive values, intentions and perceptions of climate change are in Time 1 of self-reported behaviour in Time 2. Last but certainly not least, this thesis also provides behavioural researchers with some successful examples of how more complex (non-recursive) structural equation methods can be employed to better understand intricate systems of behavioural relationships.

## **7.2 Implications for Risk Communication, Behavioural Change and Public Policy**

Overall, results of this thesis have clear practical implications. To begin with, the complex and multidimensional nature of risk perception suggests that public communicators should take an integrative approach; interventions should not only cognitively inform people about the causes, consequences and solutions to climate change

but they should also aim to foster strong biospheric values, affectively and experientially engage people and inform people that climate change is a societal risk that important referent others are worrying about as well.

To this extent, some practical suggestions are offered. First, differences in determinants between societal and personal risk perceptions are in line with results of other recent research which has suggested that the level at which people mentally construe representations of a risk are important to consider (Spence et al., 2012; Trope & Liberman, 2010). For example, results from chapter 4 suggest that people are significantly more likely to see climate change as a societal rather than a personal risk. Thus, in order to better leverage the effect of knowledge about the causes, impacts and solutions to climate change, this information should be communicated in such a way that it is made more locally relevant and relates to people's daily experience (e.g. see also Doyle, 2011; Lorenzoni et al., 2007; O'Neill & Nicholson-Cole, 2009). Indeed, the "psychological distance" of climate change needs to be reduced temporally, spatially, emotionally as well as socially (Spence et al., 2012). To illustrate, people should have information on both; how their local UK region(s) and communities are likely going to be affected by climate change as well as information on effective response strategies.

However, at the same, factors that are more proximal to people's day to day life (such as personal experiences with extreme weather) need to be clearly linked to the broader societal issue of climate change (i.e. they need to be made globally relevant). To be precise, results from this thesis strongly suggest that in order for people to form negative affective evaluations of climate change, a conscious and perceptual bridge needs to be build that links how people's experiences with extreme weather are conceptually related to the impacts of climate change (e.g. see also Weber, 2010). While of course no single weather event can be causally attributed to climate change, there is increasing

support for the usefulness of extreme weather as a persuasive communication device (e.g. Capstick & Pidgeon, 2014; Myers et al., 2012a; Spence et al., 2011), particularly because daily weather is less abstract and something people can easily relate to (Smith & Joffe, 2012). A potentially useful strategy is therefore to focus on the increasing frequency with which extreme weather events are occurring (Coumou & Rahmsorf, 2012) – so long as extremely cold weather events are framed as being compatible with the impacts of global warming (Capstick & Pidgeon, 2014).

Overall, results suggest that in forming risk judgements of climate change, socio-cultural and experiential factors weigh in substantially more than cognitive or socio-demographic factors. As mentioned, personal experience is important in stimulating more affective engagement with climate change. In fact, as this research and that of others' (e.g. Leiserowitz, 2006; Smith & Leiserowitz, 2012) has shown, negative (holistic) affect is the strongest single determinant of risk perception. As part of this frame, this thesis does however not necessarily advocate a “fear-based” approach – which, as discussed in chapter 2 has shown to be subject to many caveats and pitfalls (O'Neill & Nicholson-Cole, 2009). Fear-based approaches generally result in maladaptive responses because they short-circuit cognitive-control mechanisms in the brain. Primarily because more neural pathways run from the amygdala (i.e. the emotional centre of the brain's limbic system) to the brain's prefrontal structures than the other way around (LeDoux, 1996). Thus, it is easy to be overwhelmed by fear but relatively difficult to control it.

One finding worth mentioning is that recent research has similarly discussed a useful distinction between “worry” and “fear”. Compared to fear, worry is an active (but less intense) emotional state that often triggers and motivates increased cognitive, analytical and central processing of risk information (Smith & Leiserowitz, 2014). While taking note of the “*finite pool of worry*” hypothesis (Weber, 2010), framing climate



change as a risk about which to “worry” rather than as a risk to “fear” is likely to foster more constructive public engagement with the issue (Smith & Leiserowitz, 2014).

Lastly, the triangular relationship proposed in this thesis between cognitive, experiential and socio-cultural factors is entirely in line with the notion that information should be placed and framed in such a way that it does not trigger or aggravate existing socio-political, cultural or ideological differences, which are particularly pronounced in Anglo-Saxon countries (Painter & Ashe, 2012) such as the UK and the United States (e.g. Gromet, Kunreuther, & Larrick, 2013; Hart & Nisbet, 2012; McCright & Dunlap, 2011; Poortinga et al., 2011). One useful strategy to consider in this regard is the notion of “value-congruent” information processing (Bolderdijk et al., 2013; Corner et al., 2014; Steg et al., 2014), where the saliency of biospheric value orientations can be leveraged in specific situations without conflicting or threatening the validity of other important values that people may espouse (De Groot & Steg, 2009). To this extent, audience segmentation techniques and tailored message strategies have proven useful in testing specific frames (e.g. public health) that appeal to different audiences (e.g. Myers et al., 2012b).

As illustrated by the second part of this thesis, risk perceptions also play an important (indirect) role in driving mitigation intentions and behaviours. While a major finding of this thesis is that relevant domain (i.e. broad biospheric values) and specific climate change context variables (i.e. risk perception, response-knowledge and descriptive social norms) do not influence specific mitigation behaviours directly, they do influence a general intention to act. This general intention is an important motivating force in activating and predicting specific mitigation intentions, which in turn, in conjunction with habits predict specific mitigation behaviours. Thus, while risk perceptions, values, knowledge and norms clearly have a role to play in behavioural

change campaigns, an important conclusion of this thesis is the message that specific mitigation behaviours are driven by behaviour-specific determinants.

To this extent, as discussed in detail in chapters 1 and 2, an important objective of this thesis was to stimulate the relationship between “theories of change” and “models of behaviour”. Public interventions often fail to take into the account the determinants of specific behaviours. While experiences with extreme weather and beliefs and perceptions about climate change may influence a general intention to reduce energy consumption (e.g. Spence et al., 2011; Spence et al., 2012), whether or not someone will form a specific intention (e.g. turn down the thermostat) and act on that intention, is very much dependent on situational factors and that person’s specific attitude towards the behaviour. While it is promising that general intentions to act influence specific intentions *indirectly* by creating more favourable attitudes toward performing specific behaviours, by creating more perceived control and less perceived situational constraints, it is still important for public interventions to focus on these behaviour-specific aspects. In fact, this conclusion has received increased attention and indirect support from other scholars as well (e.g. Ajzen et al., 2011; Hansla et al., 2008; Whitmarsh & O’Neill, 2010).

Indeed, while it is often noted that many structural barriers to behavioural change exist (e.g. Lorenzoni et al., 2007; Steg & Vlek, 2009), this thesis highlights the need to focus on alleviating specific situational barriers to engagement with more high-cost, high-impact behaviours. For example, while people often report that reducing meat consumption or changing transport and mobility behaviours is very inconvenient, it is important to realise that at least some of these perceived situational constraints (e.g. time, inconvenience) are psychological in nature and thus influenced by relevant attitudes, norms and value priorities. This implies that the *perception* of such constraints can be changed if public interventions incorporate messages that are targeted at alleviating

specific barriers – a strategy that is likely to increase the probability that people will implement the requested changes.

This thesis also reaffirms the finding that many low-cost, low-impact behaviours (e.g. leaving the lights on) are entrenched in unsustainable habitual routines. When targeting specific behaviours, public campaigns should try to make people cognisant of their habits and provide information to make sure that alternative behavioural choices are mentally accessible to people. Ideally this should be done in an integrative manner as well. For example, if such information is preceded by “social proof” that referent others are changing their behaviour as well whilst endorsing biospheric values, people are more likely to be persuaded by the information provided. Indeed, such relatively simple techniques have recently demonstrated to be effective for low-cost behaviours such as bottled water consumption (e.g. Bolderdijk et al., 2013; van der Linden, 2013).

### **7.3 Limitations of Thesis and Future Research**

While this thesis constructively advanced the literature and made a number of significant and original contributions, a number of limitations apply. First, one obvious limitation is the self-reported nature of the data. It is possible that respondents overstated their self-reported intentions and mitigation behaviours or that the very act of measuring intention increased the probability of a respondent actually performing the behaviour (Gifford et al., 2011; Morwitz & Fitzsimons, 2004). In either case, this could potentially inflate the observed correlations between the psychological constructs of interest. Having mentioned this, the effect of social desirability bias in environmental surveys has shown to be relatively limited (Milfont, 2009). Moreover, one major objective of this thesis has been to investigate the psychological antecedents of a wide range of mitigation behaviours,

which limits the feasibility of other techniques (e.g. observation). Yet, future research could focus on obtaining more objective measurements (e.g. energy meter readings).

Second, while the hypothesised structure of the DCB model fit the data well and a stronger case for causality was made by separating the measurement of psychological dispositions (e.g. intention) and self-reported behaviour (Podsakoff et al., 2003), a fruitful avenue for future research would be to explore the validity of the model in other contexts and cultures and to test the causal mechanisms proposed by the model in an experimental (field) setting. Similarly, the study reported in chapter 4 could be criticised for not using “clean” measures of cognition and affect and for only providing preliminary (tentative) causal evidence for a model of dual-processing. Experimental studies could induce and measure affective states physiologically and assess to what extent personal experiences influence risk perception and intention. For example, Zaalberg and Midden (2013) have recently done so using virtual reality simulations of flooding events.

A third drawback is the fact that the national quota sample used in this thesis was obtained from a large online panel and is therefore not a probability sample. While online quota samples are generally regarded as less representative than probability samples, due to the increasing variability of membership in online panels and near universal internet access, differences between online and more traditional techniques are sharply declining (e.g. Berrens et al., 2003). Another short-coming of this thesis relates to missing data, both item non-response (e.g. due to sensitive demographic questions) and panel attrition. Although this could reasonably be controlled for by (a) identifying the likely mechanisms that determine the pattern of missingness and (b) by using the latest techniques for estimating missing data (i.e. full information maximum likelihood procedures), the reader should take this into account when interpreting the results of this thesis.

In addition, while many social-psychological constructs and behaviours were surveyed, the list is by no means exhaustive. For example, even although a substantial amount of variance could be explained using the constructs reported in this thesis, social-psychological aspects of risk perception that could be added to the model in future research include; trust in scientists and experts, perceived benefits, mass media influence and climate change scepticism (e.g. Malka et al., 2009; Poortinga & Pidgeon, 2003; Poortinga et al., 2011; Slovic, 2006; Smith & Leiserowitz, 2012) as well as the influence of positive emotions such as “hope”. In terms of behaviour, future research could explore the usefulness of other potentially important factors such as pro-environmental identities and moral norms (e.g. Poortinga et al., 2012; van der Werf et al., 2013; Whitmarsh & O’Neill, 2010). Closely related, another limitation of this study is its central focus on mitigation behaviour. For example, future studies may want to include other important actions such as adaptation behaviour and support for climate change policies.

Lastly, criticisms towards “incremental behavioural change” approaches are noted and the limitations of modelling “social, contextual and situational” factors are duly acknowledged here (e.g. Doyle, 2011; Shove, 2010; Uzzell, 2010). In addition to changing norms, beliefs and perceptions (or so-called “bottom-up” approaches), transitioning to a low-carbon society will ultimately require widespread changes in social practice, redefined meanings of human-environment interactions and large-scale policy (or “top-down”) support to help alleviate structural and monetary barriers to change (Lorenzoni et al., 2007). Still, a bottom-up approach will continue to play an important role in any multi-level effort as, at the very least, it can help increase support for and acceptability of such policies (Steg & Vlek, 2009).

## 7.4 Conclusion

This thesis has illustrated that while public risk perceptions of climate change are complex and multidimensional, they are primarily influenced by three key psychological dimensions, namely; cognitive, experiential, and socio-cultural factors. In addition, an important distinction between societal and personal risk judgements is validated empirically. At present, climate change is still regarded as a “societal” risk in the mind of the public more so than a “personal” risk. To this extent, the relationship between personal experience with extreme weather events, negative affective evaluations and risk perceptions of climate change was evaluated. While personal experiences with extreme weather influence negative affective judgements of climate change only via conscious risk appraisals, affect and risk perception strongly and reciprocally influence each other.

Overall, behavioural engagement (especially with more high-cost changes) is still relatively low among the UK public and perceived barriers are plentiful and multidimensional. Yet, while important differences in determinants exist between low and high-cost behavioural changes, evidence is provided for a common motivational roots driving mitigation intentions and behaviours. In fact, the domain-context-behaviour (DCB) model advanced in this thesis highlights that environmental values and climate change risk perceptions, norms and knowledge influence specific mitigation intentions and behaviours indirectly via a general orienting intention to help reduce climate change. Taken together, these findings strongly encourage public climate change campaigns to take an integrative approach in considering cognitive, experiential and socio-cultural factors and suggest that such campaigns should pay more attention to situational and behaviour-specific barriers and determinants in communicating and eliciting change.

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## Appendix A: Supplement 1 to Chapter 6

**Table A.1: Factor Loadings from Principal Component Analysis (PCA)**

<b>Climate Change Mitigation Behavior Scale (1-7)</b>			
<b>Rotated Factor Solution</b>	<b>Mean</b>	<b>LL</b>	<b>HH</b>
1. Maintain correct tire pressure on my car	5.96	<b>0.36</b>	-0.09
2. Only run the dishwasher when there's a full load	5.83	<b>0.24</b>	0.09
3. Use a clothesline instead of a tumble dryer, when drying wet clothes	5.49	<b>0.29</b>	-0.01
4. Alter my driving (i.e. avoiding sudden accelerations and stops)	5.41	<b>0.36</b>	-0.03
5. Unplug (or shut down) electronics completely when not using them	5.39	<b>0.30</b>	-0.05
6. Replace ordinary (non-saving) light bulbs with energy-saving (CFC) bulbs	5.32	<b>0.22</b>	0.07
7. Use energy-efficiency as a selection criterion when buying new appliances	5.18	<b>0.23</b>	0.11
8. Turn off my car when idle for longer than 30 seconds (except in traffic)	5.13	<b>0.36</b>	-0.03
9. Turn down my heating/thermostat by 2 degrees	4.96	<b>0.30</b>	0.02
10. Reduce my shower time to 5 minutes maximum	4.82	<b>0.26</b>	0.05
11. Buy more locally grown and produced foods	4.59	<b>0.21</b>	0.09
12. Reduce my driving by walking or biking more	4.33	0.18	0.10
13. Use more public transportation (e.g. train, bus) instead of driving	3.91	0.12	<b>0.23</b>
14. Reduce the number of miles that I fly	3.84	-0.01	<b>0.38</b>
15. Insulate my home or apartment	3.59	-0.02	<b>0.37</b>
16. Buy/consume less meat	3.57	0.12	<b>0.21</b>
17. Buy carbon offsets when booking an airline ticket (whenever possible)	3.52	-0.01	<b>0.38</b>
18. Reduce my driving, by sharing car rides	3.48	0.20	0.22
19. Switching from single glazed to double glazed windows	3.43	-0.06	<b>0.41</b>
20. Purchase home energy from a green source (e.g. wind or solar power)	2.83	0.01	<b>0.36</b>
21. Purchase a more fuel-efficient car	2.55	0.04	<b>0.33</b>

*Note:* Rotated (oblique oblimin) two-factor solution. LL = low-cost, low-impact, HH = high-cost, high-impact.

**Table A.2: Effect of Socio-Demographics on General Intentions**

<b>General Intention</b>	<b>Socio-Demographics</b>	<b>Context Variables</b>
	( $\beta$ )	( $\beta$ )
Gender (female)	0.14 <sup>***</sup> (0.12)	<b>0.04</b> (0.07)
Age	-0.04 (0.05)	-0.06 (0.03)
Education (higher)	0.09 <sup>*</sup> (0.13)	<b>0.01</b> (0.07)
Income	-0.01 (0.17)	-0.02 (0.10)
Political Party (liberal)	0.20 <sup>***</sup> (0.14)	<b>0.03</b> (0.08)
Biospheric Values	-	0.06 <sup>*</sup> (0.02)
Risk Perception	-	0.54 <sup>***</sup> (0.04)
Response-Knowledge	-	0.08 <sup>***</sup> (0.01)
Descriptive Social Norm	-	0.30 <sup>***</sup> (0.03)
<i>N</i>	588	588
adj. <i>R</i> <sup>2</sup>	0.07	0.67
$\Delta$ adj.		0.61
<i>F</i> <sub>change</sub>	9.43	301.02

*Note:* Hierarchical multiple regression with general intentions to help reduce climate change as the dependent variable. Values are standardised beta coefficients. Standard errors are provided in parentheses, \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ .



## Appendix B: Supplement 2 to Chapter 6

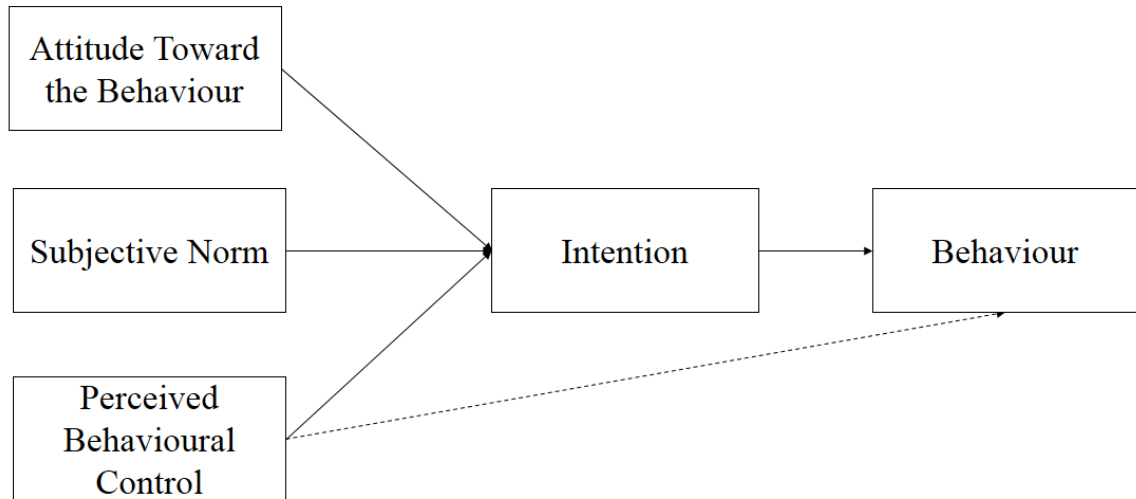


Figure B.1: Theory of Planned Behaviour (Ajzen, 1991). Note: Schematic overview of main components.

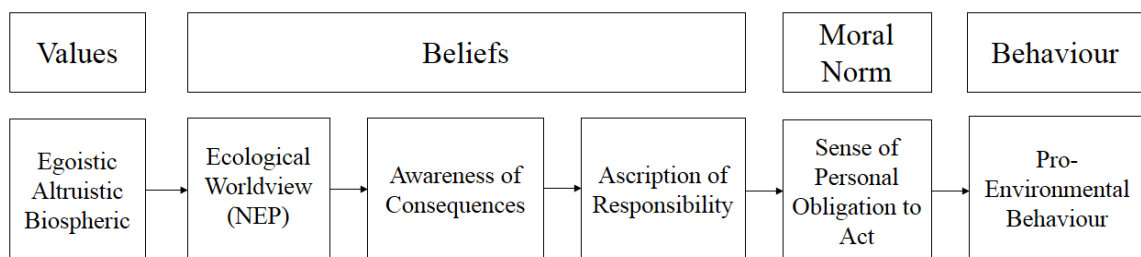
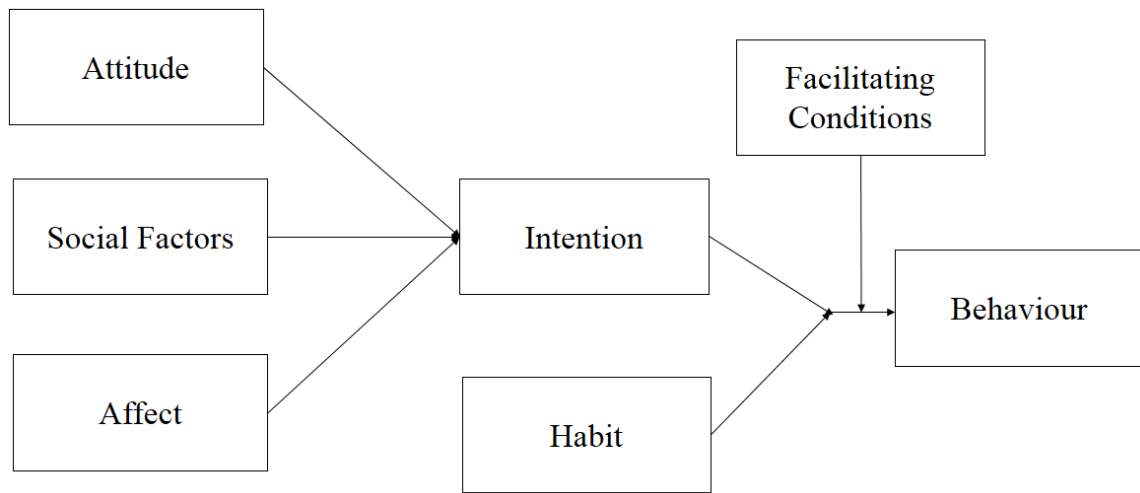


Figure B.2: Value-Belief-Norm Theory (Stern et al., 1999, Stern, 2000). Note: Schematic overview of main components.



*Figure B.3:* Theory of Interpersonal Behaviour (Triandis, 1977). *Note:* Schematic overview of main components.

## Appendix C: Sample Characteristics

**Table C.1: Sample Characteristics**

<b>Sample Characteristics</b>	<i>N</i> = 808
<b>Gender</b>	
Male	49.88%
Female	50.12%
<b>Age</b>	
18-24	12.75%
25-34	21.16%
35-44	22.77%
45-54	21.91%
55-65	21.41%
<b>Region</b>	
East Anglia	7.30%
East Midlands	6.44%
West Midlands	8.66%
London	14.60%
North East	4.83%
North West	11.26%
Scotland	8.29%
South East	14.60%
South West	8.04%
Wales	4.70%
Yorkshire & Humberside	8.17%
Northern Ireland	3.09%
<b>Education</b>	
No Qualification	3.66%
GCSE / O-Level / BTEC NVQ Level 2	23.48%
A-Level / International Baccalaureate	19.19%
Higher Education / National Certification	15.91%
Bachelor's degree or equivalent	22.35%
Master's degree or equivalent	11.49%
Doctoral Degree	1.64%
I prefer not to answer	2.27%

Table C.1 continued

**Political Party**

Conservative Party	19.57%
Labour Party	26.77%
Liberal Democrats	6.06%
UK Independence Party	4.04%
Green Party	3.41%
None of the above / other	22.98%
I prefer not to answer	17.17%

**Income**

Up to £9,999	14.52%
10,000 to 19,999	24.24%
20,000 to 29,999	19.70%
30,000 to 39,999	13.76%
40,000 to 49,999	6.82%
50,000 to 59,999	3.79%
60,000 and above	4.55%
I prefer not to answer	12.63%

**Religiosity**

Christianity	48.11%
Islam	2.40%
Judaism	0.88%
Hinduism	1.26%
Buddhism	1.14%
Sikhism	0.38%
Other	2.40%
None (No Religion)	38.13%
I prefer not to answer	5.30%

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## Appendix D: National Survey Questions and Items

Screen shots of the online survey items and questions are provided below. Please note that due to question / item randomisation the survey displayed below is not necessarily the order in which participants viewed the survey questions (with the exception of certain blocks such as the introduction, demographic quotas and the end screen). Similarly, items were grouped together here in relevant blocks for display convenience.

### 1. Introduction

**Dear Participant,**

**Thank you very much for your time and for your participation in this national survey. Your responses are greatly appreciated and please know that your identity will remain completely anonymous to the researcher conducting this study. The estimated completion time of this survey is between 15-20 minutes.**

**To start the survey, please click next.**

0%  100%

## 2. Socio-Demographics Screener for Quota Sampling

**Because this is a national survey, it would be greatly appreciated if you could provide some basic demographic information first, before proceeding to the rest of the survey. These questions are asked to make sure that the sample is broadly representative of the UK national population. Your cooperation is much appreciated and please be assured that all personal information you provide is treated in full confidence.**

**What is your gender?**

- Male
- Female

**Please indicate your age**

- 18-24
- 25-34
- 35-44
- 45-54
- 55-65

**In what region of the United Kingdom do you live?**

- East Anglia
- East Midlands
- London
- North East
- North West
- Scotland
- South East
- South West
- Wales
- West Midlands
- Yorkshire & Humberside
- Northern Ireland

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### 3. Broad Value Orientations

**Thank you. We would like to start off the survey by learning more about what values are important to you. For each value listed below, please rate the extent to which you consider it to be a 'GUIDING PRINCIPLE IN YOUR LIFE'..**


	Opposed to my values	Not Important	of little Importance	Somewhat Important	Important	Slightly more than Important	Quite Important	Very Important	of Supreme Importance
Wealth (material possessions, money)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preventing Pollution (protecting natural resources)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peace (a world free of war and conflict)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Protecting the Environment (preserving nature)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Opposed to my values	Not Important	of little Importance	Somewhat Important	Important	Slightly more than Important	Quite Important	Very Important	of Supreme Importance
Social Power (control over others, dominance)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful (working for the welfare of others)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Authority (the right to lead or command)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social Justice (correcting injustice, care for the weak)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Opposed to my values	Not Important	of little Importance	Somewhat Important	Important	Slightly more than Important	Quite Important	Very Important	of Supreme Importance
Respecting the Earth (harmony with other species)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Influential (having an impact on people and events)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unity with Nature (fitting into nature)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Equality (equal opportunity for all) ..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



#### 4. Past Behaviour

**Many of the behaviours listed below are relatively common. Please indicate how frequently you do the following things..**

	Never	Very Infrequently	Infrequently	Neutral	Frequently	Very Frequently	All the time
Travel by airplane...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leave the car running when idle for longer than 30 seconds..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Showering longer than 5 minutes (on average)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Take the car if I have to travel somewhere...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying an airline ticket without adding carbon offsets..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Never	Very Infrequently	Infrequently	Neutral	Frequently	Very Frequently	All the time
Drying clothes in the tumble dryer..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leave electronics on or on stand-by mode when not using them..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying ordinary (non-energy saving) light bulbs when old ones need to be replaced..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Running the dishwasher when it's not entirely full..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchasing foreign food when doing groceries (e.g. exotic fruits)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Never	Very Infrequently	Infrequently	Neutral	Frequently	Very Frequently	All the time
Suddenly accelerating or stopping when driving..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying meat when doing groceries..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leave the lights on when not around..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying electronics and household appliances without paying much attention to energy-efficiency labels..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leave the heating on when not at home..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>


0%  100%



## 5. Habit Strength

**In addition, please indicate the extent to which you agree that these behaviours have become automatic to you, that is, something you do on a routine basis, without consciously thinking about it...**

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Leave electronics on or on stand-by mode when not using them..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Running the dishwasher when it's not entirely full..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Showering longer than 5 minutes (on average)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Suddenly accelerating or stopping when driving..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying meat when doing groceries..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Drying clothes in the tumble dryer..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Travel by airplane...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leave the heating on when not at home..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchasing foreign food when doing groceries (e.g. exotic fruits)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying an airline ticket without adding carbon offsets..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Take the car if I have to travel somewhere...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leave the lights on when not around..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying ordinary (non-energy saving) light bulbs when old ones need to be replaced..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buying electronics and household appliances without paying much attention to energy-efficiency labels...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leave the car running when idle for longer than 30 seconds..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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## 6. Climate Change Definition

You may have heard of the term '*climate change*' (also referred to as '*global warming*' in the media). Climate change refers to the idea that the world's average temperature has been increasing in the last 150 years, may be increasing in the future and that the world's climate may change as a result.


To continue, please click next.

0%  100%

## 7. Generalised Affect

Please rate the following statements to the best of your ability..

	Very Positive	Positive	Somewhat Positive	Neutral	Somewhat Negative	Negative	Very Negative
To me, climate change is something....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Favourable	Favourable	Somewhat Favourable	Neutral	Somewhat Unfavourable	Unfavourable	Very Unfavourable
Overall, I feel that climate change is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Pleasant	Pleasant	Somewhat Pleasant	Neutral	Somewhat Unpleasant	Unpleasant	Very Unpleasant
I see climate change as something that is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%

## 8. Risk Perception

Please answer the following questions to the best of your ability..

	Not Serious at all	Not Serious	Not Really Serious	Neutral	Somewhat Serious	Serious	Very Serious
How serious of a threat do you believe that climate change is, to you personally?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How serious would you rate current impacts of climate change around the world?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How serious would you estimate the impacts of climate change for the United Kingdom?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How serious of a threat do you think that climate change is to the natural environment?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely
In your judgment, how likely do you think it is that climate change will have very harmful, long-term impacts on our society?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>


	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely
In your judgment, how likely are you, sometime during your life, to experience serious threats to your health or overall well-being, as a result of climate change?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Not concerned at all	Not concerned	Not really concerned	Neutral	Somewhat concerned	Concerned	Very Concerned
How concerned are you about climate change?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Very Rarely	Rarely	Somewhat Rarely	Neutral	Occasionally	Frequently	Very Frequently
How often do you worry about the potentially negative consequences of climate change?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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## 9. Personal Experience with Extreme Weather

Considering roughly the last 5 years, how often have you personally experienced flooding in your local area? (Only taking into account your time in the United Kingdom).

- Never
- Once
- Twice
- Three times
- I have experienced more than three floodings
- I don't remember

Considering roughly the last 5 years, how often (in total) have you personally experienced any type of *extreme weather event* (other than flooding) in your local UK area? For example, severe heat waves, droughts, freak storms or hurricanes?


- Never
- Once
- Twice
- Three times
- I have experienced more than three extreme weather events
- I don't remember



## 10. Descriptive Social Norm

Please answer the following statements to the best of your ability..


	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Most people who are important to me, are personally doing something to help reduce the risk of climate change..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Most people I care about are doing their bit to help slow climate change...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely
How likely do you think it is, that people close to you are taking personal action to address climate change?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%

## 11. Prescriptive Social Norm

Please answer the following statements to the best of your ability..

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I feel that helping to tackle climate change is something that is NOT expected of me..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People whose opinion I value, think that I should personally act to reduce the risk of climate change..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is generally expected of me that I do my bit to help reduce the risk of climate change...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People that are important to me, would support me if I decided to change my behaviour to help reduce climate change..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%

## 12. Impact-Knowledge Scale

For each of the items listed below, please indicate whether you believe that they are likely to stay constant, decrease or increase AS A RESULT of climate change..

	Likely to Decrease	No Change	Likely to Increase	I really don't know
Global average temperature..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Acid Rain..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air pollution..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Areas in the world experiencing drought..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global biodiversity (i.e. variety of plants and animals)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Melting of glaciers and polar ice caps..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global sea level..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global spread of infectious disease..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The hole in the ozone layer..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The frequency of hot days and nights..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme weather events (e.g. floodings, hurricanes, storms, etc.)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volcanic eruptions..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global fresh water supply..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### 13. Cause-Knowledge Scale

**Please indicate, to the best extent of your knowledge, how much you believe that each of the following items contribute to climate change..**

	Major Contribution to Climate Change	Minor Contribution to Climate Change	No Contribution to Climate Change at all	I really don't know
Burning fossil fuels (coal, oil, gas) for heat and electricity..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The hole in the ozone layer..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Driving a car..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aerosol spray cans (containing CFC's)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Toxic waste..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deforestation (e.g. destruction of rainforests)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nuclear power plants..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Acid rain..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Agricultural activities such as cattle breeding (cows raised for meat consumption)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Steadily rising CO2 emissions (carbon dioxide)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sun..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flying / Commercial air travel..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smoking cigarettes..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## 14. Response-Knowledge Scale

How much do you think that each of the following actions would reduce climate change if they were done worldwide?

	Likely to reduce climate change a lot	Likely to reduce climate change a little	Not going to reduce climate change at all	I really don't know
Purchasing only organic products is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Insulating buildings is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recycling paper, glass and plastic is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Switching from fossil fuels to renewable energy (wind, solar, geothermal) is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using more public transportation is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fixing the hole in the ozone layer is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Switching from petrol to electric cars is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reducing the amount of (commercial) airline flights is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Generating less toxic waste (nuclear, chemical) is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Planting trees is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Becoming a member of an environmental group is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conserving energy is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating less meat is..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



## 15. Attitude Towards Performing Mitigation Behaviours


Considering the next 4 weeks, how would you personally evaluate performing each of the behaviours listed below?

	Very Unfavourable	Unfavourable	Somewhat Unfavourable	Neutral	Somewhat Favourable	Favourable	Very Favourable	Not Applicable
Turn off my car when idle for longer than 30 seconds (except in traffic)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Only run the dishwasher when there's a full load..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my driving, by sharing car rides..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Insulate my home or apartment..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce the number of miles that I fly..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unplug (or shut down) electronics completely when not using them..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unfavourable	Unfavourable	Somewhat Unfavourable	Neutral	Somewhat Favourable	Favourable	Very Favourable	Not Applicable
Use more public transportation (e.g. train, bus) instead of driving..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy more locally grown and produced foods..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintain correct tire pressure on my car..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Replace ordinary (non-saving) light bulbs with energy saving (compact fluorescent) bulbs..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use energy-efficiency as a selection criterion when buying new electronics and household appliances..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When drying wet clothes, use a clothesline instead of a tumble dryer..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unfavourable	Unfavourable	Somewhat Unfavourable	Neutral	Somewhat Favourable	Favourable	Very Favourable	Not Applicable
Purchase a more fuel-efficient automobile..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my driving, by walking or biking more..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alter my driving (i.e. avoiding sudden accelerations and stops)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turn down my heating / thermostat by 2 degrees..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy / consume less meat..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Replace single glazed with double glazed windows..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unfavourable	Unfavourable	Somewhat Unfavourable	Neutral	Somewhat Favourable	Favourable	Very Favourable	Not Applicable
Reduce my shower time to 5 minutes maximum..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchase home energy from a green source (e.g. wind or solar power)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy carbon offsets when booking an airline ticket (whenever possible)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## 16. Perceived Control Over Performing Mitigation Behaviours

Considering the next 4 weeks, if I wanted to do so, I firmly believe that I have the ability to..

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Alter my driving (i.e. avoiding sudden accelerations and stops)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my driving, by walking or biking more..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use energy-efficiency as a selection criterion when buying new electronics and household appliances..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my shower time to 5 minutes maximum..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use more public transportation (e.g. train, bus) instead of driving..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unplug (or shut down) electronics completely when not using them..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Purchase home energy from a green source (e.g. wind or solar power)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Switch from single glazed to double glazed windows..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Insulate my home or apartment..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchase a more fuel-efficient automobile..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use a clothesline instead of a tumble dryer..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce the number of miles that I fly..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Buy carbon offsets when booking an airline ticket..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Only run the dishwasher when there's a full load..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintain correct tire pressure on my car..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy / consume less meat..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turn off my car when idle for longer than 30 seconds (except in traffic)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy more locally grown and produced foods..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Turn down my heating / thermostat by 2 degrees..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Replace ordinary (non-saving) light bulbs with energy saving (compact fluorescent) bulbs..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my driving, by sharing car rides..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%

## 17. Situational Constraints / Barriers

Sometimes we would like to change our behaviour, but we find it difficult because we don't have enough time, money, know-how or the opportunity to do so. For each of the behaviours listed below, please tick ALL reasons that apply to you (for example, you might find something too costly AND you don't have the time for it).

**note: If NONE of the options below constrain your behaviour, please tick 'NO BARRIERS'.**

	I can't afford it	I don't have the time	Decision is not entirely up to me	I don't know how to	Too Inconvenient	Other Reason	No Barriers
Switch from single glazed to double glazed windows..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unplug (or shut down) electronics completely when not using them..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce my driving, by sharing car rides..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Turn down my heating / thermostat by 2 degrees..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When drying wet clothes, use a clothesline instead of a tumble dryer..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce my shower time to 5 minutes maximum..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	I can't afford it	I don't have the time	Decision is not entirely up to me	I don't know how to	Too Inconvenient	Other Reason	No Barriers
Buy / consume less meat..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use more public transportation (e.g. train, bus) instead of driving..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Purchase a more fuel-efficient automobile..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce the number of miles that I fly..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy more locally grown and produced foods..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy carbon offsets when booking an airline ticket..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	I can't afford it	I don't have the time	Decision is not entirely up to me	I don't know how to	Too Inconvenient	Other Reason	No Barriers
Use energy-efficiency as a selection criterion when buying new electronics and household appliances..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Turn off my car when idle for longer than 30 seconds (except in traffic)..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Alter my driving (i.e. avoiding sudden accelerations and stops)..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce my driving, by walking or biking more..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Replace ordinary (non-saving) light bulbs with energy saving (compact fluorescent) bulbs..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintain correct tire pressure on my car..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	I can't afford it	I don't have the time	Decision is not entirely up to me	I don't know how to	Too Inconvenient	Other Reason	No Barriers
Insulate my home or apartment..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Purchase home energy from a green source (e.g. wind or solar power)..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Only run the dishwasher when there's a full load..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

0%  100%

## 18. General Intention

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I intend to help reduce climate change by changing my behaviour..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unlikely	Unlikely	Somewhat Unlikely	Neutral	Somewhat Likely	Likely	Very Likely
I intend to do my bit to help tackle climate change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I intend to address climate change by taking personal action..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## 19. Mitigation Intention

**To what extent do you *intend* to adopt the following behaviours in the next 4 weeks?**

**note: If a behaviour is NOT relevant to you at all (e.g. if you never eat meat or do not own a car), please use the 'not applicable' option.**

**IN THE NEXT FOUR WEEKS, I INTEND TO...**

	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely	Not Applicable
Turn down my heating / thermostat by 2 degrees..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my driving, by sharing car rides..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintain correct tire pressure on my car..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turn off my car when idle for longer than 30 seconds (except in traffic)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy carbon offsets when booking an airline ticket (whenever possible)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce the number of miles that I fly..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely	Not Applicable
Purchase a more fuel-efficient automobile..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Switch from single glazed to double glazed windows..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Replace ordinary (non-saving) light bulbs with energy saving (compact fluorescent) bulbs..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use energy-efficiency as a selection criterion when buying new electronics and household appliances..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy / consume less meat..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buy more locally grown and produced foods..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely	Not Applicable
Insulate my home or apartment..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use more public transportation (e.g. train, bus) instead of driving..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alter my driving (i.e. avoiding sudden accelerations and stops)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my shower time to 5 minutes maximum..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchase home energy from a green source (e.g. wind or solar power)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Only run the dishwasher when there's a full load..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely	Not Applicable
When drying wet clothes, use a clothesline instead of a tumble dryer, whenever possible..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce my driving, by walking or biking more..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unplug (or shut down) electronics completely when not using them..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%

## 20. End Screen Message

Thank you very much for your participation. Before ending this survey, it would be greatly appreciated if you could answer a few short questions about your background. Your cooperation is entirely voluntary and much appreciated and again, please be assured that all personal information you provide is treated in full confidence. As part of this research project, you will be contacted again in a few weeks for a short follow up. The follow up survey is extremely brief and will not take more than a few minutes to complete. Your continued cooperation is of great importance to the study and your kind consideration is much appreciated.

May you have any questions or concerns about this study, feel free to contact the principal investigator:

Mr. Sander van der Linden (London School of Economics and Political Science)

E-mail: [s.i.van-der-linden@lse.ac.uk](mailto:s.i.van-der-linden@lse.ac.uk)

### Please specify your annual income

- up to £9, 999
- £10, 000 to £19, 999
- £20, 000 to £29, 999
- £30, 000 to £39, 999
- £40 000 to £49,999
- £50 000 to £59,999
- £60 000 and above
- I prefer not to answer

### Please indicate your highest educational qualification

- No Qualification
- GCSE / O-Level / BTEC NVQ Level 2
- A-Level / International Baccalaureate / BTEC NVQ Level 3
- Higher Education / Higher National Certificates and Diplomas
- Bachelor's degree or equivalent
- Master's degree / Postgraduate qualification
- Doctoral degree
- I prefer not to answer

### For which political party do you generally express most support?

- Conservative Party
- Labour Party
- Liberal Democrats
- UK Independence Party
- Green Party
- None of the above / other
- I prefer not to answer

### Please indicate your religion (if any)

- Christianity
- Islam
- Judaism
- Hinduism
- Buddhism
- Sikhism
- Other
- None (No Religion)
- I prefer not to answer

0%  100%

## 21. Introduction Follow Up Survey (Wave 2)

Dear Participant,

You were kind enough to take part in a national survey a few weeks ago. This is a short follow up survey that should not take more than a minute or two of your time! All information is treated with complete confidentiality. Thank you again for your continued cooperation.

To start the survey, please click next.


0%  100%

## 22. Self-Reported Behaviour

Please indicate, to the best extent of your knowledge, how often in the last four weeks, you have performed the behaviours listed below....

**Note: If a behaviour does not apply to your personal situation (e.g. if you don't own a car, please use the 'not applicable' option). Additionally, if you have made any one-off purchases (e.g. a fuel-efficient car) please tick "very frequently" for "yes" or "not at all" for "no".**

	Not at all	Infrequently	Somewhat Infrequently	Neutral	Somewhat Frequently	Frequently	Very Frequently	Not Applicable
Turned off your car when idle for longer than 30 seconds (except in traffic)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduced your driving, by sharing car rides..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Replaced ordinary (non-saving) light bulbs with energy saving (compact fluorescent) bulbs..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchased home energy from a green source (e.g. wind or solar power)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When drying wet clothes, used a clothesline instead of a tumble dryer..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Checked / maintained correct tire pressure on your car..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	Infrequently	Somewhat Infrequently	Neutral	Somewhat Frequently	Frequently	Very Frequently	Not Applicable
Reduced your shower time to 5 minutes maximum..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bought carbon offsets when booking an airline ticket...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Replaced single glazed with double glazed windows..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bought / consumed less meat..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduced your driving, by using more public transportation (e.g. train, bus)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turned down your heating / thermostat by 2 degrees..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	Infrequently	Somewhat Infrequently	Neutral	Somewhat Frequently	Frequently	Very Frequently	Not Applicable
Used energy-efficiency as a selection criterion when buying new electronics and household appliances..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Only ran the dishwasher when there was a full load..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchased more locally grown and produced foods..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchased a more fuel-efficient automobile..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unplugged (or shut down) electronics completely when you did not use them..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Altered your driving (i.e. avoiding sudden accelerations and stops)..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	Infrequently	Somewhat Infrequently	Neutral	Somewhat Frequently	Frequently	Very Frequently	Not Applicable
Worked on insulating your home or apartment..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduced the number of miles that you have traveled by airplane..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduced your driving, by walking or biking more..	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%



## Appendix E: Focus Group Study Form / Human Subjects Approval

The screenshot displays the LSE experiment management system interface. At the top, there is a banner with the LSE logo and the text 'THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE'. Below the banner, a navigation menu includes 'My Studies', 'All Studies', 'Add New Study', 'Prescreen Results', 'My Profile', 'FAQ', and 'Logout'. The user is identified as 'Sander Van der Linden, Researcher'. The main content area shows a 'Study Information' box for the study '120170 - Climate Change Questionnaire'. The information includes an abstract, prescreen restrictions, duration, pay, researcher details, participant sign-up deadline, and study status.

Study Information	
<b>Study Name</b>	120170 - Climate Change Questionnaire
<b>Abstract</b>	This study involves a detailed questionnaire on climate change attitudes and behaviours. Participants will complete the survey and provide feedback on the clarity, terminology and type of questions used.
<b>Prescreen Restrictions</b>	YES - [ <a href="#">View/Modify Restrictions</a> ]
<b>Duration</b>	60 minutes
<b>Pay</b>	£10
<b>Researcher</b>	Sander Van der Linden Email: <a href="mailto:brl@lse.ac.uk">brl@lse.ac.uk</a>
<b>Participant Sign-Up Deadline</b>	1 hours before the study is to occur
<b>Study Status</b>	Visible to participants (approved) Inactive study (does not appear on list of available studies)

**Section I: Applicant Details**

Name of researcher:	Sander van der Linden
Status(delete as appropriate):	Undergraduate Student/MSc <b>Student</b> /PhD Student/Staff
Email address:	<a href="mailto:s.l.van-der-linden@lse.ac.uk">s.l.van-der-linden@lse.ac.uk</a>
Contact address:	Currently residing outside of the UK
Telephone number:	+44 (0) 7741 671 682

**Section II: Project Details**

Title of the proposal and brief abstract:  <b>Survey for PhD research. The research itself involves a detailed psychometric questionnaire on climate change attitudes and behaviours. I would like to book one meeting room, and run 2 sessions with 15 members of the general public for approx. 45 -60 mins (per session)</b>
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**Section III: Student Details:**

Details of study:	Focus group (2x 45 mins, 7-8 people per session) – same day - to pilot test a questionnaire on climate change.
Supervisor's name:	Richard Perkins
Email address:	<a href="mailto:r.m.perkins@lse.ac.uk">r.m.perkins@lse.ac.uk</a>
Contact address:	Department of Geography and Environment London School of Economics and Political Science (LSE) Houghton Street London WC2A 2AE Tel: +44 (0)20 7955 7605

## Section IV: Research Checklist

### Consent

	Yes	No	Not certain
<p>Does the study involve participants who are in any way vulnerable or may have any difficulty giving consent? <i>If you have answered yes or are not certain about this please complete Section 1 of the Research Questionnaire.</i></p> <p><i>As general guidance, the Research Ethics Committee feels that research participants under the age of 18 may be vulnerable.</i></p>		X	
<p>Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people in public places) <i>If you have answered yes or are not certain about this please complete Section 1 of the Research Questionnaire.</i></p>		X	

### Research Design/Methodology

<p>Does the research methodology use deception? <i>If you have answered yes or are not certain about this please complete Section 2 of the Research Questionnaire.</i></p>		NO	
<p>Are there any significant concerns regarding the design of the research project?</p> <p>a) If the proposed research relates to the provision of social or human services is it feasible and/or appropriate that service users or service user representatives should be in some way involved in or consulted upon the development of the project?</p> <p>b) Does the project involve the handling of any sensitive information?</p> <p><i>If you have answered yes or not certain to these questions please complete Section 3 of the Research Questionnaire.</i></p>		NO	

### Research Subjects

Is pain or more than mild discomfort likely to result from the study? <i>If you have answered yes or not certain about this please complete Section 5 of the Research Questionnaire.</i>		<b>NO</b>	
Could the study induce unacceptable psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life? Will the study involve prolonged or repetitive testing? <i>If you have answered yes or not certain about this please complete Section 5 of the Research Questionnaire.</i>		<b>NO</b>	
Are drugs, placebos or other substances to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind? <i>If you have answered yes or not certain about this please complete Section 5 of the Research Questionnaire.</i>		<b>NO</b>	

### Financial Incentives/Sponsorship

Will the independence of the research be affected by the source of the funding? <i>If you have answered yes or not certain about this please complete Section 4 of the Research Questionnaire.</i>		<b>NO</b>	
Are there payments to researchers/participants that may have an impact on the objectivity of the research? <i>If you have answered yes or not certain about this please complete Section 4 of the Research Questionnaire.</i>		<b>NO</b>	
Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants? <i>If you have answered yes or not certain about this please complete Section 4 of the Research Questionnaire.</i>		<b>NO</b>	

**Risk to Researchers**

Do you have any doubts or concerns regarding your (or your colleagues) physical or psychological wellbeing during the research period? <i>If you have answered yes or not certain about this please complete Section 6 of the Research Questionnaire.</i>		<b>NO</b>	
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**Confidentiality**

Do you or your supervisor have any concerns regarding confidentiality, privacy or data protection? <i>If you have answered yes or not certain about this please complete Section 7 of the Research Questionnaire.</i>		<b>NO</b>	
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**Dissemination**

Are there any particular groups who are likely to be harmed by dissemination of the results of this project? <i>If you have answered yes or not certain about this please complete Section 8 of the Research Questionnaire.</i>		<b>NO</b>	
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