Public engagement with climate change in light of a more balanced policy focus on adaptation and mitigation

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Abstract

Against the backdrop of the historically dominant positioning of mitigation the international policy discourse on climate change is increasingly highlighting adaptation as an equally important response to climate change. This stronger attention to adaptation has not yet been adequately reflected in research on public perceptions of climate change. The present thesis aims to address this shortcoming. First, the relationship between public perceptions of adaptation and mitigation is examined, showing that intention to perform and support for both response types are overall positively connected but that their relative predictor patterns differ. Particularly noteworthy is the finding that individual intention to adapt is not necessarily reliant on belief in climate change. Differences are then explored in more depth testing whether an adaptation or mitigation frame affects the public's overall engagement with climate change. When climate change is presented as a local issue the adaptation frame leads to more emotional engagement in right-leaning participants, while the mitigation frame decreases it. This effect is inversed for left-leaning individuals. Exploring the role of personal experience in more detail the thesis finally presents an analysis of the effect of the 2013/14 winter flooding on individual engagement. Findings indicate that experiencing flooding is strongly associated with flood adaptation intentions but not connected to mitigation intentions. Whether individuals attribute the flooding to climate change does not contribute to explain their engagement with climate change. The results are discussed arguing that a stronger focus on adaptation holds the potential to mobilise previously uninvolved audiences. If framed in the wrong way, however, it might also increase polarization. Transformative adaptation is highlighted as a potential mediator to avoid this latter scenario. This thesis concludes that more research in this line is needed to successfully exploit the current policy transition in order to comprehensively, adequately and sustainably address climate change.

Table of contents

List of figures

List of Tables

List of abbreviations

ARCGIS	Aeronautical Reconnaissance Coverage Geographic Information System
CC	Climate change
CLT	Construal Level Theory
CDR	Carbon dioxide removal
CO_2	Carbon dioxide
EU	European Union
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
M	Mean
RCP	Representative concentration pathways
SD	Standard deviation
SLR	Sea level rise
SRM	Solar radiation management
UNFCCC	United Nations Framework Convention on Climate Change
VBN	Value Belief Norm

Chapter 1 -Introduction

1.1 Climate change

Our earth's climate is changing and among scientists there is unequivocal agreement that humanity plays a major role in that (Anderegg, Prall, Harold, & Schneider, 2010). Anthropogenic or human induced climate change has attracted considerable attention in politics and academia over the past decades. This attention to manmade climate change has been accompanied by a series of major assessment reports authored by the Intergovernmental Panel on Climate Change (IPCC). The IPCC was founded by the United Nations Environment Programme and the World Meteorological Organization to assess the ever-expanding climate science, with particular attention to the risks associated with anthropogenic climate change[1] (Archer & Rahmstorf, 2010). The IPCC reports, currently in their fifth instalment, sit at the intersection of politics and science and they have been central to the debate around climate change ever since the First Assessment Report was published in 1990. They represent an extensive effort to collate scientific evidence of the human influence on climate change; its consequences and risks; and ways to address these. In today's climate change discourse these reports "have become an authoritative source that sets agendas an acts as a legitimizing device for research" (Adger, 2006, p. 273). It is for this reason that this introduction builds heavily on the IPCC reports.

The latest advancement in this series of reports by the IPCC was published in 2014. This Fifth Assessment Report (IPCC, 2014b) more clearly than ever concludes that the human population is affecting the global climate.

[1] When referring to climate change in the present document, I intend anthropogenic climate change, unless explicitly stated otherwise. This follows an established trend in both the scientific and public discourse, which has used the term climate change interchangeably with that of anthropogenic climate change.

It does so by releasing so called greenhouse gases (GHG) into the atmosphere. Carbon dioxide is the most important and well-known GHG and its concentration in the atmosphere is increasing as a consequence of human activity. Other GHG are methane (CH_4), nitrous dioxide (N_2O), and halocarbons such as fluorocarbon. While carbon dioxide is not the most potent of GHG gases, methane being approximately twenty times more potent than carbon dioxide for example, it is the quantity released into the atmosphere and its permanence that makes it a major driver of climate change. The carbon dioxide concentration in the atmosphere now is 40% higher than in pre-industrial times. The amount of GHG released into the atmosphere has in fact consistently risen since pre-industrial times and is currently higher than it has ever been in at least 800.000 years. 78% of this anthropogenic input of GHG into the atmosphere has occurred during 1970 to 2010. A large amount of this anthropogenic GHG production has happened as a consequence of fossil fuel combustion, which in turn is largely driven by economic and population growth (Archer & Rahmstorf, 2010; Dow & Downing, 2006).

The *greenhouse effect* describes the process by which anthropogenic emissions affect the climate. The greenhouse effect occurs naturally and is essential to the world's temperature balance, adding around 33°C to what would otherwise be relatively inhospitable global mean temperatures. Human activity, more specifically, the emission of greenhouse gases reinforces this mechanism thereby interfering with the balance between incoming and outgoing radiation. A measure of change in this balance is the so-called radiative forcing. Radiative forcing, in essence, is an indicator for the net balance of energy retained by the Earth in relation to what is lost to space. Radiative forcing is measured in watts per square meter (W/m^2) A radiative forcing value for a specific agent, such as carbon dioxide, thus indicates whether it adds to the world's energy budget (positive sign), or subtracts from it (negative sign). Radiative forcing values

however cannot be translated one-to-one into the individual climate change contributions of the various emissions. Climate change in essence is determined by a combination of radiative forcing, climatic feedback effects and the rate at which the climate system stores energy (Dow & Downing, 2006; Emanuel, 2007; van Vuuren et al., 2011).

With a clearly positive combined radiative forcing value for the various contributing factors it is however no surprise to find that combined land and ocean surface temperature measurements from 1880 to 2012 indicate a warming of 0.85°C during this period (IPCC, 2013). So called fingerprint studies then allow scientists to discern the effect of human drivers, such as anthropogenic GHG, on the climate system from other non-anthropogenic drivers, such as variations in solar radiation (Archer & Rahmstorf, 2010). Regarding the human contribution the Fifth Assessment Report states that there is a clear signal of anthropogenic GHG in the climate system and it is further extremely likely[2], that the warming of the climate is largely due to anthropogenic GHG and other human drivers such as land use change (IPCC, 2014b). There is also high confidence that a positive feedback exists between CO_2 output and the climate. This describes the fact that climate change, also acts as a driver itself as it negatively affects some of the mitigating processes, such as the CO_2 reuptake by trees and thus further increases CO_2 concentration in the atmosphere (IPCC, 2013).

[2] In IPCC reports three distinct ways of describing uncertainty are used. (a) When uncertainty is assessed qualitatively indicators for the quality and amount of evidence (limited to much evidence) and the degree of agreement are used (low to high agreement). (b) To describe the quantitatively assessed likelihood of an outcome the following terms are used: very low confidence (1 out of 10), low confidence (2 out of 10), medium confidence (5 out of 10), high confidence (8 out of 10), and very high confidence (9 out of 10). (c) Uncertainty for specific outcomes that has been assessed statistically or by expert judgement is expressed in the following ways: *virtually certain* (99-100% probability), *extremely likely* (95-100%), *very likely* (90-100%), *likely* (60-100%), *about as likely as not* (33-66%), *unlikely* (0-33%), *very unlikely* (0-10%), and *exceptionally unlikely* (0-1%).

When speaking of CO_2 concentrations it is important to point out that in fact the oceans hold 30% of CO_2 emissions, with another 45% in the atmosphere and the remaining 25% absorbed by the biosphere. There is an even more pronounced imbalance in how much of the energy surplus in the climate system feeds into the atmosphere and how much is absorbed by oceans. More than 90% of the energy amassed between 1971 and 2010 is stored in oceans (high confidence), compared to only 1% in the atmosphere (IPCC, 2013). This is an important fact directly linked to a phenomenon called *thermal inertia*. Thermal inertia describes the fact that rising air temperature does not immediately trigger an analogous rise in overall temperature as it is mediated through the inert warming of the oceans. What this means, is that the climate system does not yield the effect of today's GHG concentrations. This is also why the world is already committed to more warming in the future, even if we were to stabilize the amount of GHG in the atmosphere today (Archer & Rahmstorf, 2010).

One of the most prominent aspects of climate change, besides the temperature increase, certainly is sea level change, mostly discussed in terms of sea level rise. Sea level change is a function of two mechanisms: eustasy and isostasy. Eustatic sea level is determined by the global distribution of water. This distribution of water can change when the amounts of water stored in the oceans globally change, or when tectonic movements change an ocean basin's shape and thereby affect the amount of water it can hold. If, for example, the earth's climate cools, more water is stored on land in the form of ice. This redistribution of water would thus decrease current sea levels. This however is an incomplete view of sea level change, as one would have to assume that the earth is a rigid and non-rotating planet. In fact, staying with the example given above, increasing ice on land would exert a certain pressure on the land, which would cause it to sink slightly, resulting in a net sea level rise in affected areas (Nicholls et al., 2011; Shennan, Long, & Horton, 2015).

In terms of climate change induced sea level change two main contributing mechanisms can be described. First, as the oceans get warmer they expand, an effect called thermal expansion, which in itself is a rather small effect but is amplified by the depth and extent of the world's oceans, which are on average 3800 m deep and cover approximately two thirds of the globe. Second, the influx of water from melting land ice equally causes sea levels to rise, the potential of which, if all ice in Greenland and Antarctica was to melt, corresponds to an increase of 65 metres. These two mechanisms taken together explain approximately 75% of the detected sea level rise globally (Archer & Rahmstorf, 2010; Nicholls et al., 2011).

The IPCC Fifth Assessment Report concludes that the speed of sea level rise since the mid-19th century exceeds that of the previous two thousand years (high confidence). It is further very likely that between 1901 and 2010 average sea levels have increased by 0.19 metres. Since the beginning of satellite measurements of sea level rise in 1993 until 2010 it is very likely that annual increase in sea level has been 3.2 mm. This provides further evidence of accelerating sea level rise when compared to the very likely rate of 1.7mm/year for the longer time frame spanning 1901 to 2010 (Archer & Rahmstorf, 2010; IPCC, 2013).

This evidence clearly shows that the climate is changing, that cumulative anthropogenic CO_2 emissions are to a large extent behind the current warming and that this is a trend that will continue. Scientists' understanding of the changes our planet has seen and what accompanied these changes however does not allow them to make any definite predictions about the future, as to do so would presuppose perfect knowledge of future GHG emissions. To circumvent this issue scientists rely on scenario-based models, which build on the vast knowledge of past changes in climate, associated with the field of paleoclimatology. Central to this kind of scenarios is a "what-if" clause, which

translates assumed socioeconomic and climate policy trajectories[3] into future projections for the world's climate (Archer & Rahmstorf, 2010).

1.1.1 Future climate change

For the Fifth Assessment report these scenarios have been operationalized as so called "Representative Concentration Pathways" (RCPs). The Fifth Assessment report builds on four RCPs with a time horizon spanning until the year 2100. The four RCPs are named after the amount of radiative forcing measured in W/m^2 that atmospheric concentrations of GHG, air pollutant emissions and land use will impose on the climate system by 2100. RCP2.6, for example, describes a pathway that reaches a rather low forcing of 2.6 W/m^2 by the year 2100. The four RCPs in the Fifth Assessment report in detail are the following (van Vuuren et al., 2011): (1) RCP2.6 is described as the lowest mitigation scenario and it foresees a peak in radiative forcing at around 3 W/m^2 and a subsequent decrease, to reach 2.6 W/m^2 in 2100. (2) RCP4.5 is labelled a medium stabilization scenario, which reaches stable levels of 4.5 W/m^2 by 2100 without an overshoot before doing so. (3) RCP6.0 similarly can be considered a medium stabilization scenario without overshoot stabilizing at 6 W/m^2 by 2100. (4) RCP8.5 is a rising scenario reaching a radiative forcing of 8.5 W/m^2 in the year 2100. It is also described as a high emission scenario. Projected changes in climate are then modelled based on these RCPs and described for the period 2081-2100 in relation to 1986-2005. A selection of projected changes from the Fifth Assessment Report is presented in the following paragraphs.

[3] It is important to note that these scenarios do not account for any non-human influences on the climate system, such as changes in solar activity.

Temperature

Increase in temperature is likely to be higher than 1.5°C for RCP4.5, 6.0, and 8.5; and likely to exceed 2°C for RCP6.0 and 8.5 (high confidence). Temperatures in the Arctic will increase more rapidly and mean warming over land will be larger (very high confidence). Further, it is virtually certain that there will be an increase in hot and a decrease in cold temperature extremes over most land areas; and it is very likely that the frequency and duration of heat waves will increase (IPCC, 2014b).

Ice Cover

For 2081-2100 year round reductions of Arctic sea ice content are projected ranging from 43% under RCP2.6 to 94% under RCP8.5 for the sea-ice minimum in September (medium confidence). Based on modelling that best reproduces the climatological mean state and the trend for Arctic sea ice extent between 1979 and 2012 a nearly ice free Arctic ocean in September before 2050 is likely for RCP8.5. By 2100 the mass of glaciers worldwide, except those in the periphery of Antarctica, are projected to decrease by 15-55% under RCP2.6 to 35-85% under RCP8.5 (IPCC, 2013).

Precipitation

Projections of changes in precipitation are extremely complex and not uniform. It is likely that in the mid-latitudes and dry subtropics mean precipitation will decrease under RCP8.5. In many wet mid-latitudes instead precipitation is likely going to increase under RCP8.5. Extreme precipitation events will very likely increase in frequency and intensity over most of the land in the mid-latitudes and over wet tropical regions (IPCC, 2014b). This naturally would trigger an increased incidence of flooding but paradoxically the other extreme, droughts are likely to increase as well. Archer and Rahmstorf

(2010) suggest that the land area currently affected by extreme drought conditions could increase from 1 to 30%.

Sea Level

For all the RCP scenarios the pace of sea level rise will very likely surpass that of 1971-2010. Sea level rise will not be equally distributed across the globe. By 2100 however it is very likely that sea level will have risen in 95% of the area covered by oceans. The global mean of sea level rise will likely range between 0.26m (RCP2.6) and 0.98m (RCP8.5) by the year 2100. (IPCC, 2013).

1.1.2 Climate change impacts and risks

> Climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development ... Risk of climate-related-impacts results from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems, including their ability to adapt. Rising rates and magnitudes of warming and other changes in the climate system, accompanied by ocean acidification, increase the risk of severe, pervasive, and in some cases irreversible detrimental impacts. (IPCC, 2014b, p. 13)

The risks directly associated with climate change are not necessarily a sole function of change but rather the specific qualities of this change and related aspects. Archer and Rahmstorf (2010) underline four factors that make climate change as it is projected particularly dangerous: (a) The rate of temperature change in the 21st century will be up to fifty times higher than the overall maximum rate of temperature change in the Earth's history, which was typically 0.1°C per century. (b) The temperature that current climate change is projected to reach will be outside the temperature range that most species have developed in and adapted to for millions of years. (c) The human population has heavily affected the planet through land use, making it very difficult for species to move into climatically favourable latitudes. (d) The amount of ocean

acidification[4] is unprecedented and will lead to levels of acidity that will very likely exceed levels reached at any point in time during the past 20 million years.

In terms of how future climate change will affect the human population there is a variety of risks to consider. What is quite clear is that climate change will affect the most basic human needs, such as the provision of food and water. The production of major crops such as rice and wheat, for example, will be negatively affected by climate without adaptation, in case of temperature increases above 2°C relative to late 20th century levels, with the exception of some areas that might benefit (medium confidence). The reduction and redistribution of marine species will reduce the yield of fisheries and other eco-system services (high confidence). And climate change will increase the scarcity of renewable surface water and groundwater resources in most dry subtropical regions (robust evidence, high agreement) (IPCC, 2014c).

Coastal and low-lying areas will be disproportionately affected by climate change. Developing countries and Small Island States will face a substantial increase in climate change-related risks. These areas will increasingly face impacts such as coastal flooding, submergence and coastal erosion because of sea level rise (very high confidence) and aspects such as population growth, economic development and increasing urbanization will further exacerbate the effects of these phenomena (high confidence). As climate change adds to existing pressures it will affect those most strongly that are already suffering from current climate variability and extreme weather events (Adger, 2006;

[4] An aspect of climate change, which has been gaining increasing attention, more recently, is ocean acidification. Ocean acidification describes the phenomenon of oceans turning more acidic by absorbing a substantial amount of the anthropogenic CO_2 emissions. Acidity in oceans has increased by 26% since the onset of the industrial area (high confidence). Ocean acidification poses a serious threat to the eco-system of oceans around the globe in that it affects a variety of marine organisms that build their shells of calcium carbonate, the availability of which is reduced as a consequence of ocean acidification (IPCC, 2013).

Paavola & Adger, 2006). This means, that climate change impacts will not be restricted to any particular geographies. Many climate change induced impacts in fact concern urban areas (medium confidence) but equally rural areas will suffer major adverse effects (high confidence) (IPCC, 2014c).

The discussion of food security illustrates how climate change will impact humans in very direct ways, such as through ill health. This will happen mostly by worsening existing health problems (very high confidence). More severe heat waves and fires for example will increase the likelihood of injury, disease and death; and risks from food- and water-borne diseases will analogously increase (very high confidence) (IPCC, 2014c). In an effort to summarize key risks, the IPCC (2014c) highlights five so called reasons for concern.

- *Unique and threatened systems* – The number of unique and threatened systems, such as cultures and ecosystems, already at risk from climate change (high confidence) will only increase with further warming.
- *Extreme weather events* – Risk from this kind of events is already moderate (high confidence) and will be high with a 1°C increase[5] in temperature (medium confidence).
- *Distribution of impacts* – Risks are distributed disproportionately, in that disadvantaged people and communities bear greater risks.
- *Global aggregate impacts* – For temperature increases of 1-2°C risks of global aggregate impacts are moderate (medium confidence). These impacts include effects on global biodiversity and the worldwide economy. For approximately 3°C warming extensive loss of biodiversity and the associated detrimental effect on ecosystem goods and services make for a high risk of global aggregate impacts (high confidence).
- *Large-scale singular events* – While climate change itself is incremental there is a risk of abrupt and irreversible changes for certain physical systems and ecosystems. The risk of triggering such events increases with further warming (medium confidence).

[5] An increase relative to global average temperature between 1986-2005

1.1.3 Climate change impacts and risks in the UK

Translating the global climate changes to regional levels is difficult and is often associated with greater degrees of variability. Choosing a Medium Emission Scenario (MES) the UK climate projections science report predicts an increase of mean summer temperatures in parts of southern England ranging from 2.2 to 9.5°C and increases in winter precipitation of up to 33% are expected along the western side of the UK (Jenkins, Murphy, Sexton, & Lowe, 2010)

The UK is already vulnerable to severe weather events, such as droughts and floods. While climate change will reduce certain risks, such as the probability of cold weather related deaths, it will further exacerbate existing risks. Flooding stands at the top of the list. Under MES flood risk is projected to increase with climate change and this is reflected in the top four of climate change threats in the UK Climate Change Risk Assessment 2012, which are all flood related. These risks include mental health consequences of flooding, inability to obtain flood insurance for residential properties, expected annual flooding damages to residential property and the exposure of the insurance industry to the risk of flooding (Defra, 2012).

Annual damage from floods is currently £1.2 billions for England and Wales. Future projections foresee that this figure will range between £1.5 and £3.5 billions by the 2020s and between £2.1 and £12 billion by the 2080s. Beside these direct losses as a consequence of property flooding, the well being of vulnerable population strata, the integrity and operation of critical infrastructure, such as hospitals, but equally transport systems, energy and water supply, and many businesses located in floodplains will be substantially affected (Defra, 2012).

1.2 Climate change measures

Starting in the early 90s climate change and the associated impacts triggered various national and international efforts to address the issue. At the heart of these is the United Nations Framework Convention on Climate Change (UNFCCC, 1992). In Article 2 of the UNFCCC the central goal with regards to climate change is described as the

> stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. (UNFCCC, 1992, p. 4)

On the face of it, this statement is a clear commitment to tackling the problem of anthropogenic emissions. A large part though stresses that an effort should be made to ensure that challenges to nature, food security and economies aren't insurmountable. Clearly, this can be partly achieved by addressing emissions, thus reducing the extent of climate change. But the fact that we are already committed to a certain extent of climate change leaves substantial impacts that societies will have to deal with. It thus becomes equally important to increase the capacity of affected systems to deal with impacts of climate change. Even the central aim of avoiding dangerous climate change, is clearly, albeit indirectly, linked to what affected systems can cope with. Knowledge of what constitutes 'dangerous' climate change builds on projected biophysical impacts triggered by climate change but equally has to consider the extent to which natural and human systems deal with these impacts (Smit, Burton, Klein, & Street, 1999). It is thus no surprise to find that Article 4.1(b) of the UNFCC proposes "regional programmes containing measures to mitigate climate change ... and measures to facilitate adequate adaptation to climate change" (UNFCCC, 1992, p. 5) as appropriate responses.

Mitigation[6] is defined by the IPCC as a "human intervention to reduce the sources or enhance the sinks of greenhouse gases" (IPCC, 2014a, p. 1769). Adaptation on the other hand describes the "process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2014a, p. 1758).

A third option to address climate change has gained increasing attention in recent years: geoengineering[7] as the "deliberate, large-scale manipulation of the planetary environment in order to counteract anthropogenic climate change" (Shepherd, 2009, p. 1) is commonly divided into carbon dioxide removal (CDR) and solar radiation management (SRM) strategies. The main difference between these strategies is quite evident. CDR aims to remove CO_2 from the atmosphere, akin to what is proposed in the second half of the mitigation definition cited above, which states that mitigation also seeks to enhance the sinks of GHG, thus sequestering CO_2 from the atmosphere. SRM on the other hand does not address GHG but focuses on reducing or stabilizing the amount of energy uptake by the atmosphere.

The fact that CDR and SRM are substantially different and that these strategies are further not clearly distinguished from adaptation and mitigation

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[6] It is important to point out that an alternative use of the terms *mitigation* and *to mitigate* very akin to that of adaptation exists (Smit et al., 1999). In the environmental hazards, insurance and engineering literature for example, mitigation refers to the reduction of vulnerabilities or "the lessening of the potential of adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability" (IPCC, 2014a, p. 1769). As a practical example of this alternative meaning of mitigation one could refer for example to Kelly and Adger's (2000) use of climate impact mitigation to describe the rehabilitation of mangroves aimed at improving the livelihood of residents but equally serving to enhance sea-defences. The current work, however, refers to mitigation in the sense of the above-mentioned emission-centred IPCC definition.

[7] For a social science perspective on geoengineering see Corner and Pidgeon (2010).

has led some authors to propose to abandon the geoengineering concept in favour of a new classification of responses to climate change (Boucher et al., 2014; Heyward, 2013). Both classifications outline a distinction between emission reduction strategies (mitigation), strategies to remove CO_2 (CDR), strategies aimed at modifying the climate (SRM) and adaptation. Heyward (2013) includes an additional category labelled rectification, which comprises measures aimed at compensation for losses incurred through climate change, measures that could be understood to fall under the broader adaptation category (compare Paavola & Adger, 2006).

1.2.1 Adaptation

In the international policy and science discourse on climate change, adaptation or the other 'half' of the convention, as Parry and colleagues (1998) describe it, certainly received less attention than mitigation until the turn of the millennium (Burton, Huq, Lim, Pilifosova, & Schipper, 2002). Interest in adaptation was limited and, if present, mostly linked to mitigation (Kates, 1997). The first two Assessment Reports of the IPCC, just as much as the UNFCCC, did include adaptation but it wasn't until the publication of the Third Assessment Report in 2001 that adaptation emerged in a more prominent role alongside mitigation. The instalment of three separate funds geared mostly at adaptation in that same year at the seventh Conference of the Parties to the UNFCCC then marked another important step towards a deeper engagement with adaptation (Huq & Burton, 2003; Paavola & Adger, 2006). To answer the question of why adaptation has been peripheral to the climate change policy debate various explanations have been put forward.

One prominent proposition to explain the halting development of a committed adaptation agenda points toward the persistent worry of involved actors that adaptation could be understood as a form of admitting defeat, or as an ethical compromise (Parry et al., 1998; Pielke, Prins, Rayner, & Sarewitz,

2007; Schipper, 2006; M Thompson & Rayner, 1998; Tol, 2005). A view that is aptly reflected in a quote by Al Gore stating that: "believing that we can adapt to just about anything is ultimately a kind of laziness, an arrogant faith in our ability to react in time to save our skin" (Gore, 1992, p. 240). This bias reflects the conviction that mitigation, in fact, represents the best adaptation strategy, building on the fact that mitigation affects all climate-sensitive systems as opposed to more selective adaptation measures (Dewulf, 2013; Füssel, 2007). Directly related to this and another aspect that inhibited the development of a more committed adaptation agenda, it has been argued, is the preoccupation that an increasing focus on adaptation could potentially undermine societal interest and support for mitigation efforts (Klein, Schipper, & Dessai, 2005). Klein et al. (2005) further posit that the belief that adaptation would be triggered as a sort of automatism induced by processes such as natural selection and market self-regulation further hindered the explicit and active development of adaptation policies.

A factor that also has a history plaguing efforts to advance mitigation is the inherent uncertainty of climate science and the associated predictions (Barnett, 2001; Biesbroek, Swart, & van der Knaap, 2009; Stehr & von Storch, 2005). This has been used as an argument to focus on the development of better climate modelling at the expense of promoting the development of adaptation (Adger & Barnett, 2009; Burton et al., 2002). Research in this line of thought has looked at how to further minimize uncertainties, while neglecting to promote a more naturalistic approach of making informed decisions given uncertainties (Kates, Travis, & Wilbanks, 2012).

Differences in complexity between adaptation and mitigation are also thought to have contributed to the weak positioning of adaptation. Compared to mitigation, where the sources of emissions are clearly laid-out, limiting the quantity of strategies to combat emissions to a manageable number, adaptation

can appear more complicated because of the wide array of adaptation measures and impacts to consider. This goes hand in hand with the afore-mentioned difficulty in evaluating the effectiveness of adaptation. Taken together, these aspects might have led to initial reluctance in engaging with this type of responses (Füssel, 2007; Parry et al., 1998).

The last 15 years however, have seen a consistent erosion of this opposition to climate change adaptation, as scholars have put forward a variety of arguments for putting the spotlight on adaptation. The anthropogenic signal in climate change is now undeniable and future environmental risks are now better understood than ever which has led to clear calls for international action from those who will be facing the brunt of negative impacts, when they are not necessarily at the forefront of contributing economies in terms of GHG emissions (Pielke et al., 2007). This also helps to rebut the above-mentioned voices that argue for more precise forecasting before actions on climate change are determined. Irrespective of this, the fact that the negative impacts from climate change cannot be fully quantified yet, does not mean one can exclude the potential for significant environmental changes (Nelson, Adger, & Brown, 2007). More importantly, it is increasingly recognized that adaptation-, as well as mitigation decisions need to be made even if sufficiently definite climate predictions are not available yet (Barnett, 2001; Biesbroek et al., 2009). In this respect findings on the *knowledge-ignorance paradox* (Ungar, 2000) prove informative as they describe how expanding knowledge, simultaneously increases uncertainty and ignorance. Any efforts to increase knowledge will thus be counterproductive, as increasing volumes of what is known and is not known slows down the process of determining and implementing a given course of action. In fact, overly precise predictions might actually lock development into undesirable pathways that result in maladaptation (Dessai & Hulme, 2009).

Further, other and often more pressing challenges besides climate change exist, such as expanding settlements in coastal and drought affected areas, increasing poverty, the exploitation and increasing scarcity of resources (Pielke et al., 2007). Often these challenges will trump climate change in terms of how much priority they should be given in the short-term, in particular in developing countries (Biesbroek et al., 2009; Swart & Raes, 2007). These issues however, do not only compete for attention and allocation of resources but they also exacerbate the vulnerability to, and costs of, climate change impacts (Stehr & von Storch, 2005). In these regions and countries that already suffer from present day climate variability adaptation offers the opportunity to consider both present and future climate impacts contemporaneously (Füssel, 2007). It has been argued that knowledge about adaptation is generally more robust and of more practical value (Stehr & von Storch, 2005) and so some adaptation measures also present highly desirable 'no regret' or 'robust' measures, as their wide scope allows policy-makers to address a variety of current issues while at the same time proofing systems for future impacts (Wilbanks & Sathaye, 2007). This type of measures are usually cost-effective measures that involve co-benefits besides addressing climate change and thus do not rely on overly precise modelling of the future, since they yield benefits in a variety of future scenarios. These measures are also referred to as win-win or no-regret measures and are central to adaptation conceptualizations that understand the reduction of vulnerability and building of adaptive capacity as central goals of adaptation. (Wilbanks & Sathaye, 2007).

The reality of political setbacks like the USA's unwillingness to commit to the Kyoto Protocol emission targets have only added to strengthen the conviction that adaptation will be a very important policy response. Stehr and Storch (2005) propose that actually politically realistic mitigation efforts to curb GHG emission will leave the brunt of climate change to be dealt with by

adaptation. These limits to mitigation combined with the inertia of the climate system illustrate the necessary complementarity of adaptation and mitigation are potentially one of the most prominent arguments for intensifying adaptation efforts. A rationale that is succinctly reflected in the following quote by Stehr and Storch (2005, p. 539): "The risk and dangers associated with failed mitigation efforts may indeed be great. The risks and dangers of failing mitigation without any adaptive strategies will be even more serious". Assuming even optimal mitigation trajectories the lag in impacts from anthropogenic emissions dictates that despite intensive mitigation efforts climate change will be unavoidable for many decades (Stehr & von Storch, 2005). If the ultimate goal of the UNFCCC is to avoid dangerous climate change, an objective that according to current scholarly expertise will not be achieved by mitigation alone, adaptation becomes inevitable (Wilbanks & Sathaye, 2007), in particular since adaptive responses can certainly reduce impacts more substantially in the short term than mitigation can (Parry et al., 1998; Stehr & von Storch, 2005).

This inevitability of adaptation as a response to climate change has translated into growing scholarly and political attention over the last two decades (Bassett & Fogelman, 2013; Burton et al., 2002; Janssen, 2007; Parry et al., 1998; Pielke et al., 2007). Preston, Westaway, Dessai and Smith (2009) for example, documented a dramatic increase from only 2 to 62 annual adaptation plans in the USA, Australia, Canada and UK between 2000 and 2008. An analysis of the adaptation actions undertaken by 117 signing parties to the UNFCC, as communicated by national governments to the UNFCCC secretariat during the period 2009-2010, showed that adaptation has found its place in national policy agendas. The study found 709 recommendations for action plus 3395 discrete adaptation initiatives and a median number of 27

initiatives and recommendations per country. A majority (43%) of these initiatives were classified by the authors as groundwork level[8], that is, impact and vulnerability assessments. A smaller proportion (23%) of the initiatives were actual adaptation actions (Lesnikowski, Ford, Berrang-Ford, Barrera, & Heymann, 2015).

The scientific community mirrors this trend with an exponentially increasing number of scientific publications on adaptation during the last two decades (Bassett & Fogelman, 2013; Berrang-Ford, Ford, & Paterson, 2011). Janssen (2007) for example finds a relatively stable number of publications until the early 1990s, when the number of adaptation papers starts increasing, with a particularly accelerated increase after the year 2000. Scientific work on climate change adaptation according to Smit and Wandel (2006) can be classed into four research streams: (1) Studies analysing the extent to which adaptation can be expected to counterbalance projected climate impacts. (2) Research that focuses on particular adaptation measures in specific systems. (3) Scholarly work, which investigates the adaptive capacity of particular societal or geographical entities by comparing them on a set of pre-determined variables. (4) And research that addresses more practical questions in trying to provide the necessary information for the implementation of adaptation initiatives. It is important to point out that scholarly work on adaptation has not emerged as result of the recent climate change debate. A review of existing literature on adaptation clearly shows that the current surge of interest in adaptation in the context of climate change must be understood as a renaissance of the concept rather than a novel development. Adaptation has been researched for decades in fields as diverse as geography, anthropology, engineering, history, sociology,

8 "Groundwork level actions are those initiatives considered critical for informing and preparing for adaptation" (Lesnikowski et al., 2015, p. 280)

archaeology and psychology (Adger, 2006; Klein et al., 2005; Orlove, 2005; Smit et al., 1999; Tol, 2005). Individuals, societies, eco-systems, organisms have always been adapting to changing circumstances (Füssel, 2007; Nelson et al., 2007; Orlove, 2005). Described as an "anthropological constant" and "traditional form of social conduct" (Stehr & von Storch, 2005, p. 538) in human social evolution, irrigation, insurance, and weather forecasting for example, represent some of the early adaptive societal responses that have developed in response to pressures from climatic variation (Adger & Barnett, 2009). Against the backdrop of this historical foundation of social adaptation, climate change adaptation, according to Füssel (2007) does however stand out as a consequence of several new aspects. Climate change adaptation will have to address *unprecedented climate conditions*, describing the fact that many regions will experience climatic conditions never experienced before. These conditions will be met by *unprecedented knowledge* owed to societies' technological and scientific advancements. The complex, dynamic and uncertain nature of climate change, however, introduces *unprecedented methodological challenges*, which will demand new approaches. Further, the global nature of climate change means that *new actors* have to engage with the issue and will have to do so with entirely *new measures*.

Smit and Wandel (2006) trace the origin of the term adaptation as it is used in today's climate change literature back to the field of evolutionary biology and studies on the development of behavioural and genetic aspects that enhance an organism's evolutionary fitness in light of changing environmental conditions. The first to apply the term adaptation to humanity, discussing societal adjustments in subsistence practices to changes in the natural environment, was the anthropologist and cultural ecologist Julian Steward (Butzer, 1989, as cited in Smit & Wandel, 2006). Reflecting this historic view of climate change adaptation as a constant transaction between changes in the

environment and the socio-ecological system Klein and colleagues (2005, p. 580) speak of adaptation as “an ongoing process to reduce vulnerability to natural climate variability as well as human-induced climate change”

As cited above the IPCC defines adaptation in a less dynamic manner as “the process of adjustment to actual or expected climate and its effects” in human and natural systems. Its aim is to “moderate or avoid harm or exploit beneficial opportunities” (IPCC, 2014a, p. 1758). Similarly Pielke (1998, p. 159) specifies that adaptation concerns adjustments “in individual groups and institutional behaviour in order to reduce society’s vulnerability to climate".

Doria and colleagues (2009, p. 810) less stringently define adaptation as “any adjustment that reduces the risks associated with climate change, or vulnerability to climate change impacts, to a predetermined level, without compromising economic, social, and environmental sustainability”. Contrasting it with mitigation Heyward (2013, p. 24) states that “whereas mitigation deals with the causes of climate change, adaptation deals with its effects”. It seeks to “reduce the harmful impacts that a changed climate is likely to have on people’s lives “ and responds to environmental changes rather than preventing them.

In a comprehensive effort Nelson et al (2007, p. 396) expand the definition of adaptation beyond adjustments to include “the decision-making process and the set of actions undertaken to maintain the capacity to deal with future change or perturbations to a social-ecological system without undergoing significant changes in function, structural identity, or feedbacks of that system while maintaining the option to develop”.

Similarly Moser and Ekstrom (2010, p. 22026) point to “changes in social-ecological systems in response to actual and expected impacts of climate change in the context of interacting non-climatic changes.”

Common to all these definitions is the idea of a system that reacts in some form to certain pressures from changes in the environment, addressing in

essence three questions that have been proposed to describe adaptation measures (Füssel & Klein, 2006; Smit, Burton, Klein, & Wandel, 2000): 'Who adapts?', 'To what?', and 'How?'.

Who adapts?

Regarding the question of 'who adapts' most authors refer to some form of *system*. This term is applied to entities ranging from households and particular species to societies (human systems), eco-systems (natural systems), or a combination of the latter two; the socio-ecological system. Smit and colleagues (1999) specify that it is the sub-units such as species, communities and individuals that adapt and not systems as a whole. The term socio-ecological system, alternatively referred to as social ecological system or coupled human-environmental system however, rather than representing a single acting unit, echoes the assumption that human behaviour and societal processes stand in constant transaction with nature, making a distinction between the two components futile (Adger, 2006; Gallopin, 2006). Adaptation will thus depend on the typology of impacts but equally on the nature of the system, its extent, complexity, location and a range of other factors that further define it (Smit et al., 2000). Several of these factors are often used in vulnerability assessments of a particular system; a common practice in both scholarly and applied contexts to describe an adapting system in more detail (Smit et al., 1999).

Adaptation to what?

Adaptation in systems can be triggered in response to a variety of climate stimuli such as climate change itself, particular weather phenomena but equally by the societal and ecological knock on effects. There are various dimensions on which climate stimuli can be distinguished from direct or indirect to proximate or distant. It is essential to specify a particular stimulus, as its

effect will differ from other stimuli depending on its characteristics on these dimensions. Additionally, specifying the impact will help to establish its relevance with regards to the adapting system (Smit et al., 1999). Differentiating the various climatic stressors also proves useful when considering which type of adaptation needs to be employed. The type of measures which are deemed appropriate will depend largely on the combination of climatic stressors and their profiles on various dimensions. A useful distinction in this regard is achieved by ordering climatic phenomena in terms of timescale. Smit et al. (2000) group climatic phenomena into the following categories: (1) Long term trends in climate change, (2) climate variability within a range of a few years to several decades and (3) extreme weather events. While the majority of climate change literature is concerned with long-term trends, adaptation in particular demands attention to current variability and extreme weather events. Adaptation is also mostly triggered in response to extreme events, extreme events that need to be considered in a context of natural climate variability and the anthropogenic forcing on climate change (Füssel, 2007). Other temporal dimensions that have been discussed include the rate of onset, predictability and duration of the adaptation trigger. This relates to questions of spatial extent, where localized impacts, such as weather events, can be distinguished from global changes, such as an increase in mean temperature, which itself relates back to the size of the system in question (Smit et al., 1999).

How does adaptation occur?

Several scholarly efforts have focused on *how* climate change adaptation occurs to describe various forms of adaptation. Smit and colleagues (Smit et al., 1999) summarize a multitude of classifications based on differentiations of adaptation measures on dimensions such as temporal scope (e.g. short term vs. long term), spatial scope (localized vs. widespread), the function they serve (e.g. retreat, accommodate, change, restore), their form (e.g. structural, legal,

financial, technological) and their performance (e.g. cost, effectiveness, efficiency, equity).

Two somewhat related dimensions have stood out in classifying adaptation actions: timing and purposefulness. Based on the time point that measures take effect in relation to the stimulus that they address the following forms of adaptation can be distinguished: reactive adaptation, concurrent adaptation and anticipatory adaptation. Reactive adaptation refers to measures that are triggered ex post, i.e. adaptation that is triggered as a reaction to a climate impact that has already happened. Concurrent adaptation, on the other hand, is a set of measures which address a certain climate stimulus as it affects the system. Anticipatory adaptation takes effect ex ante, that is, it addresses an anticipated climate impact (Smit et al., 1999, 2000). This distinction however might not be as clear in practice as the case of an adaptation measure that is deployed after an extreme weather event to prepare for future events of this kind illustrates (Füssel, 2007)

Regarding the dimension of purposefulness two commonly accepted categories of climate change adaptation measures have been proposed. Autonomous/spontaneous adaptations, which could be described as ‚naive' reactions of an affected system to changes as they occur. This type of adaptation is prevalent in unmanaged natural systems. Planned adaptations on the other hand represent deliberate efforts to apprehend actual and expected changes; actions that are pertinent to how public agencies react. (Smit et al., 1999, 2000).

The concept of autonomous adaptation however has encountered criticism in the latest IPCC report as it has been used ambiguously, referring to actions in the above-mentioned sense but also to adaptations that were induced in absence of an external trigger. Instead a new fundamental distinction between incremental and transformative adaptation has been introduced. The

following paragraphs are dedicated to a brief discussion of incremental and transformative adaptation building on a canvas of two interpretations of vulnerability: outcome vulnerability and contextual vulnerability.

Vulnerability

The concept of vulnerability has been discussed and applied in various disciplines without any agreement on a uniform definition (Gallopin, 2006). The most current IPCC definition of vulnerability serves as a good starting point for a discussion of existing conceptualizations in the wider climate change literature. The Fifth Assessment report (IPCC, 2014a, p. 1775) defines vulnerability as the "propensity or predisposition to be adversely affected" and distinguishes contextual vulnerability and outcome vulnerability. In making this distinction the IPCC report addresses the conflation of two distinct approaches to conducting vulnerability assessments.

Outcome vulnerability conceives of vulnerability as the result of a linear cost-benefit analysis that seeks to summarize the impact of climate change after the implementation of available adaptation measures aimed at offsetting this impact. In other words, outcome vulnerability describes the net impacts on a system after measures designed to reduce these have been employed. Unsurprisingly this interpretation of vulnerability has been dominant in previous IPCC reports as it provides a straightforward way of illustrating the net outcome of climate change and defining what constitutes dangerous climate change. Vulnerability in this sense is the final assessment in a concatenation of analyses from climate projections and scenarios, to biophysical impact studies and the evaluation of available adaptation options (Adger, 2006; Kelly & Adger, 2000).

Contextual vulnerability instead, investigates the underlying causes and mechanisms that create vulnerability in the first place. This focus on vulnerability as it already exists, also described as the *wounded soldier*

approach, seeks to identify characteristics of the socio-ecological system that impede the current ability to cope with external pressures from a changing climate (Kelly & Adger, 2000). In doing so, this approach looks beyond the mere biophysical components and climatic stressors to include "social, economic, political, institutional and technological structures and processes; i.e. contextual conditions" (O'Brien, Eriksen, Nygaard, & Schjolden, 2007, p. 76).

Vulnerability has drawn scholarly attention from two separate scientific communities, with fundamentally different framings of the climate change problem. O'Brien and colleagues (2007) distinguish *scientific framings* and *human-security framings*. Central to the *scientific framings* is the question of human impacts on the global climate system. Society and nature are conceived as strictly separate from one another with a disproportionate focus on the quantification of impacts on nature. Vulnerability in this research tradition is best addressed by sectorial and technical adaptation measures, as well as mitigation. *Human-security framings* conversely concentrate on climate change as a continuous transaction between biophysical and social components and thus replace the scientific framing's view of the nature-society relationship as a duality with a mutuality. Climate change is understood as affecting individuals differently, as the effects are not solely determined by biophysical factors but rather embedded in "dynamic social, economic, institutional and technological structures and processes; i.e. contextual conditions" (O'Brien et al., 2007, p. 76). This interpretation does not allow a static understanding of vulnerability as residual climate impacts but conceives of vulnerability as a dynamic product of biophysical and social processes (O'Brien, Eriksen, Schjolden, & Nygaard, 2004; O'Brien, 2000).

Incremental and transformative adaptation

From these distinct understandings of the climate change problem which are climate change as a human security issue vs. climate change as a scientific

issue, it follows that applying one or the other concept of vulnerability dictates a different diagnosis and in consequence a different cure to climate vulnerability and essentially the issue of climate change as a whole (O'Brien et al., 2004). Clearly, differing conceptualizations of vulnerability have major implications for how adaptation is conceived and in fact the wider political responses proposed with regards to climate change (O'Brien et al., 2007). Critical climate change literature analyses how viewing vulnerability as an outcome defines adaptation as a determinant of vulnerability. The idea of contextual vulnerability instead inverts this relationship, as the interplay of climatic pressures and the "inherent social and economic processes of marginalization and inequalities as the causes of climate vulnerability" determine viable and appropriate adaptation options, the scope of which goes well beyond the usual climate change focus (O'Brien et al., 2004, p. 5). To some extent this development certainly is a consequence of a general shift in climate change literature from the view of climate change as an environmental problem to an interpretation of climate change as a human-influenced developmental issue (Biesbroek et al., 2009).

The conventional outcome vulnerability approach highlights climate change as the problem and adaptation as the solution. This interpretation of adaptation and the associated concept of outcome vulnerability have attracted criticism in recent years (Bassett & Fogelman, 2013; Brown, 2011; Füssel, 2007; Kelly & Adger, 2000; O'Brien et al., 2007; O'Brien, 2012; Ribot, 2011). When Bassett and Fogelman (2013) speak of a déjà vu, examining the predominant conceptualization of adaptation in the climate change literature, they refer to the many parallels between the *hazards school's* understanding of adaptation (Burton, Kates, & White, 1978) and the current perspective on adaptation in the IPCC reports. Political ecologists viewed the hazards school's understanding of adaptation as "palliative measures that did not address the social structural causes of vulnerability", adaptation as adjustment, as opposed to the political

economy perspective of adaptation as transformation (Bassett & Fogelman, 2013, p. 45). The *political economy* critique of the hazards school's understanding of adaptation as proportionate adjustments focuses on four aspects: (1) the idea that the social processes of adaptation are the sum of individual decisions, (2) the conservative political interpretation of adaptation as an instrument to maintain the existing political-economic system, (3) the emphasis on impacts rather than the root cause of vulnerability to these impacts (4) and consequently undue attention on biophysical aspects of natural disasters, at the expense of social components. The critical climate change adaptation literature, echoing the political economy critique of the natural hazards school's understanding of vulnerability has voiced very similar concerns. Füssel et al. (2007) conclude that the hazards based approach has been useful in describing what the risks from climate change are. The assessments carried out in this vein however, mostly lack explicit attention to other pressures such as current climate variability and do not offer high spatial and temporal resolution; deficits that make them of little practical value to decision makers and actors.

These parallels between political ecology scholarship and critical climate change adaptation literature extend to the revised concepts that have been proposed in response. Liverman (1994), in addressing the political ecology critique, proposed a distinction between biophysical vulnerability and social vulnerability, akin to the recently introduced IPCC distinction of outcome and context vulnerability. Before this distinction had been made Burton and van Aalst (2004) proposed two adaptation perspectives that resonate with this evolution of framing climate change. (1) The *Convention perspective*, central to the UNFCCC's and IPCC's approach, is linked to outcome vulnerability. Accordingly, this perspective of adaptation focuses on expected future changes in climate and the associated impacts. It assumes adaptation as a part of the

wider mitigation strategy and is concerned with incremental adaptation and measures rather than policies. (2) The *Development perspective* is linked to contextual vulnerability and it considers both current climate variability and weather extremes and long-term climate change. Evaluation of adaptation from this perspective is based on consideration of both vulnerability and poverty (Burton & Van Aalst, 2004). This brief description illustrates how the traditionally more established Convention perspective of first generation climate change adaptation research understood adaptation as "a handmaiden to impacts research in the mitigation context" (Burton et al., 2002, p. 146) and as such, by definition, forced adaptation into the backseat.

As the revised concepts of outcome and context vulnerability have found their way into the latest IPCC report it is only logical that it does also include a distinction between transformational and incremental adaptation. Incremental adaptation refers to "actions where the central aim is to maintain the essence and integrity of a system or process at a given scale" and transformational adaptation describes "adaptation that changes the fundamental attributes of a system in response to climate and its effects" (IPCC, 2014a, p. 1758). Bassett and Fogelman (2013) very similarly distinguish between what they call *adjustment* and *transformative* adaptation but add a third transitional category, namely *reformist* adaptation. (1) *Adjustment adaptation* constitutes the traditional IPCC understanding of adaptation, closely related to the Convention perspective of adaptation, outcome vulnerability and a techno-scientific problematisation of climate change. (2) *Reformist adaptation* is best described as a hybrid of adjustment and transformative adaptation, acknowledging biophysical, as well as socio-political determinants of vulnerability. Its measures seek to reduce vulnerability but do so within the confines of the existing socio-political system. (3) *Transformative adaptation*'s aim equally is to reduce vulnerability and to address the processes that effect it by contesting existing

social structures and the associated power relations that represent barriers to vulnerability reduction.

A fault line seems to be looming between these two understandings of transformative and transformational adaptation. While Basset and Fogel (2013) explicitly stress the need for transformation, in particular with regards to equity issues and power relations that generate vulnerability; the IPCC definition of transformational adaptation focuses on "options and strategies that human actors can exploit to reorganize systems when incremental adaptation has reached its limits" (Klein et al., 2014, p. 922). An absence of socio-political aspects is also evident in some of the literature the IPCC distinction builds on. Kates (2012) for example distinguishes three classes of adaptations that are described as transformational: (1) Adaptation measures that are applied at a much larger scale, (2) adaptation actions new to a particular geography or system and (3) adaptations that change places and/or locations. In essence, only the latter typology is truly qualitatively different from incremental adaptation, and this category too, only proposes transformations that lack any reference to the socio-political system. This raises the question whether transformational adaptation is in fact understood as an up-scaled version of incremental adaptation. A suspicion that is only further strengthened by the authors' comment that transformational adaptation "may alternatively include fundamental changes in institutional arrangements, priorities, and norms" (Kates et al., 2012, p. 7156) – making the essence of what distinguishes reformist from transformative adaptation an option rather than a defining criterion. It is thus questionable whether the IPCC understanding of transformational adaptation, which actually might be better described as reformist adaptation, really reflects an in-depth engagement with alternative conceptualizations of and discourses around adaptation. The reality of the scholarly discourse on climate change adaptation certainly suggests that there is

a strong imbalance towards incremental adaptation. Basset and Fogel (2013) categorized articles concerned with adaptation from four climate change, placing a majority of 70% into the adjustment category. Only 27% and 3% respectively fall into the reformist and transformative category.

The same applies to policy discourses, an indicator of the IPCC's dominance in informing the political response to climate change. Dewulf (2013) identifies three pairs of contrasting frames in current policy debates on climate change adaptation, which largely follow the present discussion. He describes (1) the adaptation vs. mitigation frame, which relates to the historical discrimination of adaptation in favour of mitigation. (2) Two frames, which conceive of climate change adaptation as a tame technical problem vs. a wicked problem of governance. Frames that resonate with understandings of adaptation as auxiliary method to better understand climate impacts, as opposed to stand-alone measures to reduce these impacts. (3) A last pair of frames, which contrasts state security and human security, a differentiation that resonates with the final discussion of incremental adjustment adaptation intended to preserve the status quo as opposed to transformative adaptation. Supporting this picture of a predominant outcome vulnerability/incremental adaptation approach a discourse analysis of the United Kingdom Climate Impacts Programme technical report on climate change adaptation finds that adaptation is predominantly problematized as a techno-scientific issue (Oppermann, 2011) but that a competing, albeit less pronounced, view of adaptation from a socio-systemic perspective exists. Similarly, Lesnikowski and colleagues (2015) in an analysis of national communications on adaptation initiatives to the UNFCCC find that only little attention is paid to vulnerable groups.

In summary the current work on adaptation in both academia and politics seems to suggest that while the wider climate change debate is overcoming its biased stance towards adaptation a new rift is opening. The

discourse around adaptation has moved from a disproportionate focus on mitigation to arrive at the next hurdle, manifest in a problematic focus on incremental adaptation, applying an outcome vulnerability interpretation. This sort of approach will allow societies to bear the impacts of climate change over a certain time period but in doing so it increases the risk of locking development into unsustainable and potentially maladaptive pathways (Brown, 2011; Burton & Van Aalst, 2004). This is due to a variety of aspects.

Adjustment to expected impacts necessarily entails some form of knowledge of future climate making adaptation, a predictive exercise more than a responsive one. Narrow techno-scientific adaptation approaches paired with the uncertainty of climate change, the possibility of increased climate variability and more frequent extreme weather events, however, means that some adaptation measures determined today will inevitably turn out to be maladaptive (O'Brien et al., 2004). In a similar vein overly rigid adaptations aimed at ensuring business as usual would certainly struggle to deliver positive outcomes going into the extremes of climate change projections (M. S. Smith, Horrocks, Harvey, & Hamilton, 2011; Travis, 2010). This relates to the distinction between inadvertent and directed transformation, where the former is "more likely to lead to undesirable system states with low productivity and less human well-being" (Nelson et al., 2007, p. 403). A solely impact-focused approach in fact reduces flexibility essential to reacting to future scenarios that diverge from what is predicted (Oppermann, 2011, p. 80). Scholars argue that instead of concentrating on particular future impacts, the focus should be on reducing current vulnerability, which will naturally increase the capacity to cope with stresses from future climate change (Burton et al., 2002, p. 154). This point gains in importance if one considers that climate change isn't the only stress that societies face (Adger & Barnett, 2009). A techno-scientific adaptation approach that does not understand climate change in the context of

multiple pressures runs the risk of perpetuating, and in the worst case, exacerbating the exact vulnerabilities it seeks to reduce as underlying inequalities and processes of marginalization equally affect access to adaptation (Adger, Arnell, & Tompkins, 2005; Brown, 2011; Eriksen & O'Brien, 2007; O'Brien et al., 2004).

The common logic behind these arguments is that adaptation as recurrent adjustments will quite probably set societies up for much deeper and thus more challenging transformations than could be induced presently. From this perspective transformative adaptation aimed at reducing current vulnerability in a starting-point sense bears considerable advantages. Addressing current issues this type of adaptation does not rely as heavily on knowledge of future climate change. Their broad scope aimed at the social dimensions of vulnerability further retains some form of flexibility and provides an excellent opportunity to implement the above mentioned "robust" or "no regrets" policies (O'Brien et al., 2004; O'Brien, 2000).

An ideal adaptation policy quite probably comprises both forms of adaptation. O'Brien and colleagues (2007) argue that outcome vulnerability and contextual vulnerability are products of different discourses and substantially different in their conceptualizations and thus cannot be unified. They remark that the two approaches are to be understood as two different but complementary aspects of climate change and that the focus should be on acknowledging the value of the variety of perspectives they entail. Likewise Burton and Van Aalst (2004) argue for a harmonization of the convention and the developmental perspective.

1.2.2 Adaptation and Mitigation

The following paragraphs expand on differences and trade-offs between mitigation, that is emission reduction strategies in the wider sense including CDR, and adaptation in line with an incremental adaptation definition, as

studied in this thesis. The section then moves to address similarities and potential synergies between these two types of climate response strategy.

One way the relationship of mitigation and adaptation can be characterized is by defining their interaction in addressing impact costs. Mitigation and adaptation strategies can be alternatives, complementary, or competitive (Wilbanks & Sathaye, 2007). Attention to this kind of comparisons is rather novel as adaptation and mitigation have previously been conceived as different and separate approaches, largely ignoring the potential for synergies and trade-offs, despite their complementary nature (Swart & Raes, 2007). This has been described as the mitigation-adaption dichotomy (Biesbroek et al., 2009). Biesbroek and colleagues (2009, p. 236) argue that this dichotomy is a function of "real or perceived differences in knowledge production, time and spatial scales, and actors involved, as well as the proposed policy strategies."

A table taken from Fuessel and Klein (2006) summarizes some of these key differences between mitigation and adaptation for various aspects.

Table 1
Characteristics of Mitigation and Adaptation

	Mitigation	Adaptation
Benefited systems	All systems	Selected systems
Scale of effect	Global	Local to regional
Life time	Centuries	Years to centuries
Lead time	Decades	Immediate to decades
Effectiveness	Certain	Generally less certain
Ancillary benefits	Sometimes	Mostly
Polluter pays	Typically yes	Not necessarily
Payer benefits	Only little	Almost fully
Monitoring	Relatively easy	More difficult

Note. Adapted from "Climate change vulnerability assessments: An evolution of conceptual thinking", by H. Füssel and R. Klein, 2006, *Climatic Change*, *75*, p. 303.

Clearly there are substantial differences between mitigation and adaptation, some of which can be highlighted by addressing the following questions (Wilbanks & Sathaye, 2007):

Who makes and implements decisions? - Actors, stakeholders and policy types

Mitigation is mostly planned and implemented at the international level but does trickle through to the individual level. Adaptation instead is mostly carried out at local, national or regional levels (Biesbroek et al., 2009; Moser, 2012; Schipper, 2006; Tol, 2005). Mitigation, to a very large extent, concentrates on the transportation and energy sector and involves a restricted number of actors. Adaptation by contrast involves a variety of sectors, from tourism to agriculture and public health; and actors at multiple levels, from the individual to governmental agencies (Klein et al., 2005).

This difference in administrative levels and actors is reflected in the way mitigation and adaptation are implemented and managed. Mitigation is more often than not conceived as a top-down processes, characterized by international agreements and a restricted number of decision makers (Tol, 2005; Wilbanks & Sathaye, 2007). In light of poor success of top-down environmental policy, bottom-up approaches to both mitigation and adaptation have gained traction in the climate change policy arena (Wilbanks & Sathaye, 2007). As so many adaptation alternatives are identified locally and at a relatively small-scale, bottom-up approaches however, lend themselves more naturally to adaptation (Schipper, 2006; Wilbanks & Sathaye, 2007). A bottom-up approach is not without its drawbacks either. Adaptation characterized by multilevel governance can be rather laborious as it involves a variety of stakeholders with differing views and goals engaging in participatory decision making (Adger, 2001; Biesbroek et al., 2009; Gupta, 2007; Tol, 2005). From a standpoint of

political feasibility top-down mitigation approaches can thus be more desirable (Biesbroek et al., 2009; Swart & Raes, 2007).

Who pays and who benefits? - Determining costs and benefits

A major difference regards the assumption of costs for the two climate change responses. For the majority of costs incurred through mitigation the *polluter pays principle* applies. It is conceivable how the major contributing countries in terms of GHG emissions, in particular with regards to historical emissions, should shoulder a large share of the costs, even if mitigation benefits are global and not specific to the temporal and spatial origins of mitigation efforts. Adaptation instead does not address GHG directly, but the climate impacts they drive, which are manifold in nature and mediated/moderated through a variety of factors. This makes determining who has to pay for adaptation a much more daunting task. More easily established is that the benefits of adaptation are usually experienced in the system they were deployed in, an aspect that is referred to as the *payer benefits principle* (Biesbroek et al., 2009; Füssel & Klein, 2006; Klein et al., 2005).

An important facet of this discourse, however, is the fact that a lot of the expenses linked to adaptation efforts are, and more importantly, will have to be, borne by nations that have played only a minor role as emitters, due to the emission-intensive past of developed countries in combination with the longevity of GHG in the atmosphere. This raises questions of historic responsibility, the application of the polluter pays principle to adaptation and discussion of equality of opportunity (Adger, 2001; Neumayer, 2000) and clearly demonstrates how discussions around climate change action, and adaptation in particular, necessarily include a consideration of equity issues (Wilbanks & Sathaye, 2007).

How do measures work? - The temporal and spatial scales

Adaptation and Mitigation differ substantially in terms of the spatial and temporal scale they work on. Adaptation plans are put into action most noticeably at local levels and tend to come to the foreground as levels of analysis become more fine-grained (Biesbroek et al., 2009; Moser, 2012; Tol, 2005). Consequently the benefits of mitigation are mostly global, whereas the benefits of adaptation usually materialize on the level of the impacted system (Klein et al., 2005). Accordingly adaptation and mitigation also differ in terms of time scale. As mitigation addresses long-lived GHG this naturally dictates a long-term perspective, whereas adaptation conventionally focuses on short-term adaptation needs. Additionally adaptive measures mostly take effect after a considerably shorter lead-time than mitigation measures. The time-scale of the effects generated will thus reflect these differences. Short-term measures with short-term benefits are predominant in an adaptation portfolio. Mitigation, equally, is fuelled by short-term investments, which conversely yield long-term benefits (Klein et al., 2005; Moser, 2012; Tol, 2005). Differences in time-scale are further accentuated by conceptualizing adaptation as mainly reactive, whereas mitigation is mostly discussed in terms of an anticipatory approach (Biesbroek et al., 2009). This could however be owed to the immediacy of adaptation, when in fact true insight into the costs and benefits of adaptation is more limited than for mitigation (Biesbroek et al., 2009). Differences regarding the benefits, their much shorter onset time for adaptation measures than for mitigation efforts, also helps to boost the political legitimacy of adaptation (Stehr & von Storch, 2005; Wilbanks & Sathaye, 2007).

These differences mean that the evaluation of mitigation and adaptation will differ accordingly. For mitigation efforts the clear-cut goal of reducing the amount of GHG in the atmosphere provides a straightforward evaluation criterion. For adaptation instead, the contested goals and lack of quantifiable

objectives regarding adaptation and the associated uncertainty as to how much human activity adds to increase climate variability, make for a much more complex task in determining what constitutes successful adaptation (Biesbroek et al., 2009; Klein et al., 2005).

Trade-offs and synergies

In considering the differences only, the mitigation adaptation dichotomy fails to acknowledge the existence of trade-offs and synergies between adaptation and mitigation. Trade-offs can be direct and immediate, or indirect and delayed (Moser, 2012). Tol and Dowlatabadi (2001), for example, focusing on increased malaria-risk in Africa provide evidence for scenarios where GHG emission abatement may actually increase the impacts from climate change. The authors show how reducing the size of the economy and allocating more money towards mitigation, both add to limit the resources for adaptation to increasing rates of vector borne diseases like Malaria. A more straightforward example for a mitigation measure that negatively affects efforts to adapt is increasing the density of housing and other infrastructure. While this can help to reduce motorized vehicle travel and increase the efficiency of public transport, thereby reducing emissions, it equally increases the urban heat island effect and impedes drainage of floodwater, issues that will further exacerbate existing adaptation pressures. This form of negative transaction likewise works from adaptation to mitigation, as projections of increasingly emission-intensive adaptation efforts to maintain coastal settlements in face of rising sea levels, clearly demonstrate (Moser, 2012).

Increasing scholarly attention has been drawn to similarities between adaptation and mitigation in an effort to prioritize measures that facilitate both. Research in this vein has looked at ways to harmonize both measures (Moser, 2012) in order to define synergies in climate policy which are "created when measures that control atmospheric greenhouse gas concentrations also

reduce adverse effects of climate change, or vice versa" (Klein et al., 2005, p. 582). Planting trees in urban areas serves as a typical example of such a synergistic climate measure. As trees grow they sequester carbon mitigating climate change, while at the same helping to adapt to higher temperatures by providing a cooling effect (Klein et al., 2005). Renewable energy resources are another common example. The use of renewables helps to curb GHG emissions (mitigation) and simultaneously helps to reduce the overall-risk of power outages and falling victim to these in conventional centralized energy infrastructure. Similarly new building codes and strategies can help to increase energy efficiency while at the same time helping to increase the resilience of structures to stress from environmental impacts such as flooding and extreme heat (Moser, 2012).

Stehr and Storch (2005, p. 537) describe adaptation and mitigation as protecting society from nature and protecting nature from society respectively. Both responses to climate change are thus embedded in social processes as climate change is conceived as "a societal problem that has an environmental constituent". As such, a common denominator for adaptation and mitigation is the assumption that the climate is changing and that cultural variation is the way humanity adjusts to this change. Wilbanks and Sathaye (2007) state that adaptation and mitigation both play crucial roles and are in fact generally supportive of each other. Mitigation will not respond in a timely manner to prevent the majority of impacts. In turn, these impacts are likely to exceed the potential of adaptive measures without any mitigation. They argue, however, that complementarity in addressing climate change does not mean that synergistic effects can be achieved for adaptation and mitigation. Existing differences between mitigation and adaptation make identifying synergies and ways of integrating mitigation and adaptation a rather complicated process. Beside these contextual factors the complicated nature of the horizontal and

vertical cooperation necessary, paired with lacking consensus on conceptual and methodological aspects, only adds to make this type of approach more arduous. (Biesbroek et al., 2009; Wilbanks & Sathaye, 2007). As the discussion of differing adaptation interpretations further up showed, this latter aspect notably concerns debates around adaptation, which build on a smaller, and more contested knowledge base, owed to its historically younger development and critically differing conceptual understandings. Biesbroek, Swart and van der Knaap (2009) point out that it is in fact not the incoherency of adaptation and mitigation that hinders efforts to integrate both approaches but rather the engrained web of agreements, institutions and policies that has established as a consequence of the mitigation adaptation dichotomy.

Some authors do in fact suggest that the development and implementation of adaptation and mitigation should be kept separate in most cases (Klein et al., 2005; Moser, 2012; Tol, 2005). Klein and colleagues (2005), for example, question whether focusing on synergies is a particularly cost-effective approach to the development climate change policy. They argue that firstly, the multitude of actors involved and institutional complexity that comes with implementing measures in this context could confine their efficiency. Secondly, if one is to rely solely on synergistic measures it is doubtful whether sufficient levels of mitigation and adaptation could be provisioned. Thirdly, they contend that a risk of synergies might also be that, at equal costs, the synergistic effect turns out to be smaller than if adaptation and mitigation were carried out separately. The bottom line of this criticism is that an unduly focus on synergies might create a policy environment where available resources would be inefficiently used to implement synergistic measures when these resources could be much more efficiently used for stand-alone adaptation and mitigation (Klein et al., 2005; Moser, 2012).

It has been argued that rather than on synergies the focus should be on interactions of climate change measures in general, a practice that has yet to be firmly established in policy assessments and evaluations (Warren, 2011). With regard to this authors have suggested to apply a systems perspective in evaluating mitigation and adaptation measures (Moser, 2012; Warren, 2011). Moser (2012) specifically proposes that the development and implementation of a single climate policy should by default include an evaluation of how it affects the ability to implement other complementary policies.

The question thus-rather than focusing on potential synergies between adaptation and mitigation-concentrates on what constitutes an optimal mix of adaptation and mitigation. Various authors have asserted that there is no single optimal mix for adaptation and mitigation (Biesbroek et al., 2009; Klein et al., 2005). An ideal combination will differ between countries and change over time. Further, characteristics of climate change, such as the long time horizons, the multitude and diversity of parties involved and the existence of non-linear and irreversible effects add to the challenge of agreeing on an ideal combination of mitigation and adaptation. These contextual differences are embedded within a variety of belief and value systems so that an ideal combination will also depend on the views of the person or society that makes this decision, an aspect that is particularly relevant to psychological research, as presented in this thesis. In any case a decision would ideally be based on relatively accurate forecasts of future climate change impacts that would help to analyse the costs and benefits of various strategy mixes for various time frames. Since this is a virtually impossible task and given the difficulties of establishing what constitutes an optimal mix, even if the future was certain, other approaches to establishing an optimal balance between adaptation and mitigation haven been put forward. The current dialogue, in particular around adaptation, focuses on what is often referred to as ‘no regret’ or ‘robust’ measures, which do not rely on this sort of

premises (Klein et al., 2005; Lempert & Schlesinger, 2000; Wilbanks & Sathaye, 2007).

1.3 Risk perception

This chapter first turns to risk, the objective quantifiable assessment it seemingly represents, which will inevitably lead to a discussion of risk perception. The concept of risk has its origins in medieval times and early days of explorations, imperialist missions and trade. It was then used in finance and moneylending contexts and was soon linked to increasingly sophisticated probability mathematics and early developments of insurance (Taylor-Gooby & Zinn, 2006). This idea of probability is still present in most contemporary definitions of risk. Risk is commonly conceived to imply two dimensions: probability and effect. A risk can thus be understood as a combination of probability information on the occurrence of an adverse event and the amount of harm it can cause (Breakwell, 2007). As Breakwell (2007) points out, these components do not necessarily have to be simultaneously present; a statement that resonates well with the Royal Society Report which in fact defines risk as "the probability that a particular adverse event occurs during a stated period of time, or results from a particular challenge" (Royal Society Study Group, 1992, pp. 2–3). This definition misses a clear quantifiable component relating to the magnitude of the adverse event and is understood as the statistical probability solely. Adams (1995) in discussing this definition states that what is commonly spoken of as risk, is labelled 'detriment' by the Royal Society Study Group. *Detriment* is defined as "the integrated product of risk and harm" (Royal Society Study Group, 1992, p. 3), or in the words of Adams (1995, p. 8) "a compound measure combining the probability and magnitude of an adverse event". Risk has been studied predominantly with a focus on events, technologies, situations, substances, processes and so forth that entail some form of negative consequences, variously referred to as hazard, harm, adverse event and similar. It is, however, important to add that the notion of risk has not been exclusively discussed in a context of negative outcomes. The idea of risk

and the associated decision process in particular necessarily entail a positive aspect as individuals weigh the potential rewards against adverse consequences (Adams, 1995). In fact much of the 19th century discussion of risk evolved around an idea of risk-taking as a premise for success in life reflected in the proverb 'nothing ventured, nothing gained'. An attitude to risk that still resonates in contemporary concepts of entrepreneurial risk taking (Taylor-Gooby & Zinn, 2006). The predominant discourse that emerged in the 20th century focuses on adverse outcomes and is characterized by increasing attention to manmade technologies and environmental degradation as the primary source of hazards (Dake, 1992).

In economy risk has traditionally been studied applying a model of *rational action*. This approach however was soon revised, as empirical evidence emerged of *plural rationalities* that transcend the single layered economic rationale and seem to provide equally valid bases for decision making about risks (Pidgeon, Hood, Jones, Turner, & Gibson, 1992, p. 94). In this light, economic scholars shifted their attention to the constraints of rational action in order to study human responses to risk more accurately. Some of these constraints lay in limits to peoples' cognitive capacities to process information and calculate probabilities (Taylor-Gooby & Zinn, 2006).

A substantial number of insights into the inadequacy of the rational action approach to risk come from psychology. Psychological research on risk is embedded in the wider social science approach to risk, a counterpoint in the major dichotomy in risk research, contrasting the technical approach to risk. In a psychological research tradition risk has been studied at the individual level mostly, applying experimental, survey and interview methods. Social psychology in particular has had a substantial impact on risk research, showing that it is not only the objective risk qualities and probabilities that define risks for laypeople but also other risk characteristics such as dread, controllability and

familiarity (Slovic, 2001). Work in this line, according to Breakwell (2007), investigates various issues such as individuals' differences in the beliefs they hold about certain risk and how they perceive them, social and psychological factors that influence risk decision-making, the role of emotion in reactions to risks, the communication of risks and how social environments shape these; the role of human behaviours in creating risks and risks in institutions or complex organisations.

What is absent from this research is the intention to objectively measure or quantify risk. This omission represents a crucial stress point between technical and social analyses of risk (Kasperson, 1992, in Tansy, 1999). From risk assessment as something performed by experts in a systematic analytical way striving for an objective measurement of risk, the focus shifts to risk perception, reflecting the notion that risk is an inherently subjective concept. In fact it is not a resignation on attempts to measure risk but rather the appraisal that subjectivity can never be excluded from any risk assessment. Social analyses of risk and the concept of risk perception contest the idea of a quantifiable and objective risk. Pidgeon et al. (1992, p. 89) combine psychological as well as sociological aspects to state that "risk perception involves people's beliefs, attitudes, judgements and feelings, as well as the wider social or cultural values and dispositions that people adopt towards hazards and their benefits". This challenges the concept of objective risk, as any judgement of risk that involves human actors will necessarily contain a subjective component (Pidgeon et al., 1992). The psychometric paradigm can be understood as one of two central approaches in this line of thought.

1.3.1 Psychometric paradigm

The psychometric paradigm was central to this shift in the conceptualization of risk. The psychometric paradigm originated in seminal work by Slovic, Fischhoff and colleagues in the 1970s (Fischhoff, Slovic,

Lichtenstein, Read, & Combs, 1978; Slovic, Fischhoff, & Lichtenstein, 1980). The psychometric paradigm is rooted in the development of the *expressed preferences* approach as an alternative approach to the *revealed preference* method in trying to answer the question 'How safe is safe enough?'. The revealed preference method proposes that individuals determine an acceptable level of a hazard, activity or technology etc. by weighing risk and benefit against one another; an approach that is owed to the engineering, planning and design research this work builds on. The revealed preferences approach further assumes that the end product of these individual cost-benefit evaluations can be read from economic data on risks and benefits, which will reveal socially acceptable risk-benefit trade-offs (Starr, 1969). This part of the analysis is thus not so much about how a certain risk is judged by a single individual but more so about what constitutes an acceptable risk on an aggregate societal level.

The unit of analysis for this type of investigation into risk perceptions is constituted by historical records of accidental deaths arising from technology use, which are conceived as revealing consistent patterns of trade-off between social preferences and costs. The measuring unit is defined as the chance of death per hour of activity or exposure to a technology, while benefit is calculated as the amount of the annual income individuals spend on, or gain from said technology or activity (Starr, 1969). To estimate the risk of a new hazard, technology, activity etc. a hazard with an established acceptable level of risk or benefits can then be used as a form of yardstick (e.g. risk of death by disease).

Research applying the revealed preference method yielded a few consistent principles of what defines an acceptable risk (Starr, 1969):

- The degree of a risk people are willing to accept is proportional to the cubic function of the benefit attached to it.

- At constant benefit levels risks taken voluntarily are more readily accepted than involuntarily taken risks at an approximate ratio of 1 to 1000.
- The statistical risk of death from disease can be understood as a form of psychological yardstick to evaluate various other risks (e.g. risks voluntarily taken are equally tolerated as risk of death from disease).
- The acceptance of a risk is influenced by the amount of public awareness of its benefits, the latter of which Starr (1969) determines from an analysis of advertising, the number of people involved and usefulness.

Critiques of the revealed preferences approach (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978) concentrate on the fact that this approach does not distinguish between what might be optimal risk levels or only accepted with reservation. Starr (1969, p. 1232) apprehends this critique by asserting that his approach does not "serve to distinguish what is 'best' for society from what is 'traditionally acceptable'. According to Fischhoff et al. (1978), however, the more fundamental question this raised is whether the lay public is knowledgeable and capable enough to actually determine acceptable levels of risk. Further, as an approach that looks at historical data, the revealed preferences are inevitably anchored in the past. This method is thus very limited in its ability to reflect quick changes in risk acceptability that spring from an ever-increasing number of new technologies and practices that enter our daily routine. Finally Fischhoff et al (1978) critically point out how the arbitrarily set manner in which benefits and risks are extrapolated from historical data might serve as a source of great variability, producing rather unreliable measures of acceptable risk. Their critique feeds into the proposition of the *expressed preferences approach*, which aims to measure attitudes towards risks and benefits through questionnaires. This method of eliciting risk judgement is central to the psychometric paradigm, which is defined as

> a theoretical framework that assumes risk is subjectively defined by individuals who may be influenced by a wide array of psychological, social, institutional and cultural factors. The paradigm assumes that, with appropriate design of survey instruments,

> many of these factors and their interrelationships can be quantified and modelled in order to illuminate the responses of individuals and their societies to hazards that confront them (Slovic, 2010, p. xxv).

In a series of questionnaire studies Fischhoff and colleagues (1978) asked respondents to rate various natural and technological hazards concerning their (1) perceived benefit to society or (2) perceived risk and (3) the acceptability of their current level of risk. In order to generate a richer picture of the various components of risks as they are perceived by individuals, this line of work moved beyond conventional risk benefit calculations and using rating scales asked respondents to assess various hazards in reference to nine risk characteristics:

- *Voluntariness of a risk* - To what extent are risks undertaken voluntarily?
- *Immediacy of effect* – To what extent is the risk of death immediate?
- *Knowledge about risk (personal)* – To what extent are risk known by people exposed to it?
- *Knowledge about risk (scientific)* – To what extent are the risks fully understood by science?
- *Control over the risk* – To what extent is it possible to avoid death by diligence and skill when engaging in the relative activity?
- *Newness* – Are the risks new or old?
- *Chronic-Catastrophic* – Is it a hazard that kills a large amount of people at once or individuals one at a time?
- *Common-Dread* – Is it a risk that evokes great dread in people, or one that people have gotten accustomed with?
- *Severity of consequences* – How likely are the consequences of exposure to the hazard going to lead to fatal consequences?

Analysis of the averages for each scale across participants indicated that certain characteristics are highly related across hazards. In other words, if a risk was rated high on one risk characteristic it was very likely to be rated high on specific other risk characteristics and these relationships persisted for evaluations of various hazards. More sophisticated statistical analysis then revealed that these interrelations between risk judgements are in essence

explained by two groups of risk characteristics ratings. In other words, similarities and differences concerning risk judgements between hazards can be explained by the profile of the hazards on two separate factors, constituted by specific risk characteristics. The first factor, commonly named *familiarity*, discriminates risks that are new, involuntarily taken, poorly understood and associated with delayed consequences. The second factor distinguishes risks with certainly fatal outcomes from risks with less dire consequences, a factor that was labelled *dread*.

A follow up study in which further risk characteristics as well as various other hazards were added confirmed these two factors and also found an additional third factor, that related to the pervasiveness of a hazard, i.e. how many people were exposed to it, and was thus named *exposure* (Slovic, Fischhoff, & Lichtenstein, 1980). These findings then allowed the various hazards to be plotted along the three dimensions of risk characteristics according to their mean ratings on these factors.

Fischhoff, Slovic and colleagues (1978; 1980) re-examined some of Starr's (1969) key findings. They found that the role of the degree of voluntariness with which one exposed oneself to a hazard was peripheral rather than central. Voluntariness was only one of the characteristics that influenced risk estimates and acceptable risk levels. In fact, statistically controlling for the influence of benefits associated with a hazard eliminated any effect voluntariness had on perceived risk. The severity of consequences, as well as the dread of a hazard instead, were strongly associated with higher risk perceptions. For acceptable levels of risk, and again statistically controlling for the benefits associated with the hazard, voluntariness along with the immediacy of a hazard, its controllability, familiarity and the knowledge about it predicted higher acceptance. The authors argued that the central role Starr (1969) ascribed to voluntariness is most likely a consequence of other characteristics such as the

potential for catastrophic loss of life, lack of control and inequity as more fundamental dimensions that characterize involuntary hazards (Slovic et al., 1980). Another central role of risk characteristics emerged in findings on what is termed the signal value/signal potential of accidents (Slovic et al., 1980; Slovic, 1987). While early research initially assumed that the amount of public reception an unfortunate event gets and the social impact it generates are a direct consequence of parameters such as number of deaths, extent of property damage and so forth, further studies showed that it was to a large extent determined by the specific characteristics of the hazard

Similarly to the findings on voluntariness the benefit of a hazard did not feature as a key factor in how individuals established acceptable levels of risk. Work on expressed preferences instead found that the degree to which people demand a reduction in risk to reach an acceptable level is directly proportional to the magnitude of perceived risk (Fischhoff et al., 1978; Slovic et al., 1980). Regarding the acceptability of risk levels overall, current risks were rated unacceptably high for most activities and technologies. This finding lends further support to the fundamental critique of extrapolating acceptable risk levels from historical data on risk benefit trade-offs, which argues that these do not necessarily represent optimal risk levels.

Slovic et al (1980) in summarizing their results state that the method of expressed preferences makes perceived risk quantifiable and predictable. In this respect Vlek and Stallen (1981) advise caution when handling averaged group ratings of risk as they point out that risk is understood differently for different hazards and by different individuals. In fact much of the work in this research tradition relies on aggregate data, i.e. data which is based on mean values across participants, and as such it allows only limited predictions regarding the risk perception of individuals (Michael Siegrist, Keller, & Kiers, 2005). Siegrist, Keller and Kiers (2005) address this issue by investigating interrelations

between hazards, between individuals in how they perceive these hazards and between rating scales (i.e. risk characteristics) used to elicit risk judgements. They find two hazard components described as *unobservable hazards* and *old hazards*; two rating scale components, which essentially indicate *unknown risks* and *dread risks*; three person components, one for participants that rate unobservable hazards as highly unknowable (*unpredictability of unobservable hazards*), one that identifies individuals which perceive old hazards as highly unknowable (*unpredictability of old hazards*) and a last component which seems to characterize people that generally rate hazards as more dreadful (*dread potential of all hazards, in particular unobservable hazards*). This research reconfirms the two major risk characteristic dimensions but underlines the importance to move beyond these to explore inter-individual differences in how risks are perceived.

Research applying the psychometric paradigm did in fact offer a more differentiated picture of how individuals substantially differ from one another in the way they understand and evaluate risks. Studies of how lay people and experts evaluate hazards showed that experts with their background in abstract technological approaches to risk assessment tend to evaluate hazards based on a single technical criterion such as the expected annual mortality rate, whereas lay people rely on a broader set of risk characteristics (Slovic, Fischhoff, & Lichtenstein, 1979). Risk characteristics thus do not only mediate much of the difference in risk ratings between hazards but the specific weight they are given is also central to disagreement between individuals concerning certain hazards.

As the focus shifted from differences between how hazards were perceived to how individuals differed in their perceptions the 1980s saw a new strand of research on inter-individual differences in risk perception emerge. Various explanations for differences in risk perception were proposed consequently. As differences between lay people and experts would intuitively suggest varying

risk perceptions were initially thought of as errors in judgement based on a lack of education and rationality. A proposition that has been termed the *rationality perspective* (Finucane, Slovic, Mertz, Flynn, & Satterfield, 2000). This view was prevalent in early work on measuring risk and deemed any deviation in judgement from an objective measure of risk, fatality rates for example, ill-informed and a consequence of ignorance. As studies found gender differences in risk perception among highly educated experts this assumption was no longer tenable (Kraus, Malmfors, & Slovic, 1992; Slovic et al., 1995; Slovic, Malmfors, Mertz, Neil, & Purchase, 1997). Further a majority of studies actually found a positive correlation between knowledge about a certain hazards and perceived risk (Davidson & Freudenburg, 1996). Research on inter-individual differences yielded a strong focus on gender differences as studies consistently found that men and women judge risk differently. Specifically, men show a robust pattern of lower perceived risk and concern (see Byrnes, Miller, & Schafer, 1999 for a meta-analysis).

Various accounts of how gender differences in risk perception arise have been put forward. Davidson and Freudenburg (1996) in related work on consistently higher female concern regarding environmental and technological risks list a series of hypotheses that aim to explain these gender differences. The *safety concern hypothesis* attributes higher concern levels among women to their traditional role as nurturers and caregivers, which induces heightened salience of health and safety. This theoretical approach to explaining gender differences in risk perception according to Davidson and Freudenburg (1996) has received the clearest and most consistent support out of all theories explaining gender differences. Similar explanations have also come from evolutionary psychologists, rebranded as the *offspring risk hypothesis* (Harris, Jenkins, & Glaser, 2006). It conceptualizes women's hypersensitivity to risk as evolutionary conditioned as a function of increased reproductive success of mothers who are

better in safeguarding their offspring by virtue of greater risk awareness. Complementary to this other evolutionary accounts have concluded that alongside heightened risk aversion in women, it may be reduced male risk aversion that equally contributes to the found gender differences. Male openness to risk can be understood as a consequence of higher reproductive success overall for risk taking males (Wilson & Daly, 1985). This theoretical approach is largely based on the theory of parental investment (Trivers, 1972) which explains how males and females are subjected to distinct reproductive pressures. While males, with a minimal investment in reproduction have to increase their reproductive fitness by taking risks, females instead face a high investment in reproduction and are thus pushed to a more conservative approach in risk taking. Explanations building on feminist theory conversely propose that women see a world of inherent interconnections making them more attentive to links between potential hazards and the things they value, whereas men tend to see the world in a more abstracted way, separate from context, making them less sensitive to potential risks (Stern, Dietz, & Kalof, 1993).

The *Institutional Trust Hypothesis* assumes that women are less trusting of science, technology and government institutions and this lower trust levels are what negatively affects their risk perception then. A view that is the second most supported in the literature reviewed by Davidson and Freudenburg (1996). The *Economic Salience Hypothesis* presumes that a preoccupation with economic issues, which the authors argue applies in particular to men as they are more likely to be the economic providers for the family, reduces concern for other issues, such as the environment. Finally, the *Parental Roles Hypothesis* states that the proposed effects of the *Safety Concerns Hypothesis* and the *Economic Salience Hypothesis* are amplified as individuals actually accept their parental roles. Davidson and Freudenburg (1996) argue that due to the

changing nature of traditional sex roles it is no surprise to find that the latter two hypotheses only find partial support.

Scholarship on inter-individual differences in risk perception eventually emancipated from this narrow focus on gender differences to include racial differences finding what is described as the so called *white male effect*. Research in this line showed that aside from a strong gender component in individual risk evaluations there is an equally crucial racial aspect and an even stronger interaction effect of gender and race (Flynn, Slovic, & Mertz, 1994). Both gender differences and racial differences exist in risk perception, in that women show higher risk estimates across racial categories, while non-white participants equally show higher risk estimates across genders. More specifically however the evidence indicates that white men, in comparison to white women, but also non-white men and women, significantly underrate risks for all presented hazards. This difference is so distinct that it trumps any other differences found based on gender or race. In other words, white women and non-white men and women are more similar in their perceptions when compared to white men, indicating that differences in risk perception are qualified by an interaction between racial background and gender (Flynn et al., 1994). This insight, along with others, which revealed inter-individual differences, partially addressed a major criticism levelled at the psychometric paradigm. This critique highlights that psychometric studies assume the risk characteristics to be attributes of the hazards themselves as opposed to being construed by individuals and thus at least to some extent a product of differences between these individuals. This is due to a general lack of attention to inter-individual differences in this line of research and the methodological difficulty involved in relying on aggregate data (Marris, Langford, & O'Riordan, 1998).

This distinct risk perception of white men was reconfirmed in further studies and a more detailed analysis showed that the white male effect was in

fact driven by about one third of the white males who skewed overall white male risk judgements by giving extremely low risk ratings (Finucane, Slovic, et al., 2000; Flynn et al., 1994). The researchers further determined that this particular subgroup of white males was highly educated, wealthier and politically more conservative. They also expressed more individualistic and hierarchical attitudes, more trust in institutions and authorities and less favourable views towards involving the public in decision making on hazards (Finucane, Alhakami, Slovic, & Johnson, 2000; Flynn et al., 1994). This strongly suggests that the white male effect, rather than being a combined effect of gender and race, is actually driven by particular value orientations, worldview and cultural preferences individuals subscribe to.

1.3.2 Heuristics and 'risk as feelings'

Parallel to the work of Slovic and colleagues, Kahneman and Tversky (1979) made a major contribution to the research area dealing with risk perceptions and judgment and decision-making. They uncovered various mental strategies, so called heuristics, which individuals rely on for the evaluation of risks and for decisions on risk taking. These heuristics, often described as mental shortcuts, serve to simplify the often overly complex task of assessing the various components, probabilities and further characteristics that define a risk. This oversimplification however comes at a price of occasionally committing judgement errors. Three such commonly described heuristics are: the availability heuristic, the anchoring and adjustment heuristic and the representativeness heuristic (Tversky & Kahneman, 1974).

Anchoring and adjustment describe the processes by which individuals depart from an initial value, anchor, to then reach a final estimate by making adjustments to this initial anchor value. These adjustments, however, are typically insufficient and so a particularly high or low anchor value will lead to an overestimation or underestimation respectively.

The representativeness heuristic describes a judgement process by which the probability of B originating from A is based on B's similarity with A. Utilizing this heuristic a description of a man as very shy, withdrawn, invariably helpful, orderly, structured and passionate about details will lead to a high probability estimate that this particular man is a librarian. This reasoning however ignores certain established probabilities, such as base rates. For example, the information that farmers are far more numerous in the population should affect the probability estimate regarding the chance of the described man being a librarian. Studies have shown, however, that this information is systematically ignored.

The availability heuristic describes a reasoning process by which individuals judge the probability of an event by how easy it is to them to recall an occurrence of such an event. This can lead to a series of biases. Biases due to the retrievability of instances describe the fact that more readily remembered instances will be judged to be more frequent. Equally, if retrieving a particular memory of an occurrence is cognitively more challenging or simply hard to imagine this will unduly affect frequency estimates.

It has been suggested that an alternative explanation for the availability heuristic is described by the affect heuristic (Slovic, Finucane, Peters, & MacGregor, 2004), which states that judgement is also a function of the strength and type of emotions of the images associated with a certain decision problem. The affect heuristic (Finucane, Alhakami, et al., 2000) closely parallels work by Loewenstein and colleagues (Loewenstein, Weber, Hsee, & Welch, 2001) who propose the 'risk as feelings' hypothesis, which equally suggests that emotions play a vital role in risk perceptions and risk decision-making.

The affect heuristic assumes that feelings inform our risk decisions. These feelings are determined by characteristics of the individual, the decision task at hand and the interaction of these two components. Affect is defined as "the

specific quality of 'goodness' or 'badness' (1) experienced as a feeling state (with or without consciousness) and (2) demarcating a positive or negative quality of a stimulus" (Slovic et al., 2004, p. 312). Affective responses are triggered quickly and do not rely on cognitive effort. Both mechanisms, the affect and the availability heuristic, are to some extent described in dual-process theories of thought (Epstein, 1994; Sloman, 1996) as characteristic of the experiential system. Dual-process models distinguish two systems of thought, an analytical system and an experiential system. Alternatively these types of processing are referred to as *System 1* (experiential) and *System 2* (analytic) processes of reasoning. (Kahneman, 2003; Stanovich & West, 2000). The experiential system is defined by quick, intuitive, potentially unconscious and effortless processing, which is laden with emotions. The experiential system is older, in that it constitutes an evolutionary legacy, which relies on real-world experience and associates stimuli, based on temporal or spatial proximity with their affective responses. The analytical system, on the other hand, is characterized by slow, sequential, conscious and effortful processing. It's younger in its origin and relies on normative judgement and decision-making rules, as specified, for example, in *expected utility* theories. (Loewenstein et al., 2001; Sloman, 1996; Slovic et al., 2004; Weber, 2006).

The two systems work in conjunction and it has been shown that the experiential system, and in particular the ability to rely on emotions as input to decision making, are vital to normal decision-making. Research around Damasio's somatic marker hypothesis (Bechara, Damasio, Tranel, & Damasio, 1997; Damasio, 1996) showed that specific brain lesions that impair individuals from experiencing certain somatic reactions as the physiological substrate of emotions, but leave other cognitive functions mostly unaffected, lead to substantial deficits in risk judgement and decision making. The 'risk as feelings' hypothesis further draws attention to the possibility that the outputs from the

two systems can diverge. When this occurs it is usually the experiential system that prevails over the analytic system in the final decision. Beyond the first encounter with a certain stimulus, or decision problem, emotional reactions also guide future encounters/decisions with that same stimulus through conditioned responses and memory (Loewenstein et al., 2001). The risk as feelings hypothesis further identifies certain contextual aspects that specifically affect emotional reactions, while only playing a minor role for cognitive evaluations. Among these is the vividness with which a situation presents itself or is imagined. Vividness is directly related to the strength of anticipatory emotions and is both dependent on inter-individual differences regarding the ability to envision a particular issue but equally on how vivid a certain issue presents itself or is presented (Loewenstein et al., 2001).

In this regard the importance of personal experience becomes evident. In particular with regard to natural hazards, such as flooding, personal experience has been highlighted as one of the most factors influencing risk perceptions (Wachinger, Renn, Begg, & Kuhlicke, 2013). In their review dealing with risk the perception of natural hazards literature, Wachinger et al. (2013) find that direct experience appears to be one of the most influential variables. Wachinger et al. (2013) make an important distinction between two types of experience: *direct experience,* which is described as internal; and *indirect experience*, which is defined as external. Their analysis of the available literature finds that personal experience of hazards is generally associated with higher risk perceptions. Flood victims in Italy have been found to have higher risk perceptions than individuals who have not experienced damage in earlier floods (Miceli, Sotgiu, & Settanni, 2008). Confirming these findings, another study finds that persons with flood experience tend to overestimate danger, whereas the opposite is true for people without such experience (Ruin, Gaillard, & Lutoff, 2007). However, direct experience, under certain circumstances, can also

decrease risk perceptions. Individuals who have lived through a hazard event without suffering any personal damage, for example, exhibit decreased risk perceptions afterwards (Hall & Slothower, 2009; Scolobig, De Marchi, & Borga, 2012). Indirect experiences of a hazard event, often related through a variety of media, can help recall previous hazard events and the associated experiences but unsurprisingly have a weaker effect on risk perceptions that quickly fades away and only plays a minor role if direct experiences exist. The short period of heightened risk perceptions after a natural disaster is often referred to as a 'window of opportunity' that represents an ideal point in time for risk communication and risk education efforts (Felgentreff, 2003; Shaw, Kobayashi, & Kobayashi, 2004).

Research has shown that personally experiencing adverse consequences, by means of changing the emotional reaction to a risk, adds to the explanation of self-protective behaviour, beyond what can be explained as a function of simply providing conscious cognitive input to decision-making (Weinstein, 1989). The process of how personal experiences influence and shape engagement with a certain type of risk or similar has been described in theories on the so-called experiential learning pathway. Experiential learning essentially corresponds to what has been discussed in dual-process theories of thought as the function of the experiential system. In the context of climate change engagement studies the experiential learning pathway describes the seemingly intuitive theoretical assumption that individuals can understand and relate to climate change through observations that fall out of their subjective range of what constitutes regular weather. Since *experiential learning* happens automatically, does not require much effort, and possesses more immediate and personally relevant qualities compared to *analytic processing*, it is much more likely to occur (Marx et al., 2007). Both the availability and the affect heuristic have been discussed in relevant literature as facilitators of the effect that

personal experiences of a certain hazard have on individual engagement (Keller, Siegrist, & Gutscher, 2006). The evidence base regarding this link between risk perceptions and personal action is, however, quite inconsistent. Wachinger et al. (2013) discuss this as *the risk perception paradox* and propose three explanations for results that often indicate a weak connection, or no connection at all, between risk perceptions and personal action: (1) The benefits of accepting a certain risk, living close to a river for example, outweigh the potential negative impacts. (2) Individuals simply do not feel responsible for action. (3) Individuals do not feel able to address the risk.

As has been shown, direct experience of risk and even high-risk perceptions do not automatically lead to personal action. That is why efficient risk communication to create the necessary awareness and induce personal action has been central to the scholarly debate around risk. Risk communication is defined as a social process that accounts for the message characteristics, the sender, the audience, the social context, the hazard characteristics and the mode/channel of delivery (Höppner, Buchecker, & Bründl, 2010, p. 45).

Höppner et al. (2012, p. 1755), in assessing the current state of risk communication, state that it is "an increasingly complex activity which is moving beyond the one-way provision of information and the building of trust in risk-managing bodies towards a two-way exchange of knowledge and views". Applying the concept of *social capacity building,* the authors highlight a series of characteristics that distinguish successful risk communication. This includes the format of the communication, where personal communication has been found to be more effective than communication via the media (Moser, 2010; Parker, Priest, & Tapsell, 2009) but equally how messages are framed (Spence & Pidgeon, 2010). Two-way (as opposed to one-way) communication has generally been found to be more effective, particularly with regard to building trust. The same applies to continuous communication efforts as opposed to one-

off communication (Buchecker, Meier, & Hunziker, 2010; Conchie & Burns, 2008; Höppner, Frick, & Buchecker, 2007). Defining risk communication as a two-way process necessarily implies that various audience characteristics also have to be considered. These include the mental models of certain risks that people hold, their personal problem frames, knowledge, beliefs and values (Bier, 2001; Kolkman, Veen, & Geurts, 2007). With regard to the adverse psychological effects of natural hazards, risk communication scholars suggest that an optimistic and energetic language as opposed to one characterized by fear and helplessness and the provision of knowledge on how to act in critical situations can attenuate some of these (Ereaut & Segnit, 2006; Höppner et al., 2012).

Linking literature on direct experiences of risk and risk communication, Höppner et al. (2012) in their review of risk communication practices reveal that a majority of communications are flood-related. They attribute this to the pervasiveness of flood events in most European countries. This has led to a risk communication literature specific to flood risks. Messling et al. (2015), for example, propose a series of principles central to engaging the public with flood risks in the context of climate change. They argue that climate scientists can help to quantify the anthropogenic input for individual flooding events but also that risk communications can build on the increasing common public perception that links climate change and flooding. Risk communications around flooding, however, should ideally happen before flood events and more generally, should be designed and carried out with diligence so they do not backfire. In communicating flood risks, it is important to strike a balance between local and global aspects and communications must seek to empower people to adapt to future flood risks. 'Peer' messengers and stories from affected communities then offer strong narratives to foster engagement and learning.

Orr et al. (2015), in reviewing literature on flood risk communication, underline the importance of considering how audiences might react differently and identifying the factors that determine these differences. They argue that peoples' attitudes and values shape their reactions to risk communication. It is therefore essential to identify specific audiences, to describe their attitudes, interests, values and concerns and to then design communications which suit these. A discussion of factors influencing how individuals respond to information about flooding starts with a useful distinction of three different theoretical frameworks of how people perceive flood risk outlined by Wood et al (2012): (1) *individual level theories* focus on the role of the individual and internal factors in shaping responses; (2) *interpersonal level theories* focus on other people's role and external factors; and (3) *community and group level theories* consider the influence of the wider social context and communities, focusing on factors within the wider social systems. The next chapter presents a major theory in risk perception research that, to some extent, incorporates all these perspectives, starting with an initial focus on individuals themselves as opposed to the psychometric paradigm's starting-point of hazard characteristics.

1.3.3 Cultural theory of risk

A strong focus on how individuals' rather than hazards themselves shape risk perception has been central to *Cultural theory*, which builds on scholarship in anthropology and sociology. The Cultural Theory of Risk originates in work by Douglas and Wildavsky (1983) which aimed to explain increasing environmental concerns and risk awareness during the late 1960s and 1970s. The observation that this trend was in fact contrasted by increasing quality of life, increasing life expectancy and increasing control over hazards lead the authors to propose that these preoccupations are in fact social in origin (Tansey & O'Riordan, 1999). Cultural theory, in essence, provides a theoretical framework to better understand what is termed the *social construction of risk*.

The concept of social construction of risk is derived from the more general assumption of the social constructions of meaning or social construction of reality describing the idea that all perceptions, knowledge, language, every aspect of human living, is in fact socially construed (Dake, 1992; Tansey & O'Riordan, 1999). Cultural theory' investigates these social constructions of risk of how groups choose risks and how they choose to frame them by describing social relations between individuals (Tansey & O'Riordan, 1999).

This research focus is reflected in two central assumptions of cultural theory: (1) Adherence to a certain form of how *social relations* are organized is related to a specific way of social construction; of viewing, interpreting the world, so called *cultural biases*, which logically includes how individuals perceive risks. Cultural biases describe the idea that "competing cultures confer different meanings on situations, events, objects, and especially relationships" (1992, p. 27). The idea of 'competing cultures' expresses the underlying assumption that the varying social constructions of risk are functional in that they maintain and legitimize a preferred form of social relations, culture, or way of life, while weakening the others (Michael Thompson, Ellis, & Wildavsky, 1990; Wildavsky & Dake, 1990). The relationship of societal relations and cultural biases is reciprocal and mutually reinforcing in that cultural biases legitimize a chosen pattern of societal relations, which in turn favour certain cultural biases. This interplay of cultural biases and societal relations is sometimes summarized as a particular way of life – alternatively described as worldview or ideology – that individuals subscribe to (Dake, 1992; Douglas & Wildavsky, 1983; Marris et al., 1998; Michael Thompson et al., 1990). (2) Cultural theory further posits that four distinct ideology groups can be described by their specific profile on two dimensions. The *group* dimension reflects the strength of allegiance to a group. The *grid* dimension indicates the amount of prescriptions an individual is confronted with in a particular social environment. In other words the group

characteristic reflects the degree to which a person forms part of a collective. Grid on the other hand describes to what extent a person's life is determined by norms and regulations. The group/grid taxonomy, as Cultural theory is sometimes alternatively referred to, in its core includes four possible combinations of high/low group/grid characteristics: *hierarchy* (high group, high grid), *egalitarianism* (high group, low grid), *individualism* (low group, low grid) and *fatalism* (low group, high grid) (Dake, 1992; Douglas & Wildavsky, 1983; Marris et al., 1998; Michael Thompson et al., 1990).

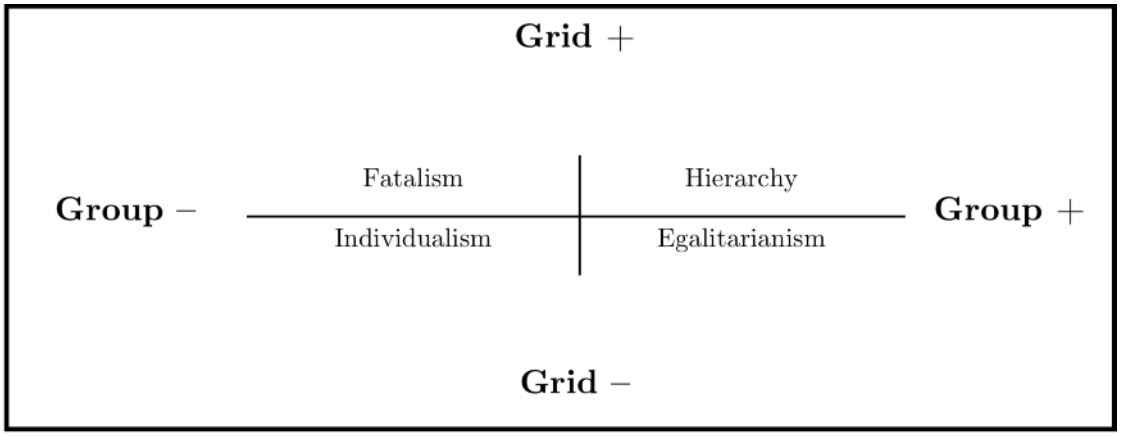

Figure 1. The four group/grid typologies

The four group/grid typologies as shown in Figure 1 can be described in more detail by the "distinctive myths of nature, specific types of rationality, and particular risk management strategies" they hold (Dake, 1992, p. 28). Central to *hierarchical groups* is the belief in the myth that nature is *perverse or tolerant*, which describes the idea that nature is robust up to certain limits. Groups are organized hierarchically as compliance flows up the ranks and commands flow down. Sustainable development with expert decision makers to prescribe limits and regulations is thus the strategy of choice in managing the environment. *Egalitarian groups* conceive nature as *fragile*. Egalitarian groups are concerned with outcome equality and thus critical of hierarchical decision processes. Discussions of risks concentrate on ethical aspects, as a way of examining the

social and political aspects of technologies and scrutinizing the role of institutions in risk management. It follows that the preferred environmental management strategy is anchored in precautionary principles. Adherents of the *individualist group* subscribe to the myth of nature as *benign*. They assume that if individuals are freed from imposed constraints arising from group and grid pressures they will find abundance; and any hazards created in the process of getting more of the good will be outweighed by the benefits accrued. Deregulation is thus favoured in environmental management in order to act freely in self-regulated networks with as little external interference as possible. Central to the fatalist typology[9] is the myth of nature as *capricious*. Nature cannot be controlled and fatalists' behaviour is controlled by external entities they do not or choose not to form part of. Consequently this group yields little interest in management strategies as they withdraw into isolation and disengagement (Dake, 1992; Wildavsky & Dake, 1990).

Empirical work on Cultural theory has looked at how these specific worldviews affect the perception of specific risks in comparison to other predictors of risk perception, namely knowledge, personality traits and demographic characteristics. The general finding is that "however conceptualized-whether as political ideology or cultural biases-worldviews best account for patterns of risk perceptions" (Wildavsky & Dake, 1990, p. 56). 'Patterns of risk' refers to the finding that risk perceptions emerge from an interplay of cultural biases and the type of hazard that is being evaluated. Particular risks are more salient to individuals from one group than they are to individuals from another. Wildavsky and Dake found (1990) that overall egalitarianism is positively related to the mean perceived risk, and negatively

[9] The fatalist typology is not discussed in much detail in relevant research. Tansley and O'Riordan (1999) attribute this to the fact that fatalists are uncoupled from political debate.

related to the average benefit, of technologies. In particular, egalitarians are most concerned about technical and environmental risk. Specifically, egalitarianism is most strongly associated with concern for 'environmental pollution', 'dangers associated with nuclear energy' and the 'threat of nuclear war'. Egalitarianism correlates with high risk-estimates for environmental threats with potentially catastrophic outcomes such as 'nuclear power' and the 'ozone depletion'; and unnatural risks, such as 'genetic engineering' and 'micro wave ovens' (Dake, 1992; Marris et al., 1998).

Hierarchism and individualism by contrast are positively associated with technological risk-taking and correlate with average ratings regarding technological benefits. Distinctive of individuals is that they dread the risk of war more than others and individualism is generally more highly correlated with concern for economic issues such as the 'lack of a stable investment climate'. Individualism correlates with low risk perceptions for environmental threats and what the authors interpret as personal risks, such as alcoholic drinks, car driving etc. Hierarchists are most preoccupied with forms of social deviance and insubordination as a particularly strong correlation between hierarchy and concern for 'loss of respect for authority' suggests. The hierarchical worldview is associated with high risk perceptions concerning social threat such as terrorism and mugging (Dake, 1992; Marris et al., 1998).

Integrating both the psychometric paradigm and cultural theory Marris et al. (1998) expanded this line of work to provide a valuable comparison of the relative predictive power of the two approaches in explaining risk perceptions. The authors found that qualitative risk characteristics of the psychometric paradigm explain a substantially larger proportion of risk perceptions than do cultural biases. They explain the relatively low power of cultural biases in predicting risk perceptions pointing to the relatively distant nature of the operationalization of cultural biases when compared to measures of risk

perception and the various risk characteristics which could be argued to measure much more similar constructs. The authors further add that the more interesting results do in fact pertain to the differences found between cultural biases, yielding distinct patterns of risk perceptions in line with previous research and predictions of cultural theory.

In summarizing how cultural biases lead to these distinctive patterns of risk perceptions Wildavsky and Dake state that

hierarchists favour technological risk taking because they see this as supporting the institutions that they rely on to make good their promises, to wit: technology can promote a stronger society and a safer future provided that their rules (and stratified social relations) are maintained. Individualists also deem technology to be good. They hold that following market principles (and individually negotiated social relations) will allow technological innovation to triumph, conferring creative human value on otherwise inert resources. They also believe that the enormous benefits of technological innovation will convey their premise that unfettered bidding and bargaining leaves people better off. If they believed that free market institutions are intrinsically ruinous to nature, individualists could no longer defend a life of minimum restraints. By the same token, egalitarians are opposed to taking technological risks because they see them as supporting the inegalitarian markets and coercive hierarchies to which they are opposed (Wildavsky & Dake, 1990, p. 52)

Just like the psychometric paradigm cultural theory has attracted criticism. A first criticism focuses on what is labelled the 'impossibility theorem', the idea that only the four forms of social organization (egalitarian, hierarchical, individualist and fatalist) represent stable enough combinations of high/low group/grid characteristics. As Dake (1992) points out, however, relaxing this strict classification does not conflict with the core assumption of functional interdependency of social relations and cultural biases. This criticism

relates to discussions around two interpretations of cultural theory. (1) The stability version of cultural theory assumes that individuals adhere to one worldview across different spheres and periods of their life. (2) The mobility conceptualization instead accepts that adherence to certain cultural biases can change over time and will also depend on the particular sphere of life the individual lives. In support of this latter interpretation of cultural theory Marris, Langford and O'Riordan (1998) find that only approximately a third of respondents can actually be clearly subdivided according to the group/grid taxonomy. They conclude that "the four cultural biases may be best interpreted as extreme reference points" (Marris et al., 1998, p. 646). The majority of respondents adhere to multiple cultural biases, lending support to Dake's (1992) proposition of relaxing categorical assumptions. The finding itself is not necessarily surprising considering that the scales used to measure preference for a particular worldview are not independent of each other. In particular, individualism shows a strong negative correlation with egalitarianism and a strong positive association with hierarchism. Many of these criticisms actually relate to the operationalization of cultural theory and with regards to this informed criticism needs to acknowledge some of the caveats and constraints explicitly referred to in cultural theory summarized by Tansey and O'Riordan (1999). Firstly, the grid/group model is not designed to explain individual behaviour. The tendency to focus on individual behaviour in explaining social action, labelled *methodological individualism* is dominant in social sciences but cultural theory instead focuses on what people who form groups have in common. Cultural theory thus cannot provide insight into what particular personality type is attracted by a particular form of social organization. Secondly, cultural theory is static and does not attempt to describe how changes in cultural orientation happen. Thirdly, cultural theory's value is heuristic in nature, rather than being an analytical tool. Finally, cultural theory

should be applied to social environments rather than societies as a whole (Tansey & O'Riordan, 1999).

The value of cultural theory, as has been pointed out by Marris et al (1998) lies in the sophistication it allows in analysing how groups of individuals differ in their risk perception of particular hazards. The authors are able to show that these differences between cultural biases extend to how certain characteristics are rated. In particular the aspect of 'harm to future generations' yielded numerous significant correlations with the various cultural biases. In accordance with cultural theory egalitarianism correlated positively with risk ratings concerning this characteristic for 7 out of 13 risk issues while both individualism and hierarchism correlated negatively with most of these. High ratings regarding the feature 'harm to future generations' for 'terrorism' and 'mugging' by contrast, were strongly associated with hierarchism but not with any other cultural bias (Marris et al., 1998). This clearly illustrates how cultural biases, more than just producing biased risk perceptions do in fact influence the way hazards are interpreted.

1.4 Adaptation behaviour and engagement with climate change

Since adaptation is often also a form of individual behaviour, this last section concentrates on a short discussion of the psychological literature on the factors driving individual adaptation behaviour. It is important to note, though, that for adaptation climate change does not represent a necessary analytical context. As has been outlined in chapter 1.2.1, adaptation is a form of response to changing environmental conditions that existed long before climate change entered the picture. As such, there are various psychological research areas that have looked at adaptation responses in a non-climate change related way. Environmental stress literature, for example, explores how organisms

react/adapt to environmental stressors such as noise or pollution. Equally, research on human engagement with natural hazards has looked at how individuals respond to natural hazards, such as flooding, which potentially offers considerable overlap with research on adaptation to climate change impacts. With this thesis' background in social psychology, and environmental psychology in particular, the work presented here tries to situate climate change adaptation within the wider literature on pro-environmental behaviour, in order to explore the applicability of this research tradition to climate change adaptation.

For the application of a of a pro-environmental behaviour framework to adaptation, Stern (2000) offers a helpful and crucial distinction between intent- and impact-oriented behaviour. Intent-oriented pro-environmental behaviour is primarily motivated by the intention to change the environment, whereas its impact-oriented counterpart is driven by a clear determination to actually change the environment. I understand the mitigation and adaptation intention measures employed in this study as proxies for impact-oriented behaviour. This however does not preclude the possibility that participants' responses to the actions proposed in the questionnaire are in fact motivated by intention more than they are by the impact they should achieve. It could also be hypothesized that mitigation as the more established category of climate change measures is more strongly embedded in attitudinal and value networks and thus, already more strongly dissociated from its purpose/impact than adaptation is.

Stern et al. (1999) further distinguish between activist and non-activist behaviour. The latter is then further subdivided into consumer behaviour, environmental citizenship and policy support. This distinction offers a valuable addition of nuances to behaviour that is often measured, neglecting peculiar variances in behaviour types that potentially exhibit different predictor patterns. That said, Stern et al. (1999) do not propose how these might differ

for the various dimension. Applying the terminology of Stern et al. (1999), this research will focus on non-activist behaviour and consumer behaviour and policy support in particular.

Value belief norm (VBN) theory (Stern, 2000) has been proposed as one of the principal theories in the environmental psychology literature to explain pro-environmental behaviour. VBN theory offers an overarching framework for including variables from other theories on environmentalism and the broader social psychology literature. It describes a causal chain of five variables that lead to pro-environmental behaviour. The model builds on (1) *personal values*, which are assessed with a scale based on measures by Schwartz and colleagues (1987; 1994) and adapted to the context of pro-environmental values. Personal values then inform a person's (2) *ecological worldview*, which is measured by the NEP-scale (Dunlap & Vanliere, 1978). Both of these constructs can be described as belonging to what is often referred to as human values in social psychology. Depending on these values, an individual can then exhibit (3) *awareness of consequences for a valued object* (AC), which is operationalized here as affective engagement. (4) A*scription of responsibility to the self* then leads to (5) *pro-environmental personal norms*, which serve as a direct precursor of pro-environmental action.

While to the best of my knowledge no specific theory of climate change relevant behaviour exists yet, various aspects and theories have been discussed in the wider literature examining individuals' engagement with climate change. Debates about the reality of climate change in particular have sparked interesting discussion of psychological constructs that could help explain peoples' engagement with climate change. It seems, that as evidence of human influence on global climate is increasing, so are the voices that question, doubt or straight-out reject the idea of anthropogenic climate change (Dunlap & McCright, 2008; N. Smith & Leiserowitz, 2012). Tendencies like these have been

referred to as *climate change scepticism* or *climate change denial*. The latter term of denial has a long history in psychological research going back to early psychoanalytical work and commonly describes "a defence mechanism involving a disavowal or failure consciously to acknowledge thoughts, feelings, desires, or aspects of reality that would be painful or unacceptable ..." (Colman, 2009, p. 199). Scepticism, from what is/was once conceived as an essential virtue of scientific scrutiny (Merton, 1973) has instead increasingly been turned into a label to describe the behaviour, attitudes and beliefs of those disengaged or dismissive of climate change science. This chapter will discuss the issue of *climate change scepticism* and related constructs largely in line with the above-mentioned definition of denial as a defence mechanism. I understand climate change scepticism as attitudes and beliefs that challenge established scientific facts regarding climate change. These challenges can vary in extent and intensity, from a complete negation of the problem[10] to less pronounced forms such as doubt and uncertainty over certain aspects of climate change.

In this vein various taxonomies of climate change scepticism have been proposed. Rahmstorf (2004) for example, distinguishes three types of sceptics: (1) *Attribution Sceptics*, who doubt climate change is caused by humans, (2) *Impact Sceptics*, who contest the negative effects climate change will have and (3) *Trend Sceptics*, who doubt there is such a thing as climate change. A similar form of classification is outlined by Opotow and Weiss (2000) in their work on denial and moral exclusion in environmental conflicts. They describe three forms of denial in environmental conflicts applicable to climate change scepticism: (1) *Denial of outcome severity*, similarly to impact scepticism it does not acknowledge negative impacts or harmful consequences. (2) *Denial of*

[10] I argue that the term denial applies to this form of climate change scepticism only, whereas scepticism illustrates the various degrees of sceptic beliefs more accurately.

stakeholder inclusion legitimizes moral exclusion and hence reduced concern, on the basis of unfavourable evaluations of others, who are often labelled as 'outsiders' or 'extremists' in this context (3) *Denial of self-involvement* closely parallels the attribution sceptic typology and describes a mechanism whereby the individual negates any responsibility or even ability to act. More recently Capstick and Pidgeon (2014b) in an effort to refine the concept, have proposed two forms of climate change scepticism: (1) *Epistemic Scepticism*, relating to uncertainty about the science and overall matter of climate change itself and (2) *Response scepticism*, summarizing doubts regarding the efficacy of climate change measures. It could be argued that the latter form of scepticism might be very similar to what is often also discussed as efficacy beliefs. These types of beliefs are traditionally understood as a precondition to action and express whether a person judges a certain behaviour to be effective and/or whether he/she thinks, that he/she is actually able to perform the respective behaviour. These parallels between scepticism and efficacy beliefs add a valuable new perspective to efficacy beliefs contrasting the idea that efficacy beliefs are typically grounded in an objective evaluation of the actions in question.

The above-mentioned typologies of scepticism offer insight into the various forms of scepticism but do not provide us with a procedural account of how climate change triggers these responses and what function they might serve. Stoll-Kleemann, O'Riordan, and Jaeger (2001) looking at the constituting components of climate change denial in more detail argue that it builds on four interrelated so-called interpretations: (1) The *comfort* interpretation describes the reluctance of individuals to give up certain accustomed ways of living that are closely linked to one's definition of self. (2) The *tragedy of the commons* interpretation is based on the idea that individual action is of little value and that while the individual tries to maximize the collective long-term interest, others will maximize their own personal benefit, thus justifying their inaction

and/or unsustainable practices. (3) The "*managerial fix*" interpretation is characterized by the belief that the issue of climate change will be resolved by future technological and administrative innovations. (4) The *governance distrust* interpretation builds on the conviction that while the individual will have to contribute; the state will not live up to its commitments. Apart from the *comfort* interpretation however, these explanations seem to represent descriptions of the various pathways via which scepticism can be expressed, rather than explaining the underlying mechanism and its purpose. The *comfort* interpretation instead suggests that scepticism is much more than just a different view on the issue of climate change but that it serves a self-serving purpose.

Taking a broader perspective one could argue that scepticism falls within a wider set of climate change perceptions that is often referred to as the *psychological distance of climate change* (Haden, Niles, Lubell, Perlman, & Jackson, 2012; Spence, Poortinga, & Pidgeon, 2012). This describes the consistent finding that the majority of people think of climate change as a threat that is uncertain, most likely to affect other people, far-away communities and countries more heavily, and in a distant future. Concern for climate change generally is quite widespread but when compared to other concerns in life, so called issue importance, climate change consistently ranks comparatively low (Lorenzoni & Pidgeon, 2006; Nisbet & Myers, 2007; Pidgeon, 2012). Emotional engagement likewise seems to be of a rather detached nature. Negative emotions are dominant but are not intensely felt and primary, visceral emotions such as fear or anxiety appear to be lacking mostly (Leiserowitz, Maibach, Roser-Renouf, & Smith, 2010a, 2010b; Leiserowitz, 2006; Lorenzoni, Leiserowitz, Doria, Poortinga, & Pidgeon, 2006; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; O'Neill & Nicholson-Cole, 2009; Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011).

Research has shown that there are instances that can ameliorate these psychologically distant perceptions and lack of affective processing which relate to the above-mentioned experiential learning pathway. Prime examples are extreme weather events, such as flooding, which can provide the avowedly questionable opportunity for this sort of processing and shift in perceptions, which can induce greater engagement with climate change (Spence, Poortinga, Butler, & Pidgeon, 2011; Zsamboky, Fernández-Bilbao, Smith, Knight, & Allan, 2011). In most cases though, and thankfully so, in absence of traumatic extreme weather events, the nature of climate change remains abstract and makes it difficult for individuals to gather real-life experience.

The concept of psychological distance itself is most prominently linked to Construal Level Theory (CLT) (Trope & Liberman, 2010). CLT assumes that so-called mental construals of a certain issue are established in relation to the self in the here and now as a reference point characterized by four dimensions of psychological distance: *time (present* to *future)*, *space (here* to *there)*, *social distance (us* to *them)* and *hypotheticality (certain* to *uncertain).* Trope and Liberman (2010) propose that for individuals to transcend their egocentric viewpoint they have to rely on these mental construals, which gain in abstraction from *low level construals* to *high level construals* as distance on the above-mentioned dimensions increases. Mental construals are separate from immediate experience and entail contents such as memories, predictions and speculations. Research in this domain has highlighted three main findings: (1) The above-mentioned dimensions of distance are cognitively linked to one another and (2) these dimensions and mental construals reciprocally affect each other. (3) Furthermore these dimensions influence predictions, preferences and actions in similar ways (for a review see Trope & Liberman, 2010). As shown above climate change perceptions seem to be consistently located at the more distant end of these. It is thus important to note that distant public views on

climate change should not be understood as overly flawed or misinformed. If one is to apply the theoretical insights from CLT to the issue of public perceptions of climate change, it becomes conceivable how for the average citizen of a wealthy state this phenomenon does in fact lend itself much easier to a distant and abstract perception. The process of climate change is slow and associated with inertia. Future generations are most likely to be more affected than we are now and on a societal and geographical dimension it is reasonable to think that less wealthy countries, remote from respondents' realities, will face the brunt of climate impacts. Finally, uncertainty like for any other science is inherent in climate science itself.

1.5 Summary, research aim and structure

1.5.1 Summary

The overwhelming majority of scientists today agree that humanity is affecting the world's climate and it does so mostly by releasing greenhouse gases (GHG), such as carbon dioxide, into the atmosphere. It is virtually certain that this increase in GHG there will lead to an increase in temperature extremes over most land areas, and it is very likely that the frequency and duration of heat waves will increase. Similarly, extreme precipitation will very likely increase, both in frequency and intensity. This creates a paradoxical state of future climate in which societies will be simultaneously confronted with more flooding events and more periods of drought. Sea level rise will only further add to these challenges, as its pace is very likely to surpass that between 1971 to 2010.

Two major climate change response strategies, adaptation and mitigation can be highlighted. Mitigation is defined as a "human intervention to reduce the sources or enhance the sinks of greenhouse gases" (IPCC, 2014a, p. 1769). Adaptation instead is described as a "process of adjustment to actual or

expected climate and its effects" (IPCC, 2014a, p. 1758). Since this thesis' focus is on public perceptions of and responses towards adaptation the introduction explored the concept of adaptation and its history in more detail. Historically the international debate on climate change paid less attention to adaptation until the turn of the millennium. Interest in adaptation before that was limited and if adaptation was dealt with then mostly in its function as "a handmaiden to impacts research in the mitigation context" (Burton et al., 2002, p. 146).

The past 15 years, however, have seen an increasing interest in adaptation. Various reasons have been put forward for why adaptation needs to be considered to the same extent. Potentially the most prominent arguments for intensifying adaptation efforts are related to the limits of mitigation, the complementarity of mitigation and adaptation in addressing climate change and the inertia of the climate system, committing future societies to a considerable amount of climate change, even if societies were to execute very stringent mitigation plans today. The political reality of setbacks in international negotiations on emission reductions only adds to the urgency in shifting some of the attention towards adaptation. This tendency is evident in increasing scholarly and political attention to adaptation. Research in a psychological research tradition, however, has been lagging behind, as very little scholarly work has examined how individuals perceive and, on a more general level, engage with climate change adaptation. The principal research aim of this thesis is thus, to narrow this gap.

In doing so this thesis partly relies on scholarly work on risk perception, and social psychological research in particular. Social psychological research on risk is embedded in the wider context of social analyses of risk that contrasted the formerly predominantly technological approach. One of two major paradigms in social analyses of risk is the psychometric approach, which is the principal heuristic paradigm of this thesis.

Following research in this tradition, this thesis further focuses on so-called heuristics and the affect heuristic in particular. This latter heuristic assumes, that feelings inform our risk decisions. Theory on the affect heuristic is linked to scholarly work on dual-process models, which generally distinguish between an analytical system and an experiential system. The experiential system, as the substrate of the affect heuristic, is defined by quick, intuitive, effortless and emotional processing.

The experiential and analytical system work in conjunction. but when the two systems reach opposing judgement it is conventionally the experiential system that comes out on top. Related to the latter is the concept of experiential learning. In the context of climate change engagement studies, the concept of experiential learning suggests that individuals can comprehend climate change through observations of particular weather phenomena, which they link to climate change. Both the availability and the affect heuristic have been discussed in relevant literature as facilitators of the effect that personal experiences of a certain hazard have on individual engagement (Keller et al., 2006).

Studies in a psychometric research tradition also paid attention to inter-individual differences. Work in this line has found that to some extent risk perceptions are actually driven by adherence to certain cultural preferences. A strong focus on this type of cultural and inter-individual differences has been central to cultural theory of risk, the second major paradigm in social analyses of risk. The central insight from research applying cultural theory is that cultural biases, informed by adherence to four group-grid cultural typologies, best account for patterns of individual risk perceptions, finding that particular risks, but also particular risk characteristics, are more salient and mean different things to individuals from one group, than they do to individuals from another.

This thesis combines the two major elements of the introduction as it offers an empirical exploration of public engagement with climate change, paying particular attention to the role of climate change adaptation as a more recently established category of climate change action. It does so in a psychometric research tradition but with a strong effort to incorporate scholarship on cultural theory and risk as affect, to the extent that the methodologically individualistic approach taken here allows. By focusing on public engagement this thesis seeks to explore much more than just public perceptions. It equally aims to investigate how these perceptions are then translated into behavioural intentions and support. To do so this thesis, in a first step, relies on a core theoretical approach in environmental psychology that has been proposed to explain pro-environmental behaviour.

1.5.2 Research aim & structure

The overarching aim of this thesis is to explore how the overall engagement with climate change changes in light of a more balanced focus on both climate change adaptation and mitigation. It does so in multiple ways and by asking a series of research questions.

Chapter 2 explores the link between individual risk perceptions regarding climate change and individual behaviour intentions and policy support for both climate change adaptation and mitigation. On an elementary level it thus explores the relationship of adaptation and mitigation with regards to individuals' intentions and support, moving beyond the solely theoretical considerations presented in the introduction. More sophisticated analysis then looks at psychological correlates of the various behavioural intention and policy support, comparing again adaptation and mitigation with regards to the specific predictor patterns that emerge. The questionnaire employed includes a variety of variables. To illustrate, the survey instrument is concerned with various

aspects of individuals' climate change perceptions. It asks participants to indicate whether they believe in climate change and whether they agree that they, their families, etc. will be affected by climate change. A series of items aims to capture respondents' emotional engagement with and concern for climate change and sea level rise and tests their climate change-related knowledge. The questionnaire also includes value- and ideology-related scale measurements. A large part of the survey is then concerned with behavioural intentions and policy support for both mitigation and adaptation but also includes questions that aim to measure efficacy beliefs and responsibility attributions. Finally, various socio-demographic variables are surveyed. This chapter is mainly of exploratory nature and aims to address two main research questions: (1) Can pro-environmental theory be applied to explain adaptation and mitigation behaviour intentions and policy support? (2) What are the similarities and dissimilarities of adaptation and mitigation in terms of psychological predictor patterns?

Chapter 3 investigates whether climate change adaptation as a novel aspect of the wider climate change debate induces a shift in risk perceptions and consequently affects individual behaviour intentions and policy support, addressing some of the questions raised in chapter 2. To this end, an experimental study tests the effect of a series of frames, that is, particular ways of presenting and speaking of climate change on individuals' engagement with climate change. The four frames present climate change as either a local or a global issue and propose either mitigation or adaptation as the appropriate response strategy. Participants are randomly allocated to one of four groups and are presented with a fictitious newspaper article, via which the frames are operationalized. In addition to these differences in framing climate change, the study pays particular attention to how individuals who adhere to distinct ideologies, operationalized as political orientation, might perceive the frames

differently and thus react differently. The survey instrument built around these experimental conditions measures a series of variables, some of which are employed before and after participants have read the contrived article. Pre-post-measures include scales on climate change scepticism, environmental identity, concern for the effects of climate change and sea level rise, efficacy beliefs, emotional engagement with climate change and perceived distance of climate change. Participants' cultural orientation is measured and individuals are also asked to rate their political orientation, the measure that ultimately serves to split the sample into right- and left-leaning individuals. The survey includes policy support measures, which in addition to personal support also asks individuals to rate the efficacy of these measures. A simpler measure also ask respondents whether they would like more information on adaptation or mitigation. Socio-demographics and political preferences are also measured.

The study presented in chapter 3 builds on work on identity protective cognitions, in a cultural theory of risk research tradition. It investigates whether there is an effect that pertains to the local and more concrete nature of adaptation measures that helps increase the salience of climate change among liberals and conservatives, increasing overall engagement, with a potentially antipodal effect for liberal individuals who object addressing a global issue at the local level. Further, an additional effect of adaptation is tested. I hypothesize that adaptation resonates better with conservative values, providing a more ideology congruent narrative around solutions to climate change and thereby dismantling some of the conservative audiences' dismissive stance towards the issue of climate change as a whole. In essence, the principal research question this chapter addresses is: How do the spatial (local vs. global) and climate change measure (adaptation vs. mitigation) framing of climate change affect the engagement of right-leaning and left-leaning individuals?

Chapter 4 presents a study, which investigates whether personally experiencing flooding and the attribution of flooding to climate change, alongside other variables, are associated with mitigation and adaptation intentions. In addressing the question of the role personal experiences plays with regards to both mitigation and adaptation intentions it thus addresses an important shortcoming due to sample restrictions in the first two studies. The data investigated here represent a section from a larger project which collected a nationally representative sample to investigate the effect of personal experiences of flooding on climate change engagement in the aftermath of a series of flood events during the UK winter 2013/14.

The study incorporates a measure of personal flooding experience that is designed to assess the effect of personal experiences as well as possible using cross-sectional data. Whether individuals actually link the flooding to climate change is also surveyed in order to control for the essential role attribution beliefs play. The regression models further include variables that have also been included in chapters 2 and 3, such as environmental identity, psychological distance of climate change and climate change belief. Lastly, constructs directly related to experiencing flood are incorporated. These include measures like flood coping belief, perceived personal flood risk and the emotional consequences of the flooding events.

Multiple regression analysis is carried out for flood adaptation and mitigation intentions. For both adaptation and mitigation previous experiences of flooding have been linked to stronger intentions. Two competing hypotheses explaining this effect exist in literature. The experiential learning hypothesis suggests that experiences of what could be interpreted as climate change impacts heighten the salience of climate change in the personal memory of affected individuals and thus lead to higher risk perceptions. The motivated reasoning hypothesis instead reverses the direction of effect building on work

around cultural biases. It argues that individuals tend to process information in a way that confirms their a priori conclusions. Following this logic respondents have higher risk perceptions regarding climate change to start with and would thus pay more attention to climate change impacts, and consequently report these more frequently. This study seeks to answer the following two principle research questions: (1) Does the personal experience of flooding serve as a predictor of flood adaptation and mitigation intentions, and if yes, what is the sign of these effect? (2) Is this potential effect of personally experiencing flooding moderated by whether individuals attribute flooding to climate change or not?

Chapter 2 - Psychological Variables Associated with Behaviour Intentions and Policy Support for Adaptation and Mitigation

2.1 Introduction

This chapter presents a study of risk perceptions around climate change and sea-level rise and how these link to intentions to perform, and support for, adaptation and mitigation measures. The study links the two main issues presented in the previous introduction from an environmental psychology perspective: the issue of risk perception and the establishment of adaptation as an equally important climate change measure alongside mitigation. Linking these two aspects is achieved by relying on the rich environmental psychology literature of the past decades that has looked at psychological variables that are related to or determine pro-environmental behaviour. As has been shown in chapter 1.2.1 it will be essential to implement both adaptation and mitigation measures. The public's support, compliance and motivation are at the core of effectively executing these approaches. Thus, to understand how people perceive climate change and the various responses to it; what their attitudes and beliefs are; and to comprehend the mechanics of their decision processes, becomes central to efficiently promoting and implementing adaptation and mitigation measures. The social sciences and psychology in particular can do a great deal to progress our understanding of the complex mechanisms involved. The present study builds on environmental psychology studies of determinants of pro-environmental behaviour and climate-change risk perception literature.

Some studies that have investigated climate change relevant behaviour have done so by describing factors that impede climate change mitigation and adaptation efforts in individuals. Gifford (2011), for example, arranges these into seven categories, namely: limited cognition, ideologies, comparisons with others, sunk costs, distrust, perceived risks and limited behaviour. In the same vein Lorenzoni, Nicholson-Cole, and Whitmarsh (2007) have written about barriers perceived by the public to cognitively, affectively and behaviourally engage with climate change. They highlight multiple barriers operating at individual as well as societal levels, such as: lack of knowledge, uncertainty and scepticism, fatalism, lack of action by business and industry, lack of political action and social norms and expectations. Even a limited cross section of the available literature on climate change engagement like this, clearly illustrates the wealth of contributing factors and forms of engagement that have been discussed in relevant literature. Merging insights from literature on determinants of pro-environmental behaviour with existing scholarly work on risk perceptions the following section will elaborate on key factors and theoretical constructs that underlie the present research and conceptual framework. Broadly, the subsequently discussed variables fall into the three categories outlined by Lorenzoni, Nicholson-Cole, and Whitmarsh (2007): cognitive, affective and behavioural engagement with climate change.

2.1.1 Determinants of adaptation and mitigation intentions and behaviours

Fundamental to engagement with climate change is the perception of climate change as something that might affect the individual, or valued persons and objects in a negative way (Stern et al., 1999). Risk perception, as elaborated in the previous chapter, therefore is an essential aspect of peoples' motivation to act on climate change. Pidgeon, Hood, Hones, Turner, and Gibson (1992, p. 89) assert that "risk perception involves people's beliefs,

attitudes, judgements and feelings, as well as the wider social or cultural values and dispositions that people adopt towards hazards and their benefits". This definition covers a range of components of risk perception, from the rather cognitive and systematic assessment of risks to acknowledgements of sociocultural aspects, values and affective evaluation of risks. This broadly mirrors the theoretical development of risk perception as solely grounded in rule-based judgement, to today's more comprehensive understanding of risk perception as a result of complementary analytical and experiential processing in a sociocultural context (Epstein, 1994).

Cognitive engagement with climate change

Knowledge about climate change and its impacts can be understood as one of the most essential, albeit not sufficient, constituting components of concern and subsequently action. Studies in the past have looked at what people know about climate change and, despite the fact that climate change is a widely known and well-understood phenomenon, they found considerable misinformation among lay-people. Among the most common misconceptions were the idea of stratospheric ozone depletion as a main cause of climate change and lacking knowledge of CO_2 as a main contributor to climate change and its relation to the combustion of fossil fuels (Bord, O'Connor, & Fisher, 2000; Kempton, 1991; Lorenzoni et al., 2007). More recent studies have shown that there is higher awareness and understanding regarding climate change. Ozone depletion, for example, is only rarely mentioned as a cause of climate change and respondents are now more likely to list energy use as a major contributing factor. Some incorrect beliefs however still persist. Such as the important role CO_2 as a climate change cause and how CO_2 is linked to the combustion of fossil fuels (Reynolds, Bostrom, Read, & Morgan, 2010).

As a possible explanation for a situation where more scientific insights simultaneously increase ignorance Ungar (2000) discusses the *knowledge-*

ignorance paradox. He argues that this happens as a result of progressively specialized expert groups with decreasing common knowledge, information overload and increasing barriers, including speech barriers, which inhibit the appreciation for other knowledge domains. Studies have shown that knowledge about climate change is positively linked to concern, personal efficacy, belief in anthropogenic climate change and support for mitigation policies (Bord et al., 2000; Milfont, 2012; Stevenson, Peterson, Bondell, Moore, & Carrier, 2014; Tobler, Visschers, & Siegrist, 2012). These findings support the knowledge-deficit hypothesis, which assumes that awareness and concern, as preconditions of appropriate action are low because the public is uninformed. Consequently it proposes that the dissemination of appropriate information can amend this. In this vein Leary (2012) for example reports that various case studies on adaptation underline the need to increase and communicate knowledge. The knowledge-deficit hypothesis however has come under increasing criticism. For example, a comprehensive study on social psychological and structural determinants of climate change policy support found that climate change knowledge does not play the central and immediate role the knowledge-deficit hypothesis proposes (Dietz, Dan, & Shwom, 2007). Bord et al.'s findings (2000) further support this by showing that erroneous knowledge of climate change serves as a stronger predictor of belief in climate change than correct knowledge. Relevant literature suggests that the relationship between knowledge and other relevant variables is in fact not as evident as the knowledge-deficit hypothesis suggests and that knowledge itself is actually a function of certain variables, such as value and cultural orientations, which have a strong moderating effect on the way we assimilate and understand information (A Corner, Whitmarsh, & Xenias, 2012; Kahan et al., 2012; Kellstedt, Zahran, & Vedlitz, 2008; Malka, Krosnick, & Langer, 2009). While these studies often find the expected positive relationship in initial analyses, the

addition of moderating variables such as *party identification* and *trust in science* cancels or actually inverts this relationship and makes it stand true only for a particular subgroup of respondents.

One particular subgroup of individuals, which have attracted considerable research interest in this research domain, is a cohort of people that are to a greater or lesser extent not convinced of the existence of climate change or certain aspects of it – a group often referred to as climate change sceptics[11]. Research has found that the more sceptical individuals are regarding various aspects of climate change the less likely they are to positively engage with climate change, e.g. through supporting mitigation policies through personal mitigation intentions (Akter, Bennett, & Ward, 2012; Lorenzoni et al., 2007).

Rahmstorf (2004) distinguishes three types of sceptics: *attribution sceptics*, who doubt the human causation of climate change; *impact sceptics*, who doubt the negative effects climate change will have and *trend sceptics*, who question if climate change exists at all. The latter represents a rather extreme typology but still Leiserowitz and colleagues (2010a, 2010b) report figures of approximately a fifth of US-citizens who do not believe that climate change is happening. Similarly in the UK, a significant portion of the population expresses at least some level of uncertainty with regards to climate change (Whitmarsh, 2011). Poortinga et al. (2011) report that uncertainty and scepticism about the effects of climate change (impact sceptics) are fairly common for their UK sample, while trend- and attribution sceptics are far less widespread among the UK public.

Values

As elaborated in chapter 1.4 this diversity in beliefs and attitudes regarding climate change can be understood as functions of more deeply

[11] A more detailed discussion of climate change scepticism can be found in chapter 3.1.1

entrenched values - often also referred to as worldviews or ideologies - that constitute an integral part of how people understand and interpret risks. These variables inform attitudes towards certain issues and, in consequence, affect our motivation to exhibit a specific behaviour and other key variables, such as concern. In research on the fundamental determinants of environmentalism, variables such as post-materialistic values (Banerjee & Mckeage, 1994), altruistic, egoistic and biospheric values (Stern et al., 1993) and more abstract and common aspects of values (Schwartz, 1994) have been investigated (for a review see Dietz, Fitzgerald, & Shwom, 2005). The importance of values in the case of climate change becomes particularly evident in the US public debate on this issue. The climate change debate there has long become a question of politics with Republicans and Democrats increasingly divided over this subject (Dunlap & McCright, 2008). In the US political orientation has proven to be a stable predictor, with conservatives compared to their liberal counterparts being less likely to engage in pro-environmental behaviour (Dunlap, Van Liere, Mertig, & Jones, 2000) and more likely to exhibit climate change-scepticism (Jacques, Dunlap, & Freeman, 2008). In this context Leiserowitz (2003, 2005) paints the picture of the US-American sceptical "naysayer" that is mostly Republican and politically conservative.

Apart from these basic value- and ideology-structures, constructs specific to the issue of environmentalism have been developed. Among the most prominent is the New Environmental/Ecological Paradigm (NEP) and its measure of pro-environmental orientation, the NEP-scale (Dunlap et al., 2000; Dunlap & Vanliere, 1978). The NEP is centred on beliefs of limits to human growth, antianthropocentrism, the fragility of nature's balance, the rejection of human exemptionalism and the possibility of an ecocrisis. Research however has shown that the effect of the broader nature of these environmental values is often overridden by particular motivations and structural constraints and

frequently correlates only weakly with specific behavioural intentions (Stern, 2000). As less abstract measures of how much individuals subscribe to the general idea of environmentalism Whitmarsh and O'Neill (2010) apply the concept of self-identity to their research. In their study Whitmarsh and O'Neill (2010) investigate the intention to purchase carbon offsets and self-reported pro-environmental behaviour. Their measure of environmental identity proved to be the strongest predictor of a set of pro-environmental behaviours outperforming the longer and more complex NEP-scale, which failed to reach significance.

Affective engagement with climate change

Moving on from these supposedly more easily measurable components such as values and knowledge a discussion of correlates of climate change relevant behaviour has to arrive at the less frequently investigated but frequently discussed emotional and affective components. The unforeseeable and potentially emotive consequences of climate change have the ability to evoke a variety of emotions. Hulme (2008, p. 5) quite vividly describes a "climate of fear" that is determining our interaction with the phenomena of climate change. Lorenzoni et al. (2007) on the other hand reveal feelings of helplessness, distrust and lacking urgency in an analysis of qualitative data on public perceptions of climate change in the UK. O'Neill and Nicholson-Cole (2009) investigate individuals' conceptualizations of climate change and find that most participants describe feeling fearful, scared, distressed and depressed. In contrast, Weber (2006) argues that global warming for now does not dispose of the necessary concrete and immediate aspects to elicit strong visceral reactions such as fear or anxiety. She argues for design strategies to evoke these types of emotional reactions, while O'Neill and Nicholson-Cole (2009) sound a note of caution when using emotional messages and specify that nonthreatening communication relating to daily emotions and concerns is most effective. Roeser

(2012) argues for increased attention towards the role of emotions in effective communication on climate change. She states that emotions do not only determine our general understanding and risk perception of climate change, but they also inform our moral judgements and can therefore be an ideal channel to invoke ethical reflection. Preliminary support for the role of emotions in communicating aspects of climate change comes from the findings of Wong-Parodi, Dowlatabadi, McDaniels, and Ray (2011) who state that persuasive expert messages on carbon capture and sequestration are more efficient when put into an emotionally self-referent framework.

Based on the work presented in chapter 1.3.2 a considerable amount of research has looked at the function of emotions in climate change risk perception and risk communication. The role of these emotions, however, in determining climate change relevant behaviour and behavioural intentions has been less intensely investigated. This is particularly true for studies on mitigation- and adaptation-behaviour as most of research focuses on pro-environmental behaviour. Grob (1995), in early work on environmental attitudes and behaviour shows that emotions are among the most important predictors of pro-environmental behaviour, while other research specifies that this is only the case if the attitude-strength for the relative behaviour is weak (S. M. Smith, Haugtvedt, & Petty, 2006). More recent research similarly demonstrates that negative anticipated emotions are statistically significant predictors of the desire to engage in pro-environmental behaviour (Carrus, Passafaro, & Bonnes, 2008). Specifically investigating mitigation behaviour feelings of collective guilt have been shown to significantly correlate with willingness to engage in behaviours (Ferguson & Branscombe, 2010).

Even fewer studies have looked at the specific relationship of emotions and adaptation. Those that have are mostly concerned with flood adaptation behaviour. Harries (2012), for example, proposes that the uptake of flood

protective measures might not be as dependent on material, or monetary determinants, as it is on feelings of insecurity and anxiety. However, his findings only lend marginal support to this proposition. Weber (2006) specifically states that visceral (emotive) judgements of risk fuel self-protective behaviours and Siegrist and Gutscher (2008) claim that highlighting negative emotional consequences is likely to increase motivation for flood-mitigation behaviour. This is supported by findings that indicate that negative affect is not only integral to predicting adaptation but also mediates the differences in behavioural intentions and threat denial between flood-victims and non-victims (Zaalberg, Midden, Meijnders, & McCalley, 2009).

Overall this study's focus is not solely on climate change but also partly on sea-level rise. The reason for this is three-fold. (1) As has been shown in chapters 1.1.1 and 1.1.2, sea-level change is one of the major components of climate change and the associated impacts. It is thus important to allow for this component to be proportionally represented in this study of climate change perceptions. (2) Further, I wanted to confront participants with a more concrete instance of climate change highly relevant to the area of the Severn Estuary, where this study was conducted. (3) Finally, it also reflects the hypothesis that sea-level rise as a concrete instance of climate change will potentially be more strongly linked to engagement with climate change, but in particular the similarly more concrete and localized adaptation measures. Tentative support for this comes from research that was able to show that living in proximity of the coast positively affected climate change belief and support for mitigation policies. The authors argue that living by the coast helps make the effects of climate change become more concrete and local, that is, tangible climate change impacts such as sea level rise are of higher salience to coastal dwellers and thus help draw attention to the broader instance of climate change (Milfont, Evans, Sibley, Ries, & Cunningham, 2014). Following this reasoning I investigated

concern for the effects of, overall emotional response to and ascription of responsibility for, climate change, but also sea-level rise. Also the adaptation outcomes measures had a focus on preparations for impacts directly linked to rising sea levels, most notably flooding. Time restrictions however did not allow for a full representation of these two dimensions in all variables and so the efficacy belief scales and emotional engagement scale were measured for climate change only. Incorporating these measures for sea-level rise as well, would have led to a substantial increase in survey length and created a very repetitive and potentially disengaging survey instrument. Questions of specificity and abstraction, however, were further addressed by measuring efficacy beliefs and concern for the effects of climate change and sea-level rise on the individual but also the collective level.

2.1.2 Summary and research question

As the previous paragraphs have illustrated the intersection of risk perception literature and environmental psychology theories on pro-environmental behaviour offers a rich foundation to investigate public perceptions of climate change and sea-level rise and how they relate to intentions to perform and support for adaptation and mitigation measures. An investigation of the various psychological correlates for mitigation and adaptation seems expedient as the scholarly discourse on climate change highlights the necessity of employing both measures. The main research question this exploratory study seeks to answer is:

- Using a theoretical approach that combines scholarship from risk perception and environmental psychology research, what are the similarities and dissimilarities of adaptation and mitigation in terms of the associated theoretical constructs that can be highlighted?

2.2 Method

2.2.1 Participants

The ethical board of the School of Psychology, Cardiff University, approved the study. The online survey was conducted in England and Wales, focusing on the area of the Severn Estuary and the Inner Bristol Channel. Since this study also investigated concern for sea-level rise, I tried to ensure that participants resided within a sensible distance from the coast. I used ARC GIS, a Geographical Information System program, to draw a 12.5 miles[12] buffer zone around the Inner Bristol Channel outline. I then extracted all the postcodes that fell within this area. Subsequently those postcodes were passed on to the social research company Maximiles that handled the recruitment and remuneration process.

The final sample consisted of 288 participants and slightly more women (59%) than men. The sample was more or less evenly split between Welsh (53.8%) and English (44.8%) respondents. The sample was normally distributed across age groups, with the biggest group consisting of the 45 to 54 year old, making up nearly a quarter of the sample (24.7%). 17.6% indicated they had a university degree or that they were studying to obtain one, 31.1% that they had passed their A levels, 22.3% that they had vocational qualifications or similar, 8.1%. that they had earned GCSE and 20.8% that they had obtained no formal qualifications. 64.1% stated they had lived at the same address for more than 10 years and nearly two thirds (72.5%) indicated that they owned, or were buying their property with a mortgage/loan. 44,1% specified that they worked full time, 13.9% part time and 18.2% reported that they were in retirement. Only

[12] While 12.5 miles can be understood as a considerable distance it was set as low as possible, after consultation with Maximiles to achieve a sufficiently large sample size considering the reach of Maximiles and the regular response rate.

3.5% classified themselves as students. 26.7% of the respondents constituted the biggest income class, reporting that their total household income before tax and any other deductions ranged between £20.000 and £29.000.

2.2.2 Materials

Participants were asked to fill out an online survey, a link to which was send to them by the social research company. The median time it took participants to complete the survey was 18 minutes. The survey instrument contained a variety of items and scales that were intended to measure the three forms of engagement with climate change outlined above. The various constructs and the way they were operationalized are described in more detail below. The complete questionnaire and topline results can be found in Appendix 2.1.

Cognitive engagement with climate change

Knowledge about climate change

I intended to measure factual knowledge and thus implemented a shortened and adapted versions of three climate change knowledge scales by Tobler et al. (2012) designed to measure factual knowledge about the (1) causes of climate change, (2) the physics of climate change and (3) the expected impacts of climate change. To restrict the time necessary to fill out the questionnaire I chose to include only four items for each scale based on the magnitude of their scalability coefficients. An additional item on ocean acidification was added to the impacts-scale (Q23.1-5) for exploratory purposes and was retained as part of the scale. The physics-scale (Q22.5-8) and causes-scale (Q22.1-4) consist of 4 items each. Respondents are asked whether they believe statements to be true or false, but are also given the opportunity to indicate that they don't know the answer. The three scales include items such as "The ozone hole is the main cause of the greenhouse effect." (Causes, false); "Carbon dioxide (CO_2) is harmful to plants." (Physics, false) and "For the next

few decades, the majority of climate scientists expect an increase in extreme events, such as droughts, floods and storms." (Impacts, true).

Scepticism

The scepticism scale (Q1.1-6, $\alpha = .91$) is a condensed version of the scale used by Corner et al. (2012) and was constructed by isolating the six highest loading items of the original measure. It includes statements such as: "I am convinced that climate change is really happening" (reverse coded) and "The evidence for climate change is unreliable", for which participants than had to indicate their agreement on a 5-point scale (*strongly agree* to *strongly disagree*).

Values

Human Values Scale

Consistent with Stern's (2000) choice of a value measure by Schwartz and colleagues (1987; 1994) (see chapter 1.4), values were measured here with the *Human Values Scale* (Schwartz, 2003), which is a modification of the *Portrait Values Questionnaire* (PVQ) (Schwartz et al., 2001). This measure was chosen in preference to the scale originally used by Stern (2000) as it is considerably shorter while still allowing for a comparable measurement of human values as employed by Stern (2000). Further advantages of this scale include the fact that it was developed with the specific aim of transnational validity and that it addresses some of the problematic aspects of earlier scales by Schwartz and colleagues (Schwartz et al., 2001), such as their abstract nature.. The Human Values Scale includes 21 items presenting the participants with short portraits of various people. For example: "Being very successful is important to her/him." "She/He likes to impress other people." The respondents are then asked to indicate on a 6-point scale (*very much like me, like me, somewhat like me, a little like me, not like me, not like me at all*) how much they are like the described person. Conducting a factor analysis I was not able to reproduce the original scale structure that suggests 10 value types. Instead

an initial exploratory factor analysis (see Appendix 2.2.1) indicated a four-factor solution, essentially mirroring the two orthogonal dimension proposed to explain the integrated structure of all values: self-enhancement vs. self-transcendence and openness to change vs. conservatism. Universalism (Q8.8, 8.3, 8.19) and benevolence (Q8.12, 8.18) items loaded on the first factor. The scale accordingly was labelled *self-transcendence*, yielding a Cronbach alpha of .83. One security (Q8.14), one tradition (Q8.20) and two self-direction (Q8.1, 8.11) items also loaded on this factor but were excluded from further calculations as they were conceptually incongruous and also yielded low communalities and factor loadings. Based on the obtained factor solution I further calculated a *self-enhancement*-scale ($\alpha = .82$) composed of two power (Q8.13, 8.4) and two achievement (Q8.17, 8.2) items, a four-item *openness to change*-scale ($\alpha = .81$) consisting of hedonism (Q8.21, 8.10 items) and stimulation (Q8.15, 8.6) items and a 3-item *conservatism*-scale ($\alpha = .67$,) calculated from conformity (Q8.7, 8.16) and tradition (Q8.9) items.

Environmental Identity

In addition to this general measure of values I also captured *Environmental identity* (Whitmarsh & O'Neill, 2010). The environmental identity scale was chosen over the NEP-scale for the reasons outlined above. The included measures ask participants how much they agree with statements such as: "I think of myself as someone who is very concerned with environmental issues" on a 5-point scale (*strongly agree, tend to agree, neither agree nor disagree, tend to disagree, strongly disagree*). The final scale ($\alpha = .93$) consists of three items (Q9.1-3) previously used by Whitmarsh and O'Neill (Whitmarsh & O'Neill, 2010) but does not include one item (Q9.4) that yielded a markedly weak factor loading in an exploratory factor analysis (see Appendix 2.2.2).

Affective engagement with climate change

General Emotional Response and Emotional engagement

To assess participants' emotional response to climate change and sea-level rise, they were presented with two statements (Q3.3, 3.4): "On a purely emotional level, how do you personally feel about climate change/sea-level rise?" The questions are adopted from Poortinga et al. (2011) and answer options on a 5-point scale range from *very positive*, *fairly positive* to *neither positive nor negative*, *fairly negative* and *very negative*. Further I presented participants with a list of emotions (Q14.1-18). Participants had to indicate to what extent they feel the respective emotion when thinking about climate change using a 4-point scale (*great extent, somewhat, very little, not at all*). This array of emotions was mostly based on work by Boehm and Pfister (2005; 2003) on emotional reactions to environmental risks and had been supplemented with five positive emotions in order to generate a less negative measure. The final emotional engagement measure ($\alpha = .95$) included 14 emotions excluding four emotions (Q4.1, 4.3, 4.4, 4.7) that clearly loaded on a separate factor (see Appendix 2.2.3).

Climate change and sea level rise concern. I also asked individuals multiple concern questions which are adapted from work by Spence, Poortinga, and Pidgeon (2012). These items ask participants to rate their concern about climate change/sea-level rise overall and for effects of these phenomena on themselves, society in general and the world (Q5.1-3, Q6.1-3) The answer options on a 4-point scale range from *very concerned*, *fairly concerned*, *not very concerned* to *not at all concerned*.

Behavioural engagement with climate change

Behavioural engagement with climate change was operationalized as the outcome measures described below but equally through efficacy beliefs and ascription of responsibility as predictors. These latter two variables were

surveyed to allow for both of the constructs included in the ambiguous construct 'ascription of responsibility' in VBN to be investigated

Personal and collective efficacy

The present efficacy measures (Q14.1-6, Q15.1-6) stem from an international research effort on risk perception, understandings and responses to climate change (Reser et al., 2011). They have been integrated as the original version measuring individual efficacy beliefs as well as in an adapted version looking at collective efficacy beliefs. Respondents are asked to rate their agreement with statements such as: "I can personally help to reduce climate change by changing my behaviour", "Our society can make a difference with regard to climate change" and "It is our responsibility to help to do something about climate change" on a 5-point scale (*strongly agree* to *strongly disagree*)[13]. Following the exploratory factor solutions for these two sets of items (see Appendix 2.2.4-5) the final personal efficacy measure ($\alpha = .88$) included four items (Q14.1, 14.4-6) and three items (Q15.1, 15.4, 15.6) constituted the collective efficacy measure ($\alpha = .92$).

Ascription of responsibility

Just like the efficacy measures, the ascription of responsibility measure was adapted from work by Reser and colleagues (2011). Participants were instructed to indicate one group out of a list of seven social actors that they deem responsible for taking action against climate change and sea-level rise respectively. They were also presented with an open-ended answer category. A substantial number of respondents consistently made use of this free answer category indicating that everyone was responsible for taking action against climate change as well as sea-level rise. As a consequence an additional post hoc

[13] One item in this scale asked participants about responsibility to act and thus analogous to Stern seems to confound efficacy beliefs and ascription of responsibility. Factor analysis however indicated that these items constituted a stable factor with the other efficacy items.

answer category was created. The reported answer options thus include: *industry/companies*, *local authorities*, *environmental groups*, *individuals and their families*, *the European Union*, *national governments and agencies*, *the international community*, e*veryone and Don't know/Other*.

Outcome measures

Measures are based on scales used by Brügger, Morton and Dessai (2015)studying public support for mitigation and adaptation. The scale for adaptation intentions was modified to include items concerned with adaptation to rising sea levels and flood risk. As has been mentioned above this stronger focus on sea-level rise and flooding reflects the understanding that these impacts are an issue of high relevance to the area of the Severn Estuary and thus potentially represent the principal issues through which respondents relate to and engage with climate change.

The outcome measures were intended to constitute four scales: *adaptation intentions*, *mitigation intentions*, *support for adaptation policies* and *support for mitigation policies*. The questions on support for adaptation and mitigation policies ask individuals to indicate how they would vote in a national referendum for a range of proposals ranging from tax- and price-increases for household electricity (mitigation) and water consumption (adaptation), to subsidies for the household production of green energy (mitigation), and the creation of habitat corridors (adaptation). In the instructions the participants are reminded that each of these proposals might be associated with considerable costs and/or inconveniences. Answer options are provided on a 5-point scale (*definitely yes, probably yes, unsure, probably no, definitely no*).

The adaptation intentions scale includes items that ask participants how likely they are to take certain actions in the future to adapt to climate change. Proposed actions include measures such as buying flood insurance, reading about how to avoid heat stress and putting irreplaceable or valuable items on

high mounted shelves. The mitigation intentions scale analogously asks individuals how likely they are to perform certain activities in the future to combat climate change. Items cover mitigation measures such as installing more insulation at home, eating less meat and choosing a car that gets a good petrol/diesel mileage. For both of the intention scales respondents are asked to answer on a 5-point scale (*very likely, likely, neither, unlikely, very unlikely*), Additionally they are asked to indicate separately if they have already taken, or are currently taking such actions, while still referring to the main answer options to specify how likely they are to continue to do so.

Contrary to the intended four scales division exploratory factor analyses (see Appendix 2.2.6 to 2.2.10) of the outcome measures suggested a split into five scales. This mostly concerned the two policy support scales, which split into three scales. Factor analysis indicated that mitigation and adaptation policies such as price and tax increases form a separate factor, while the remaining policies formed part of the intended scales. This meant that analyses proceeded with the following five outcome measures: the *adaptation intentions* scale (α = .91) consisting of ten items (Q21.1-5, Q21.7-11), the *mitigation intentions* scale (α = .79) constituted by six items (Q19.3-5, Q19.8-10), seven items (Q20.2-3, Q20.7-9, Q20.12-13) that make up the *support for adaptation policies* scale (α = .85), the *support for mitigation policies* scale (α = .79) consisting of five items (Q18.9-11, Q19.12-13) and the *support for financial regulation* scale (α = .86) that integrated both mitigation and adaptation policies (Q18.1, Q18.3-4, Q18.8, Q20.5, Q20.10).

Socio-demographic and contextual variables included in this survey were: age, gender, whether respondents have children or grandchildren, working status, income, education, post code, number of European and transcontinental flights during the last year, duration of residence in the area, type of occupancy

of current accommodation, estimated distance from the coastline[14] and three items concerning previous flooding experience[15].

2.2.3 Procedure

The opening page of the online questionnaire provided general information regarding the survey, the responsible researchers and information that was necessary for informed consent. The questionnaire was only made accessible to participants who indicated that they gave consent to participate in the study by clicking the appropriate consent button. Scales were presented in a randomized fashion where applicable. After completing the questionnaire participants were fully debriefed and provided with contact details should they have any further questions or comments. Data collection started the second of 7th of June, 2013 and ended the 19th of June, 2013.

2.3 Results

2.3.1 Descriptive Results

Outcome measures

Percentages for policy support and behaviour intentions are displayed in Figures 2-6. As noted earlier the policy support measures did not yield the expected factor structure with adaptation policies and mitigation policies breaking up into adaptation and mitigation policies and financial regulation. This separation is very well reflected in the descriptive statistics for these

[14] The purpose of this measure was twofold. First, this measure was intended to check whether the goal to sample respondents that lived close by the shore had been sufficiently met. Also it was included in the subsequently reported regression models to investigate whether the perceived distance to the coastline had any relation to the outcome measures. I speculate that in particular for the adaptation measures lower perceived distance has a positive effect.

[15] Research has shown that previous experiences of flooding have an effect on climate change-relevant behavioural outcomes (Broomell et al., 2015; Spence et al., 2011). While the focus in this survey was not specifically on the effect of extreme weather events, the variables were included in the initial regression models to control for potential differences between respondents with regards to previous experiences of flood. Study 3 will specifically address the issue of previous flood experience and how it influences engagement with adaptation and mitigation.

measures. Financial regulation measures were consistently found to be the least favoured by respondents.

Starting with adaptation intentions ($M = 2.68$, SD $= .91$) the two most popular measures turned out to be *reading about how to avoid heat stress* (40.6% very likely/likely) and *putting irreplaceable or valuable items on high mounted shelves* (37.8% very likely/likely). Less popular were what could be described as more extensive adaptation measures, such as *buying flood insurance* (15.7% very likely/likely) and *using horizontal plaster board or lime-based plaster instead of gypsum* (15.7% very likely/likely).

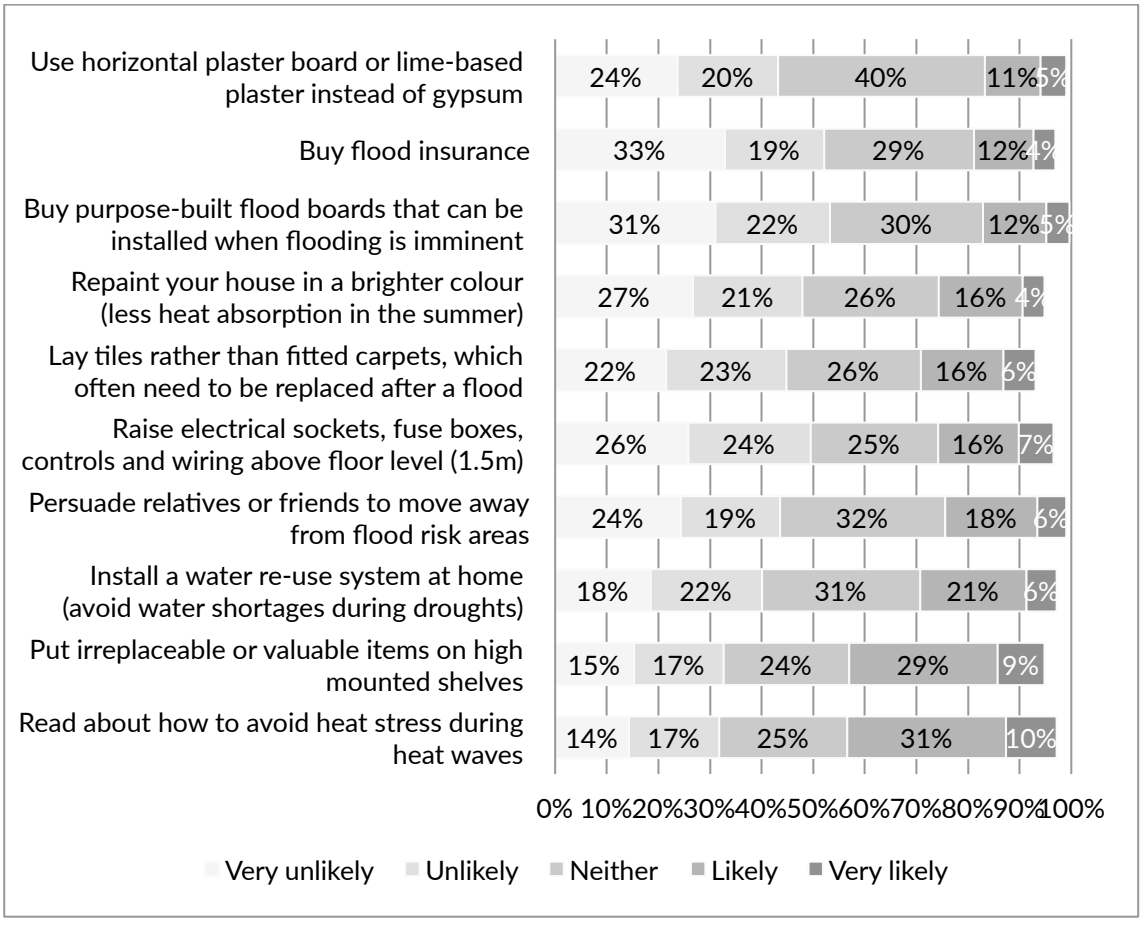

Figure 2. Frequency statistics for adaptation intentions. *Note*. "I have already done this" answer category is not included and so the displayed figures do not add up to 100%.

Frequency statistics for mitigation intentions (M = 3.16, SD = .91) saw *walking and cycling more often* (49.5% very likely/likely) and *reducing the number of new things one buys* (39.1% very likely/likely) at the top two places, while *car sharing* (30.7% very likely/likely) and *eating less meat* (26.1% very likely/likely) ranked lowest.

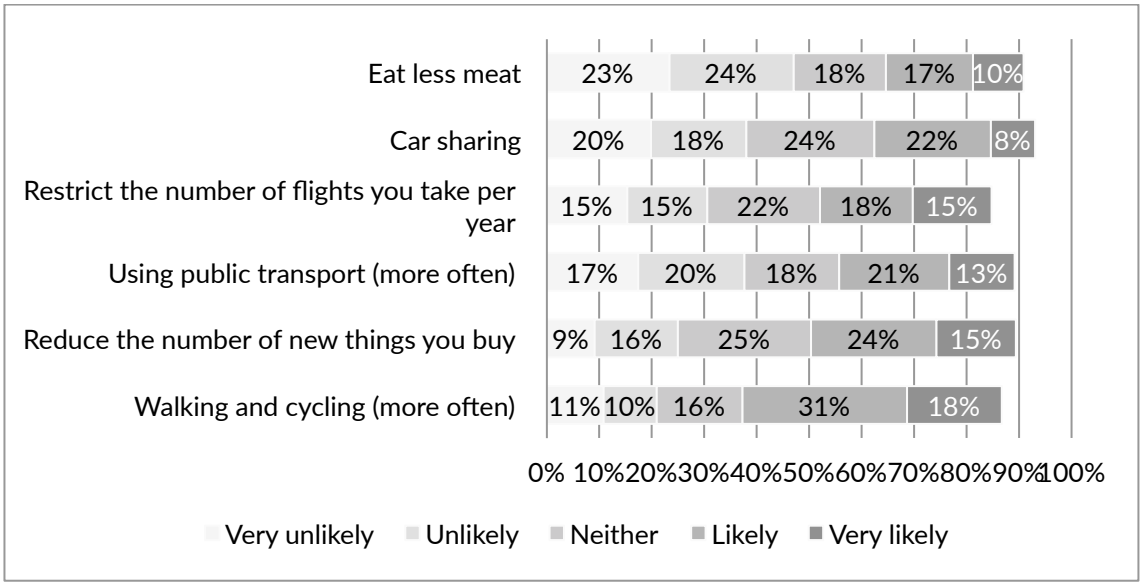

Figure 3. Frequency statistics for mitigation intentions. *Note.* "I have already done this" answer category is not included and so the displayed figures do not add up to 100%.

For adaptation policies (M = 3.88, SD = .91) the *improvement and better maintenance of existing flood defences* (84.0% yes/probably yes) and the *construction of new ones* (77.3% yes/probably yes) were most favoured, whereas more *funding for research and monitoring to better understand sea-level rise on the Severn Estuary* (63.9% yes/probably yes) and the *production and distribution of guidance on how to avoid heat stress* (51.7% yes/probably yes) were less favoured.

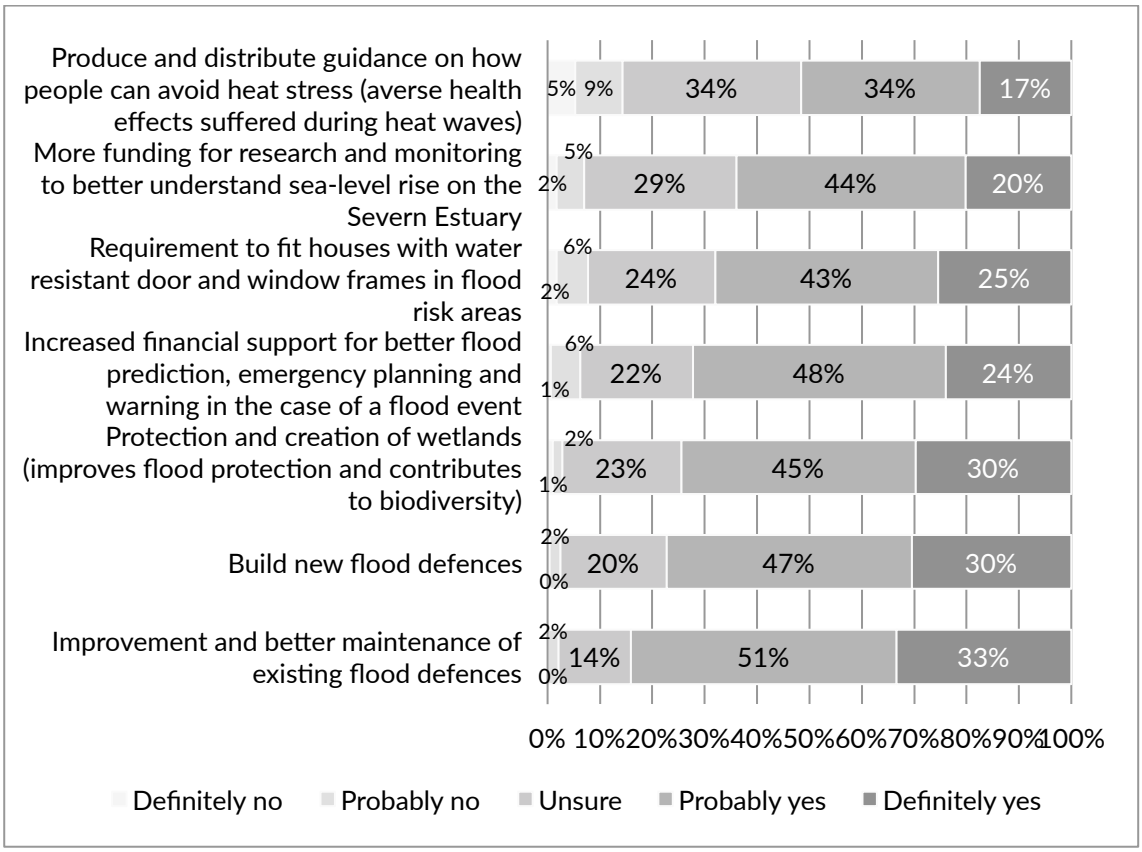

Figure 4. Frequency statistics for adaptation policies.

Mitigation policies ($M = 4.06$, SD $= .68$) were ranked as follows: *teaching children about the causes, consequences and potential solutions to climate change* (82.3% yes/probably yes) and *subsidies for house insulation* (82.3% yes/probably yes) ranked as the most supported and *more investments in safe cycling- and walking-routes* (74.9% yes/probably yes) and *subsidies for electric vehicles* (66.2% yes/probably yes) as the least supported out of the five proposed policies.

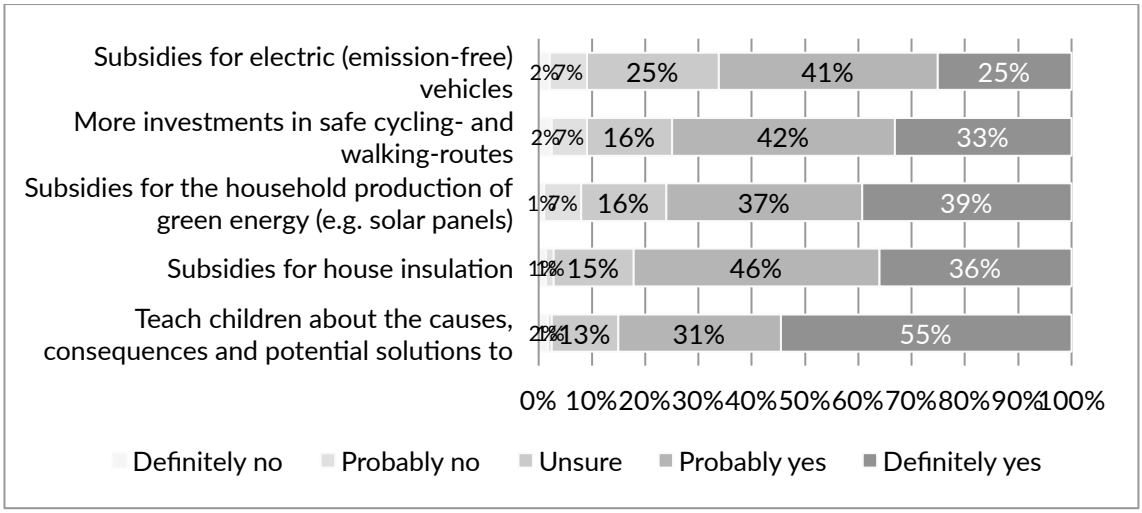

Figure 5. Frequency statistics for mitigation policies.

Financial regulation ($M = 2.34$, SD $= .85$) measures were overwhelmingly unpopular with the two most popular, *congestion charging for cars in all city areas* (31.7% yes/probably yes) and a *new tax to alleviate unavoidable climate impacts in the UK* (24.4% yes/probably yes), failing to reach the level of support for the least popular mitigation and adaptation policies. Most unpopular were policies that concerned the provision of everyday services such *increased prices for water consumption* (10.1% yes/probably yes) and *increased household electricity taxes* (6.6% yes/probably yes).

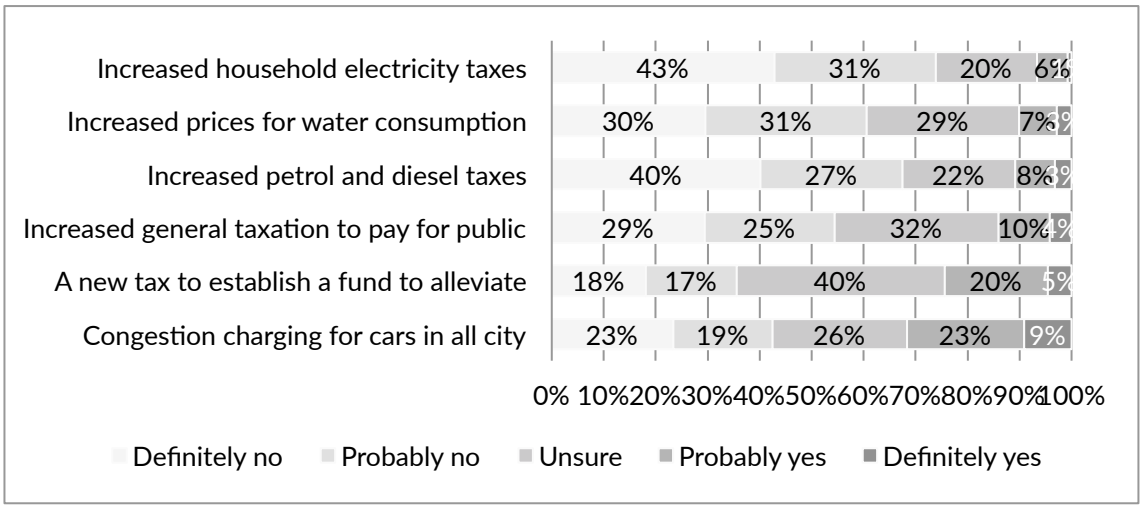

Figure 6. Frequency statistics for financial regulation.

Predictors

Scepticism

A certain amount of scepticism regarding the phenomenon of climate change was evident in this sample (M = 2.45, SD = 1.00). While only 16.9% agreed with the statement that they believed that climate change was not a real problem, a quarter of respondents (25.2%) indicated that they were uncertain about whether climate change is really happening. The scepticism statement on the unreliability of evidence for climate change had the highest percentage (31.5%) out of all the items affirmative of scepticism. These sceptic tendencies were counterbalanced by a majority of 69.1% who agreed that climate change was happening.

Climate change knowledge

The survey found that some substantial misconceptions of climate change still persist. For example, nearly half of participants (47.0%) thought that the ozone hole was the primary cause of climate change. Further results indicated that knowledge of the physics of climate change was lower (56.4% Don't know/Incorrect) than knowledge of the causes (49.3% Don't know/Incorrect) and impacts of climate change (43.3% Don't know/Incorrect).

Environmental identity

Respondents on average showed a positive environmental identity with an overall mean score for the environmental identity scale of 3.70 (SD = .95).

Values

Self-transcendence was rather high with a mean score of 4.51 (SD = .94) on a scale from one to six, where higher values indicated a stronger identification with the proposed value. *Self-Enhancement* on the other hand was least pronounced with a mean score (M = 2.93, SD = 1.06) just below the scale midpoint. *Openness to change* (M = 3.25, SD = 1.07) yielded a mean slightly

above the scale midpoint, while *Conservatism* ($M = 4.00$, $SD = 1.02$) was again more pronounced in this sample.

Emotional response to climate change and sea-level rise

The single item measures on the overall emotional response to the two phenomena yielded identical means ($M_{CC} = 2.67$, $SD_{CC} = .92$; $M_{SLR} = 2.67$, $SD_{SLR} = .91$) for climate change and sea-level rise, indicating that overall participants had a rather indifferent to marginally positive emotional response towards both.

Emotional engagement

Emotional engagement ($M = 2.27$, SD = .76) on average was slightly above the mid point of the four-point answer scale. Interest (18.5% to a great extent) was ranked first in terms of how many participants indicated that they felt it to a great extent, followed by sadness (18.2% to a great extent), worry (13.2% to a great extent) and fear (10.9% to a great extent). The least frequently listed in this respect were guilt (3.8% to a great extent), shame (5.2% to a great extent) and outrage (7.0% to a great extent).

Concern

85.4% of participants agree with the statement that climate change will affect plants and animal species, followed by the world (82.6% strongly agree/tend to agree) and developing countries (80.4% strongly agree/tend to agree). On the more proximal side only 59.6% of respondents agree with a statement that they themselves, or their family (65.4%) and local community (65.5%) will be affected. This pattern of low proximal and high distal ratings is also reflected in the various concern measures, which exhibit a consistent pattern of high distal concern and low proximal concern. Both for the effects of sea-level rise and climate change, levels of concern were highest for the world (73.0%/73.3% *concerned* for the effects of CC/SLR on the world) followed by society (64.7%/64.5% *concerned* for the effects of CC/SLR on society) and the

self (50.0%/47.7% *concerned* for the effects of CC/SLR on the self). The two broad concern measures for climate change and sea-level rise (65.9% and 64.4% *concerned* respectively) seemed to be anchored approximately at the same level as *concern for the effects on society*

Ascription of responsibility.

Responsibility [16] was predominantly associated with institutions. Approximately a third of all respondents for both climate change (31.3%) and sea-level rise (36.7) judged the responsibility to lie with national governments. A noticeable difference is that 18.9% ascribe responsibility to act on climate change to industries and companies as opposed to only 6.7% for sea-level rise but equally responsibility to act is perceived to lie more with the individual for climate change (10.3%) than for sea-level rise (2.1%). Around a fifth perceived the responsibility to act on climate change (17.4%) and sea-level rise (21.2%) to lie with the international community.

Efficacy beliefs

Efficacy beliefs were a little lower at the personal level (M = 3.24, SD = .90) than at the collective level (M = 3.82, SD = .89). A little more than half of the participants agreed that it was their responsibility to do something about climate change (57.0%) and that they could help by changing their behaviour (52.8%). Participants were less confident that they could make a difference though (36.5%) and two thirds of them did not feel a sense of urgency to change their behaviour (31.6%). For collective efficacy levels of agreement were consistently around the two thirds mark. 70.9% indicated that they think that it is our responsibility to do something about climate change, 70.4% agree that society can make a difference with regard to climate change and 69.0% believe

[16] Substantially unequal group sizes and the lack of possibilities to sensibly combine some of the answer categories meant that this variable could not be included in multiple regression analyses

that people in our society can personally help reduce climate change by changing their behaviour.

Adaptation and Mitigation

To investigate the relationship of adaptation and mitigation, first, a simple correlation analysis of all outcome measures was performed. As can be seen in Table 1 correlations between the outcome measures were mostly positive and significant. Essentially only support for financial regulation and support for adaptation policies did not correlate at all.

Table 1.
Correlation Matrix for outcome measures.

	Adaptation intentions	Mitigation intentions	Adaptation policies	Financial regulation	Mitigation policies
Adaptation intentions	1	,429**	,233**	,276**	,265**
Mitigation intentions	,429**	1	,228**	,345**	,357**
Adaptation policies	,233**	,228**	1	-0,034	,558**
Financial regulation	,276**	,345**	-0,034	1	,171**
Mitigation policies	,265**	,357**	,558**	,171**	1

Note. *(** p < .01; * p< .05)*

2.3.2 Multiple regression analysis

To investigate the relationship between the predictor variables and the outcome measures the data were analysed using multiple regression and using the *Enter* procedure. This section will present the results from the regression models for each one of the five outcome measures. These were chosen based on the theories and previous research outlined above. Socio-demographic variables were also entered to control for the influence of these. Predictor variables that did not yield significant regression weights in a first exploratory regression were

excluded from further calculations. For variables that I expected to measure similar constructs and/or correlate strongly – i.e. the various concern measures, knowledge measures and Self-transcendence & environmental identity – the one predictor that scored the highest regression weight was kept to run a second exploratory regression, even if it yielded a non-significant result initially. This procedure was chosen to account for the fact that related variables potentially split up explained variance among them resulting in non-significant contribution to the model, while the single strongest predictor by itself does yield a significant effect. Excluding related variables further decreases the likelihood of multicollinearity issues. If the single predictor without related variables included in this second stage failed to reach significance it was excluded from further calculations at this point. The final regression models, as presented here, were then run applying boot strapping with bias-corrected accelerated confidence intervals. For ease of comparison, standardized beta weights are reported together with significance values from the bootstrapping procedure. A correlation matrix for the significant predictors and the outcome variables in the five following regression models is attached in Appendix 2.3

Adaptation Intentions

As shown in Table 2 the multiple regression model for adaptation intentions explained 31.3% of variance. For this model the strongest predictor was *scepticism* ($\beta = .30$, $p < .01$) trailed by *concern for the effects of sea-level rise on oneself* ($\beta = .25$, $p < .01$), *emotion* ($\beta = .25$, $p < .01$), *environmental identity* ($\beta = .22$, $p = .004$) and *personal efficacy* ($\beta = .21$, $p = .024$). The result for scepticism is opposed to what I expected, in that the more sceptical a person is, the higher his/her intentions are to perform adaptation measures.

Table 2
Linear model of predictors of adaptation intention

Adaptation intention	B	SE B	β	adj. R^2	p ≤
Model 1				.313	.001
Constant	-.630 (-.976, -.285)	.175			.001
Scepticism	.296 (.148, .443)	.075	.297		.001
Concern for the effects of SLR on oneself	.258 (.123, .392)	.068	.252		.001
Emotional engagement	.239 (.090, .388)	.076	.248		.002
Environmental identity	.210 (.083, .338)	.065	.215		.001
Personal efficacy	.211 (.059, .364)	.077	.207		.007

Note. **95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples**

Mitigation Intentions

The results of the final regression model for mitigation intentions are displayed in Table 3. The model accounted for 36.5% of total variance. *Personal efficacy* ($\beta = .27$, $p = .001$) yields the highest standardized regression weight, followed by *emotional engagement* ($\beta = .21$, $p = .006$), climate change concern ($\beta = .20$, $p = .020$), *income* ($\beta = -.15$, $p = .008$) and *conservatism* ($\beta = -.13$, $p = .008$.).

Table 3
Linear model of predictors of mitigation intention

Mitigation intention	B	SE B	β	adj. R^2	p ≤
Model 1				.365	.001
Constant	-.325 (-.788, -.159)	.243			.193
Personal efficacy	.252 (.119, .374)	.065	.265		.001
Emotional engagement	.188 (.047, .329)	.070	.206		.006
Climate change concern	.200 (.039, .362)	.084	.195		.020

Income	-.072 (-125, -.021) .026	-.145	.008
Conservatism	-.137 (-.232, -.039) .050	-.131	.008

Note. **95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples**

Support for Adaptation Policies

Table 4 displays the results of the multiple regression for support for adaptation policies. The significant predictors ordered by size of their standardized regression weights are: *age* ($\beta = .32$, $p = .038$), *self-transcendence* ($\beta = .30$, $p = .001$), *concern for the effects of sea-level rise on oneself* ($\beta = .24$, $p = .001$), *estimated distance from coastline* ($\beta = .17$, $p = .005$) and *scepticism* ($\beta = .13$, $p = .029$). The regression model accounted for 30.7% of total variance.

Table 4
Linear model of predictors of adaptation policy support

Adaptation policies	B	SE B	β	adj. R^2	p ≤
Model 1				.307	.001
Constant	-1.96 (-2.60, -1.25)	.289			.001
Age	.204 (.125, .278)	.035	.322		.001
Self-transcendence	.311 (.199, .444)	.059	.300		.001
Concern for the effects of SLR on oneself	.231 (.115, .356)	.064	.235		.001
Estimated distance from the coastline	.152 (047, .245)	.050	.169		.005
Knowledge of CC causes	.422 (.049, .772)	.062	.131		.029

Note. **95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples**

Support for financial regulation

The regression model for financial regulation yielded the lowest percentage of explained variance from all the models with an adjusted R^2 value of .235 (23.5% of explained variance). As can be seen in Table 5 only three

predictors reached significance: *emotion* ($\beta = .32$, $p = .001$) followed by *general climate change concern* ($\beta = .26$, $p = .002$) and *self-transcendence* ($\beta = -.16$, $p = .010$). It is worth highlighting that the regression weight for self-transcendence is negative and thus opposed to what I expected.

Table 5
Linear model of predictors of financial regulation support

Financial regulation	B	SE B	β	adj. R^2	p ≤
Model 1				.235	.001
Constant	-.801 (-1.30, -.331)	.254			.002
Emotional engagement	.313 (.127, .487)	.088	.322		.001
General climate change concern	.287 (.102, .496)	.092	.264		.001
Self-transcendence	-.163 (-.271, -.042)	.064	-.158		.009

Note. **95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples**

Support for mitigation policies

Results for this final regression model are displayed in Table 6. The significant predictors of support for mitigation policies were: *scepticism* ($\beta = -.38$, $p = .001$), *self-transcendence* ($\beta = .23$, $p = .001$) and *knowledge about the causes of climate change* ($\beta = .16$, $p = .010$). This model explained 34.1% of variance.

Table 6
Linear model of predictors of mitigation policy support

Mitigation policies	B	SE B	β	adj. R^2	p ≤
Model 1				.341	.001
Constant	-.239 (-.465, -.019)	.107			.030
Scepticism	-.356 (-.466, -.247)	.058	-.380		.001
Self-transcendence	.224 (.117, .334)	.055	.228		.001

Knowledge of CC causes	.479 (.148, .837)	.183	.158	.010

Note. **95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples**

2.4 Discussion

This study investigated various variables and their association with intention to perform and support for adaptation and mitigation. As such it presents a novel look beyond the confines of pro-environmental behaviour or mitigation alone, at how these two climate change measures might relate or differ in terms of the variables they are associated with. Statistical analyses consisted of five regression models for each of the outcome measures: *adaptation intentions, mitigation intentions, support for adaptation policies, support for financial regulation and support for mitigation policies.*

The fact that the initial exploratory factor analysis of the outcome measures yielded a factor solution with an additional outcome measure, rather than the intended four outcome measures, represents an interesting result in itself already. The force that drove towards this additional outcome measure is a strong correlation between certain adaptation and mitigation policies that most probably has a basis in their common theme of financial regulation. In the eye of the public this characteristic apparently trumps any differences between adaptation and mitigation. Not only does this eliminate any effect that could arise from the difference between adaptation and mitigation but the same also seems to apply to inter-individual differences. The very low support across groups and the lowest explained variance suggest that this kind of measures more than others unites individuals in their disdain across otherwise divisive categories.

Starting with adaptation intentions, multiple regression yielded five significant predictors. Concern for the effect of sea level rise on oneself was a significant positive predictor of adaptation intentions. This indicates that

intentions to perform adaptation are born out of concern for one's own immediate safety more so than out of concern for the wider society or the world as a whole. How strongly participants felt as environmentalists and how strong their emotional engagement with climate change is constituted two other variables that were positively associated with adaptation intentions. It is notable that environmental identity did not yield a significant effect for any of the other outcome measures apart from adaptation intentions. Research that has investigated this variable so far would suggest that is a good predictor of pro-environmental action and as such should predict mitigation intentions best. Analogous to the effect on mitigation intentions, personal efficacy also had a significant effect on adaptation intentions.

A truly unexpected result was the fact that scepticism turned out to be the strongest, and more importantly, positive predictor of adaptation intentions. Contrary to intuition this result would suggest that the more individuals reported to be sceptical about climate change, the more they intended to prepare for it. A stepwise multiple regression (see Appendix 2.4) helped shed light on this unusual finding. Entering scepticism into the regression model first and subsequently entering the other significant predictors separately revealed a substantial suppressor effect. As is also visible in the correlation matrix in Appendix 2.3 scepticism initially significantly and negatively predicts adaptation intentions (β = -.23, $p < .01$) but this relationship turns positive and significant as the remaining predictors are added. This suppressor effect is mainly contributed to by emotional engagement and personal efficacy, indicating that the variance in adaptation intentions that scepticism should negatively predict is better explained by these two variables. Emotional engagement and personal efficacy are also significant predictors of mitigation intentions and significantly correlate with environmental identity. Based on these findings they thus represent what one would expect to separate engaged

from less engaged persons, at least in terms of mitigation. Scepticism is also strongly but negatively correlated with this triplet of variables but seems to possess another strong component that is independent of the primary climate change engagement aspect in predicting adaptation intentions.

This discussion can be further elucidated by referring to the cultural cognition framework and theory of motivated reasoning (Kahan, 2013). Building heavily on Douglas and Wildavsky´s work (1983) on ideologies this theory posits that individuals process information in order to maintain and, ideally, promote their standing in the social group they adhere to. Applying this reasoning, a climate change sceptical view could be interpreted as a consequence of a conflict between aspects of the contested issue with one's goals, social commitments and ideology. One such aspect of climate change could be mitigation measures via which, as McCright and Dunlap (2011) specify, climate change continuously challenges conservative domains of interest such as the industrial capitalist economic system or the fossil fuel industry. Scepticism – more than just a passive perception of an issue – thus can be conceptualized as an active effort to apprehend climate change in a way that helps resolve the conflict between identity, convictions and interests of a person on one side (e.g. economic growth at any cost), and identity-incongruent aspects of the wider climate change discourse on the other (e.g. measures to cut carbon emissions that also limit the traditional economic growth model). Adaptation in this survey was presented as part of the wider discussion around the climate change debate. Individuals' reactions to adaptation would thus be tainted by their overall attitude towards the wider issue of climate change. It is therefore not surprising to find that the initial correlation of scepticism and adaptation is negative. However, once the variance associated with the overall negative attitude towards any climate change related issue such as adaptation is explained by lower environmental engagement – as measured through lower

emotional engagement, personal efficacy and similar – the positive association between scepticism and the remaining variance suggests that there is something particular to adaptation actions that seems to be more appealing to sceptical than non-sceptical audiences. A potential explanation for this finding is the more locally relevant and concrete nature of adaptation measures. This could be of particular relevance to public engagement campaigns directed at audiences that oppose mitigation as a set of measures that conflicts with their ideology.

Mitigation intentions were best explained by personal efficacy. This finding indicates that whether an individual intends to perform an action is most strongly related to whether he or she feels that his or her actions will actually have an effect. The fact that both intention regression models included personal efficacy as a significant predictor underlines the importance of this variable. This finding is in line with previous literature (Tabernero & Hernandez, 2011). Again, analogous to adaptation intentions, the extent to which participants reported feeling certain emotions with regards to climate change also significantly predicts mitigation intentions. Contrasting the specific and egocentric focus of the concern measure that best predicted adaptation intentions, mitigation intentions were associated with the broadest general climate change concern measure. A noticeable finding, or lack thereof, is the absence of environmental identity from the list of significant predictors. In terms of value/identity, results indicate that the broader value dimension Conservatism best explains mitigation intentions. One could thus hypothesize that mitigation, more than just appealing to people with a strong environmental identity, has found its place in the wider societal debate as a behaviour that differentiates well between groups that subscribe to differing value sets. This could hint at increasing polarization between ideological camps similarly to what studies find in the US (Dunlap & McCright, 2008). Adaptation intentions instead were more strongly associated with environmental identity, which could

suggest that adaptation is not yet determined by broader value constructs, potentially due to its relatively novel role in the climate change discourse. Interestingly the more income respondents reported the lower their intentions were to engage in mitigation. This finding is in line with previous research that found higher income to be associated with lower climate change concern and risk perceptions (O'Connor, Bord, & Fisher, 1999; Semenza et al., 2008).

The regression model for support for adaptation policies yielded five significant predictors. An unexpected result was that as perceived distance from the coast increased so did support for adaptation policies. One would expect the individuals who live in proximity of the coast to be more supportive of adaptation policies such as flood defences due to the immediate relevance to them. Some insight regarding this finding can come from research on public risk perceptions of nuclear power plants which has consistently found that proximity to established facilities correlates with decreased perceived risk (e.g. Venables, Pidgeon, Parkhill, Henwood, & Simmons, 2012). Venables et al. (2012) summarize that the association between lower levels of perceived risk and proximity might be due to increased familiarity and cognitive coping efforts.

If reported distances are to be understood as moderately accurate, one could suggest that individuals' perceptions are affected by a form of self-protective optimism bias, which results in decreased support for measures that would seem unnecessary. Similarly people who live by the coast may have learned to live with the perils of the sea, developing a sense of mastery that minimizes their concern and reassures them in their belief that they can rely on themselves to handle adaptation issues. Of course this sense of mastery might as well be a cognitive coping effort to keep overwhelming feelings of helplessness and threat at bay. Another explanation for this finding is the idea that proximity to the coast can be one, but certainly is not the only factor relevant to some of the risk the proposed adaptation measures address. Fluvial flooding

for example might be more prevalent inland. Further, in some areas certain coastal characteristics might actually protect against some of the risks, conclusively explaining the inversion of the expected correlation. For future studies, a more detailed investigation of the various contextual factors and individual perceptions regarding respondents' exposure to risks with regards to their place of residence could help clarify this association.

Age was the strongest positive predictor of support for adaptation policies. Age is also significantly negatively correlated with perceived distance from the coast, indicating that older people live closer to the sea, thus making quite a few proposed policies more relevant and desirable to them (Stockdale, 2011; Zsamboky et al., 2011) . However, as the finding on perceived distance illustrated, proximity does not translate into more support for adaptation measures. Potentially it is only with increasing age that individuals rely more on others to solve frequently labour intensive issues regarding adaptation. Equally it could be the expression of a motivation to support structural measures that will benefit their descendants in the future, more than they will benefit them personally.

An altruistic interpretation like this, is certainly supported by the finding that self-transcendence is positively related to adaptation policy support. This comes as no surprise with items such as 'Increased financial support for better flood prediction, emergency planning and warning in the case of a flood event' and 'Creation of habitat corridors for animals (e.g. bridges over motorways)' suggesting actions geared at safeguarding the well-being of everyone, including nature, and thus very much in line with universalist and benevolent values.

Analogous to adaptation intentions concern for the effects of sea-level rise on oneself is significantly associated with support for adaptation policy support. Out of all concern measures both adaptation measures are thus most strongly associated with concern for the effects of sea-level rise on oneself. The specificity

of concern for the effects of sea-level rise then is most probably related to the outcome measures' focus on flood prevention, which is probably more readily associated with sea-level rise. More interesting is the strong egocentric component in people's support for and intention to perform adaptation measures. I would argue that this specificity of concern for the self is a consequence of two aspects: first, as variables such as self-transcendence and environmental identity are already in the model, related concern measures (concern for society/world) will find little variance left to be explained, paving the way for a significant contribution of concern for the self. Second, as alluded to earlier adaptation itself carries a strong individualist component as an approach that, much more than mitigation, is anchored in the here and now and is often associated with immediate benefits for the safety of the individual.

The regression model for support for financial regulation yielded the lowest amount of explained variance. It is thus safe to assume that support for financial regulation fits the least best into the conglomerate of variables studied here. General climate change concern was associated with support for financial regulation, as one would expect to find based on existing literature. A noticeable finding however was the negative regression weight found for self-transcendence. Literature would suggest that people high in Self-transcendence are usually more favourable towards mitigation, or environmental protection measures more generally (Adam Corner, Markowitz, & Pidgeon, 2014). Again a stepwise regression for the three significant predictors entering Self-transcendence first into the model showed that Self-transcendence does in fact yield a non-significant positive beta weight first ($\beta = .10$, $p = .11$), pointing again to a suppressor effect that turns the contribution of Self-transcendence from a marginally positive into a significant negative one, indicating that support for financial regulation is actually lower among individuals high in self-transcendence. One could speculate that this might be a consequence of the

particular nature of these measures that opposes self-transcendence values, once the generally positive attitude towards climate change issues is accounted for by the other variables in the model. Such values on the other end of Schwartz's value continuum would be power and achievement (Schwartz, 1994). How these values relate to financial regulation measures is not clear and warrants further research. Emotional engagement was the strongest predictor of support for financial regulation. This association and the fact that it also significantly predicts mitigation and adaptation intentions markedly distinguishes emotional engagement from less influential variables such as the knowledge of the causes of climate change variable. Emotional engagement appears as a consistent predictor of outcome variables that are testament to a more committed engagement with climate change.

The regression model for support for mitigation policies yielded 34.1% of explained variance with only three significant predictors, namely: scepticism, Self-transcendence and knowledge about the causes of climate change. The fact that it was only three predictors that explained a third of the variance further underlines the performance of this regression model. Knowledge of climate change causes was also positively associated with support for adaptation policies. It is tempting to assume that individuals who are more knowledgeable about climate change also see the necessity to adapt more clearly and thus support this kind of measures more strongly. The same applies for mitigation intentions and the significant contribution knowledge of climate change causes exhibits for the corresponding regression model. The fact that knowledge of the causes of climate change only reaches significance for these two predictors makes this type of interpretation questionable. If knowledge of the causes of climate change was really indicative of greater conviction regarding the necessity of addressing climate change then one would logically expect an

equally strong, if not stronger, association with the other outcome measures investigated here.

An alternative explanation could be that the climate change knowledge scale measures that were used here are popularly associated with low commitment climate change engagement as measured by the two policy support scales. This reasoning is directly related to the good performance in terms of explained variance of the regression model for support for mitigation policies. The limited number of predictors necessary to explain more than a third of the variance of support for mitigation policies suggests that this latter policy support measure is rather simplistic in terms of the psychological constructs it is associated with. I hypothesize that this form of support can be understood as prototypical of low-commitment climate change engagement. A prevalent form of support for action on climate change conditional on very low or no cost of the proposed measures. Results in support of this argument have found that pro-environmental actions are more likely to be associated with environmental values, than are actions that require some sort of sacrifice, which prove to be more reliant on contextual and situational variables (Gatersleben, Steg, & Vlek, 2002; Whitmarsh, 2009).

This research carried shortcomings. The collected sample constitutes a convenience sample and it thus unsure whether these results will be equally applicable to the general population. Further aspects that limit the applicability of the results presented here to the general population exist. The adaptation measures' focus on flooding must be acknowledged and it is unclear if the results generated here for adaptation are applicable to adaptation measures that have a stronger focus on other impacts such as heat stress. The importance of concern for the effect of sea level rise on the self are most probably borne out of this particular focus of the adaptation measures. I would expect, however, that

the strong egocentric component this particular finding demonstrates applies to most of the adaptation measures, regardless of the impact they focus on.

Another potential critique of this study concerns the emotional engagement measure. It is questionable whether the scale used here to measure emotions, measures emotions as they occur in the moment. It is in fact questionable whether a survey measure can actually capture the instantaneous character of emotions. For surveys at this scale however physiological measures of emotion and arousal, such as heart rate and skin conductance levels are extremely laborious to administer and essentially infeasible. Still, and pointing again to the essentially exploratory function of this study, valuable insight was gained concerning the importance of emotion and future research, where possible, should seek to employ alternative measures of affect.

2.5 Conclusion

This research investigated psychological variables related to intentions to perform, and support for, adaptation and mitigation measures. The spread in explained variance for the various outcomes measures is certainly to a large extent due to what could be critically reviewed as an effort to create a universal model for very varied constructs. This naturally comes with a less than perfect fit for at least some of the outcome measures. The aim of this research however was a broad exploratory investigation of similarities and dissimilarities in predictor patterns of intention to perform and support for adaptation and mitigation measures. Intriguingly in terms of public acceptance and explained variance the two most distinctive outcome measures did not reproduce a mitigation-adaptation dichotomy. Models for adaptation and mitigation instead performed comparably well in terms of explained variance. In the same vein simple correlations between adaptation and mitigation outcomes measures were all positive and significant, suggesting that in the public's opinion there is not trade-off between adaptation and mitigation.

Parallels also showed in terms of predictor patterns, as personal efficacy and emotional engagement were significantly associated with both intention measures. Initiatives to engage the public for both adaptation and mitigation would thus be well advised to consider that individuals who intend to mitigate and adapt, think that they can do so and are also emotionally engaged by climate change.

Some characteristic differences between adaptation and mitigation do exist however. The picture that presented itself would suggest that adaptation has not been fully engrossed yet by what appears to be the dominant narrative on climate change. This has important implications for communicating the risks of climate change. As Evans, Milfont, and Lawrence (2014) note, adaptation could serve as a tool to engage individuals who have been previously unengaged by, or even dismissive of climate change. The finding that adaptation intentions and climate change scepticism are positively associated needs to be replicated but it hints at an aspect of adaptation measures that does in fact offer a less biased access point for people's engagement with climate change, in particular for previously disengaged audiences such as climate change sceptics.

A distinguishing feature of the predictor patterns found for both adaptation outcome measures is the consistent role concern for the effects of sea-level rise on oneself assumes. Adaptation in comparison to mitigation thus seems to be more strongly linked to egocentric concerns. This connects again to the different appeal that might characterize adaptation as an alternative to the predominantly altruistic nature of mitigation.

A last finding to highlight is that emotional engagement was among the three strongest predictors for three of the outcome measures. Adaptation intentions, mitigation intentions but also support for financial regulation. In terms of costs, behavioural as much as economical, this triplet of outcome measures certainly asks a relatively high commitment of respondents. Emotional

engagement can thus be understood as a stable predictor of committed engagement with climate change. Going into more detail emotional engagement was the strongest predictor of support for financial regulation, an outcome measure that was least well explained by the variables examined here and arguably most obviously linked to costs for the individual. For the other policy support scales emotional engagement was strikingly absent, which raises the question what these scales measure. One could speculate that, rather than committed engagement with climate change, these scales survey a lip service to what are perceived to be social standards and norms rooted in ideologies and belonging to a particular peer group. Consequently the significant predictors of these measures would have to be considered equally superficial as the outcome measures, suggesting that they would perform poorly in explaining actual behaviour and support for measures that involve costs for the individual. This underlines the importance of considering affective components such as emotional engagement as they could serve an important role as stable predictors of committed engagement with climate change across adaptation, mitigation and financial regulation measures.

Chapter 3 - Adaptation as a New Gateway to Engagement with Climate Change

3.1 Introduction

The first study presented in this thesis looked at how various psychological constructs relate to intention to perform and support for adaptation and mitigation measures. One of the findings indicated that a typically dismissive stance towards climate change, climate change scepticism, was positively associated with intentions to perform climate change adaptation measures. This surprising result can be interpreted as suggesting that there is something about adaptation measures that might appeal to a sceptic audience.

While there are certain audiences that are particularly unengaged, or outright dismissive, such as climate change sceptics, various authors (Myers, Maibach, Roser-Renouf, Akerlof, & Leiserowitz, 2013; Weber, 2006, 2010) propose that certain qualities of climate change generally make it difficult for people to relate to it. Central to their argument is that climate change, with its inherent inertia, gradual changes and its overall low signal-value, makes it difficult for people to gain personal experience and climate change thus has to be understood mostly through abstract analytical thought. This clearly resonates with the distinction between *analytic processing* and *experiential learning* (Kahneman, 2003; Stanovich & West, 2000).

Climate scientists' perceptions of climate change for example, can be understood as being largely based on analytic processing. Scientists, however, dispose of the necessary knowledge, tools, and attention resources to deal with climate change evidence that is of statistical nature mostly. For lay people on the other hand, analytic processing of climate change means dealing with

information that they are not familiar with and that, in most cases, exceeds their abilities, knowledge and experience to properly process. This has been particularly visible in studies showing that even highly educated individuals still perform very poorly at understanding and applying the most basic climate change knowledge (Sterman & Sweeney, 2002, 2007; Sterman, 2008). Since climate change mostly lacks the qualities for experiential learning, individuals are faced with information they struggle to process, on a phenomenon that does not lend itself to the type of processing they can easily engage in. To make things worse any information they are provided with, then stands in constant competition with other contents, as the cognitive effort required for analytic processing represents "a scarce commodity, which people expend sparingly" (Myers et al., 2013, p. 343).

It would, however, be overly simplifying to reduce this discussion to a question of certain aspects of climate change, that seem to favour this type of apprehension and processing. Moser (2014) coins the term *distancing* to discuss the consistent and somewhat incongruous results showing that, contrary to widespread climate change awareness and reports of personal experience of climate change impacts, studies simultaneously find that people continue to describe climate change as something that is distant from them. This notion of *distancing* as an active process accredits the individual a less passive role in perceptions which have been summarized as the psychological distance of climate change (Lorenzoni & Pidgeon, 2006; Pidgeon, 2012; Spence et al., 2012). In this light, analogous to the discussion of scepticism in chapter 1.4, one would have to ask if there is a self-serving purpose to this kind of perception.

3.1.1 Climate change perceptions as a function of coping strategies

I propose that a well-established theory can help guide a discussion of the origin and function of certain types of engagement with climate change. As has

been noted elsewhere, the phenomenon of scepticism, for example, lends itself very aptly to the mechanisms outlined in Lazarus' (1991) cognitive theory of stress/appraisal theory (Crompton & Kasser, 2009; Lorenzoni et al., 2007). This theory conceives of stress as a transaction in which a potential *threat* and *personal resources* are confronted via a series of cognitive operations, so-called appraisal processes. The process that could lead to scepticism in appraisal theory must start with an initial assertion, a so-called *primary appraisal*, of climate change as a threat. Intriguingly this parallels an essential assumption in Value Belief Norm theory (Stern, 2000). Stern and colleagues (Stern et al., 1999; Stern, 2000) similarly argue that the precondition of any pro-environmental action is a state of worry. That is, a person must be aware of negative consequences for a valued object. In both theories a person would thus consider the potentially negative effects climate change might have on oneself, family, friends and/or other valued objects such as one's house, nature, or a particular animal species for example. It is clear that the outcome of this primary appraisal process thus depends heavily on what a person defines as a 'valued object' which in both theoretical approaches is based on a person's individual set of values and beliefs that he or she subscribes to (Folkman, 1984; Stern, 2000).

Following the primary appraisal of a stimulus as a threat, *secondary appraisals* are induced. This type of cognitive operations investigates possible ways to engage the threatening entity, so-called coping mechanisms. The individual can then mitigate a threatening stimulus applying problem-focused and/or cognitive coping strategies. Problem-focused coping strategies describe actions that are directed at a threatening stimulus to ameliorate the outcome for the individual. A person could for example determine that climate change is something he/she can tackle as an individual, applying problem-focused coping strategies, such as mitigation and adaptation efforts. Another person conversely

could find the problem-focused coping strategies at his/her disposal to be insufficient or inapplicable and therefore resort to cognitive coping strategies. This type of mechanism, rather than engaging the threat directly, aims to change the way the threat is perceived, or how it is understood, as to minimize the negative emotional outcome. It is important to note that Lazarus and colleagues (Folkman, 1984; Lazarus, 1991) have pointed out that it is in fact hard to separate cognitive coping and appraisal processes since they are in essence constituted by the same cognitive operations. This is reflected by early references to reappraisal, a third form of coping that Lazarus and Folkman (1984) initially introduced as a more comprehensive re-evaluation of the threat, rather than just adjusting the emotional reaction to a threat, a strategy that was originally called emotional coping.

The following paragraphs focus on cognitive coping, defining it as the sum of cognitive operations, conscious and subconscious, that help conceive a stimulus in a manner that creates a more favourable outcome for the person. The rationale applied here is that any engagement with climate change thus becomes a product of (1) objective features – that might as well favour one or the other outcome – and (2) the various cognitive coping operations through which these are manipulated. I propose that one of the most easily identifiable – in absence of factual information favouring such a view – and most widespread results of such a process is in fact climate change scepticism. Appraisal theory would suggest that the growing threat of climate change will trigger more and more efforts to keep this threat at bay, which helps explain the paradoxical finding that the increasing reality of anthropogenic climate change seems to simultaneously increase disbelief. With regards to climate change a variety of cognitive coping options could be described by referring to Rahmstorf's (Rahmstorf, 2004) taxonomy of sceptics. Attribution sceptics for example resort to the conviction they have no involvement in the creation of climate change

and thus cannot do anything about it even if they wanted to[17]. Impact sceptics on the other hand turn their blind eye on climate impacts thereby legitimizing inaction and trend sceptics are probably what one could describe as closest to the idea of complete denial, disavowing that there is a problem at all. While climate change scepticism might constitute an overly obvious result of unambiguous facts being distorted, it is important to point out that, as the above-mentioned concept of distancing alludes to, less distinctive outcomes could exist. The same processes could also stand behind more distant perceptions of climate change than it would actually merit. Temporal, social and spatial distance and also uncertainty, all reduce urgency, immediacy, the need to act and thereby allow the individual to shift his/her attention to potentially more pleasant things in life, without having to feel anxious about it.

These hypothesized forms of cognitive coping differ in relation to what aspect of climate change they affect. From a cognitive theory of stress perspective however, they all serve the same purpose of relieving the individual from psychological distress by providing less threat-inducing appraisals. Very few studies have looked at environmental issues, let alone climate change, in line with a cognitive theory of stress (Higginbotham, Connor, & Baker, 2014; Homburg & Stolberg, 2006). Their common theme is that they explain mitigation and adaptation behaviours as a consequence of primary threat appraisals of environmental issues, or climate change respectively. In applying this theory these studies (Higginbotham et al., 2014; Homburg & Stolberg, 2006; Iwata, 2002) have exclusively looked at actual behaviour as a form of problem-focused coping without considering cognitive coping as a potential outcome.

[17] This relates to the above-mentioned overlap between what is often referred to as efficacy beliefs but could be understood as the result of a cognitive coping effort. Low efficacy beliefs equally could be exploited to suggest to the self that one's inaction is in fact a simple consequence of lacking ability and/or opportunity, sparing oneself from the inconvenient and threatening admission that actions need to be taken.

Applying the concept of cognitive coping to the formation of climate change scepticism and the wider perceptions, beliefs and attitudes around it, hinges on two central assumptions: first, climate change is perceived as a threat. Second, this threat is furthermore perceived as exceeding the individual's problem focused coping strategies, inducing cognitive coping strategies. I argue that the crux of the applicability of a cognitive theory of stress approach to climate change scepticism in fact lies mostly with the first assumption, that climate change is judged to be threatening. Arguably, climate change does in fact represent a considerable threat to societies and the individual. Threats, that in their magnitude and comprehensiveness are very likely to exceed an individual's problem focused coping strategies and as such should trigger cognitive coping. It is however doubtful if the idea of climate change as an immediate threat holds true for most of human interaction with it, as the above discussion on the psychological distance of climate change and its low signal value underlines.

3.1.2 The other threat of climate change

The assertion that climate change does not represent a tangible threat for a majority of the population raises the question of what actually triggers coping effort then. It seems plausible that climate change does in fact offer another kind of threat. The opportunity to experience a "strong negative affect associated with the concrete, immediate costs and sacrifices" of climate change actions contrasted by an "absence of feelings of worry about possible abstract and distant consequences of global warming" (Weber, 2006, p. 110). This type of threat has been discussed in work around cultural cognitions (Kahan, Braman, Gastil, Slovic, & Mertz, 2007), proposing that conservative white males assimilate or ignore information so as to not conflict with their favoured form of societal organization. Building on this work and investigating the reluctant engagement of conservative audiences with climate change, McCright and

Dunlap (2011) specify that the climate change discourse, by means of ascribing responsibilities to humans and more importantly through proposed countermeasures, challenges conservative domains of interest such as the fossil fuel industry. In essence this work suggests that the threat of climate change is constituted by a misalignment between the identity, convictions and interests of a person on one side, and measures proposed to address climate change (i.e. mitigation measures) on the other. Applying the terminology of appraisal theory, affected publics then could respond to this with cognitive coping.

If these dismissive and distant perceptions are at least to some extent due to the proposed solution to the issue, then policy makers and communicators face a demanding task in trying to motivate these unengaged publics to participate in a constructive way. A challenge that is to some extent addressed by Corner (2013) who proposes five narratives to better engage conservative audiences, who are known to be less engaged by climate change. (1) He recommends highlighting the *localism* aspect of climate change and a sense of responsibility to fellow citizens and future generations. The assertion that action on climate change does not need international involvement but instead starts at home further underpins the core message of local obligations and actions. (2) Messages should also focus on *energy security*. This narrative proposes a shift towards renewable energies to secure abundant, safe and economically viable energy sources. It is described as a prerequisite for securing long-term jobs and opportunities for British citizens and as a way of increasing resilience to future energy shortages. (3) The third narrative frames climate change as an opportunity for a *green economy* and *new environmentalism*. The messages that this should convey are those of a second industrial revolution in harmony with nature and the establishment of a green economy, investing and innovating for a better society. Entrepreneurs and business leaders are also called upon to take on the challenge of climate change off liberals to ensure the

transition to a low-carbon future as they envision it. (5) Central to the last set of messages is the idea of *good life,* as it highlights the importance of mitigating threats posed by climate change to the health and overall quality of life of communities. These messages highlight the threats that climate change poses to the health and overall quality of life of communities; in particular threats to the young and elderly through climate impacts, such as increased flooding, are accentuated. In a similar vein Bain, Hornsey, Bongiorno, and Jeffries (2012) suggest that climate change communication aimed at promoting pro-environmental behaviour in climate change deniers should accentuate how mitigation efforts advance progress in science and economy, while at the same time making us more caring and considerate people. In essence these approaches try to highlight aspects of climate change, and more importantly the measures proposed in response to it, in a way that potentially resonates with conservative core values.

There is, however, only so much carefully designed messages can do to portray certain mitigation measures, which are essentially opposed to conservative values, in a fashion that will resonate with them. Furthermore it is important to note that, as Moser (2014, p. 340) argues, any message will be embedded in a "discursive context that is coloured by the historical legacies of communicating climate change science and mitigation". The historical legacies of the climate change debate are clearly dominated by mitigation. This one-sidedness has made climate change "become suffused with antagonistic meanings, generating conflict that persists even in the face of ample and widely distributed scientific evidence" (Braman, Kahan, Jenkins-Smith, Tarantola, & Silva, 2012, p. 21). One could thus argue that it is the historical focus on mitigation measures, which has led to the current polarization between publics of different political and/or ideological orientations (Dunlap & McCright, 2008). A situation, where in some contexts the mere mentioning of climate change

seems to clearly indicate to individuals where to take up position within the deeply polarized playing field of the climate change debate.

So if mitigation measures to address climate change form a large part of the problem, then it follows that an alternative set of measures, such as adaptation measures, might provide a more favourable starting ground in trying to reduce sceptical responses. This hypothesis finds initial support in research, which has shown that climate change adaptation can actually serve as a catalyst for increased mitigation efforts. Adams et al. (2011) showed that respondents who had participated in public forums on adaptation planning showed more interest in climate mitigation than non-participants. The authors speculate that this effect could be mediated by concern for local impacts, which was found to be higher among the former group. While this research did not investigate how sceptical publics specifically reacted to that framing, it does suggest that the above-mentioned localism narrative seems to be activated to some extent by considering climate change adaptation.

A similar qualitative study (Furth & Gantwerk, 2013) found that citizen dialogues discussing sea-level rise in terms of impacts and preparations led to a strong agreement among participants regarding the necessity of adaptation policies among liberal and conservative participants. Further, the discussions also quickly moved from adaptation to mitigation measures, a tendency that was also reflected in the highest overall popularity of one out of four proposed scenarios that promoted preparing for sea level rise (adaptation) but also addressing its root causes (mitigation). While levels of scepticism did not change before and after the discourse there was consistent support for mitigation measures even among those participants that thought that climate change had not been proven yet. This latter finding is a strong indication for a mechanism that is triggered by an adaptation framing that, much more than just ameliorating the negative attitude towards climate change, actually

increases mitigation efforts, even among sceptical audiences. An effect that was tested in an experimental study by Evans, Milfont, and Lawrence (2014). The authors confirmed that persons who had previously considered local adaptation reported higher willingness to perform mitigation actions; an effect that was found for sceptics, as well as non-sceptical respondents. Further, a study that similarly looked at the effect of reading a newspaper article that focuses on adaptation, also found some tentative support for an engaging effect of adaptation but, more importantly, pointed to the importance of considering political orientation as moderating variable (Carrico, Truelove, Vandenbergh, & Dana, 2015).

Evidence for this type of mechanism also comes from research into public perceptions of geo-engineering. In an experimental study (Braman et al., 2012) participants who had read a news article demanding more investments in geoengineering, as opposed to one that talked about further lowering the current atmospheric CO_2 ceiling, exhibited less polarization between hierarchical individualists and egalitarian communitarians. Additionally this study found an overall increase in perceived climate change risk for the geoengineering condition when compared to the control condition. A preliminary investigation into public perceptions and attitudes towards geoengineering embedded within 2009 Royal Society report on this emerging climate change response strategy (Shepherd, 2009) found that perceptions of participants in focus groups concerning geoengineering were rather negative but interestingly several suggested that they were motivated to put more effort into mitigation if geoengineering was actually considered as a response strategy.

These results represent a very promising basis on which to hypothesize that adaptation can serve as a catalyst for overall engagement with climate change and in particular for previously unengaged publics. I propose that there

are two major aspects of adaptation that will increase engagement with climate change:

(1) On a very general level, adaptation can increase the immediacy of climate change by coupling it to actions in the here and now. Applying one of the main findings of CLT – the fact that mental construals reciprocally affect each other – would suggest that, as climate change gets associated with the more concrete and local adaptation measures, the overall psychological distance of climate change decreases. Adaptation measures geared towards buttressing people's houses, their property, their health – concrete instances of their daily lives – against climate change impacts could potentially help convey the urgency and immediacy of climate change more effectively than the idea of mitigating essentially invisible greenhouse gases. Building on results that have found that lower levels of psychological distance are associated with higher levels of concern (Spence et al., 2012) one could expect that this local quality of adaptation would have a positive effect on engagement with climate change. This is an effect that could be particularly accentuated for, but not exclusive to, previously unengaged publics such as conservatives. There is, however, potential for a negative effect of adaptation frames among liberal publics, in that the concept of climate change as a global issue and the universalist communitarian values held by this audience might contrast sharply with adaptation measures that focus at the local level and the benefit of a few. This sort of mismatch could potentially induce lower engagement among these individuals, comparable to how Kahan and colleagues (2012) found that the depolarizing effect of the geoengineering condition was a function of both hierarchical individualists becoming less dismissive but egalitarian communitarians becoming more so.

(2) On a more specific level cues for the applicability of climate change adaptation to a conservative discourse are in fact implied in the semantics of the issues at hand – Climate *change* and *conservatism*. According to Jost,

Glaser, Ktuglanski, and Sulloway (2003) one of two core dimensions that liberals and conservatives differ on is whether they advocate or resist change. The idea of adaptation as an effort to *conserve* the status quo can function as a powerful antidote to conservatives' reluctance to engage with the subject. In particular if climate change is framed as an issue that will change societal relations, the stability of which is of great importance to conservatives. Furthermore, the concept of adaptation as protecting what is dear to people against climate impacts speaks to local concerns for immediate valued entities such as one's house, neighbourhood or local environment, as outlined in the *localism*-narrative by Corner (2013). This view is corroborated by results that have found adaptation intentions to be mostly driven by proximate concerns for local impacts (Haden et al., 2012). Another aspect of adaptation that lends itself more easily to a conservative mind-set is its technocratic nature. The authors of the above mentioned experimental study argue that geo-engineering as a symbol for overcoming limits to economic growth set by the environment by virtues of new technologies affirms hierarchical individualists' values, which makes them less likely to dismiss information concerning climate change (Braman et al., 2012). Adaptation analogously can carry notions of a *green economy*-narrative, as mentioned above, focusing on issues such as innovation and economic opportunities. At the same time adaptation builds resilience and independence, helping to maintain a certain standard of living; aspects that resonate both with the *good life*- as well as the *energy security*-narrative.

3.1.3 Summary and research question

This experimental study aims to disaggregate these two aspects fused into adaptation. It does so by manipulating the local relevance of climate change by putting it into a local or global reference frame, in addition to presenting climate change as a matter of adaptation or mitigation. To test these hypotheses, four different fictitious newspaper articles were created. These

articles highlight climate change impacts either at the local or global scale and refer to either adaptation or mitigation as the response strategy of choice.

This 2x2 design is what separates this research effort from similar work by Evans, Milfont, and Lawrence (2014). Manipulating the climate change measure framing (adaptation vs. mitigation), as well as the spatial framing (global vs. local) should allow for a more detailed investigation of the effects that arise from local relevance and those induced by other aspects of adaptation. Since these aspects are expected to resonate differently with audiences of different political orientations, particular attention will be directed to potential interaction effects arising from the interplay of political orientation (left-leaning vs. right-leaning) and the two framing manipulations. Analysis will investigate whether these conditions affect engagement with climate change as surveyed through a variety of pre-post measurements[18]. The study covered a considerable breadth of dependent variables; from the perceptual-cognitive level with items on climate change scepticism, to affective responses, such as emotional engagement with climate change. The breadth of constructs investigated should provide an opportunity to determine at what level the experimental manipulations might have an effect – from the rather cognitive perceptual to the more affective components. Additionally variables of a more applied nature, such as support for adaptation and mitigation policies, were also investigated. Analogous to the adaptation measures presented in the previous chapter the measures used here include variables that deal with the central theme of climate change but also the more specific issue of sea-level rise.

[18] Increased engagement is used to summarize one or more of the following effects: decreased scepticism b) increase in efficacy beliefs c) less socially distant perceptions for both CC- and SLR-effects, d) increase in concern for CC and SLR, e) increase in emotional engagement with CC and f) higher support and efficacy ratings for financial regulation, mitigation and adaptation.

Summarizing the above, I anticipate that there is an effect that pertains to the immediate nature of adaptation measures that I aim to test separately from other aspects that characterize adaptation, by providing a direct manipulation through a local or global frame for climate change. Alternative predictions regarding the effect of this spatial framing can be made. A first hypothesis predicts that a local frame increases overall engagement, regardless of political orientation. One could, however, equally expect to find that this effect is particularly accentuated for right-leaning individuals and rather small or undetectable for left-leaning participants. The reason for this alternative expectation is the assumption that left-leaning individuals are already engaged with climate change, evidencing somewhat of a ceiling effect regardless of the information they are provided with. The specific combination of a global reference frame and an adaptation frame could see this generally positive engagement of left-leaning individuals reversed though. This prediction is based on the assumption that the discrepancy of responding to an issue that has been described as global, with a measure that possesses a strong local component should be particularly striking to these individuals as it stands in conflict with their convictions.

I expect to find an effect of adaptation specifically, as it resonates well with conservative values, providing a more politically congruent climate change narrative and thereby dismantling some of the conservative audiences' dismissive stance towards the issue of climate change as a whole. The effect of the climate change measure framing should thus be exclusive to right-leaning individuals. Regarding the isolated effect of political orientation I expect to find that left-leaning individuals generally show higher engagement with climate change.

Summarizing the above, this study's main goal is to address the following research question:

- How do the spatial (local vs. global) and climate change measure (adaptation vs. mitigation) framings of climate change affect the engagement of right-leaning and left-leaning individuals?

This research question can be translated into the following more specific hypotheses:

H1 Political orientation is expected to influence overall engagement with climate change, which should be lower in right-leaning individuals.

H2 The effect of the climate change measure frame depends on the political orientation of the individual. The adaptation condition is more engaging to right-leaning individuals and the mitigation condition is more engaging for left-leaning participants.

H3 Local frames increase overall-engagement.

H4 Local frames are more engaging to right-leaning individuals than they are to left-leaning participants.

H5 Global adaptation frames are disengaging to left-leaning participants.

3.2 Method

3.2.1 Participants

Ethics approval was sought with the Cardiff University School of Psychology Ethics Board and granted. A call for participants was then published on the electronic notice board of the university's web platform accessible to both students and staff. The call provided some basic information on the questionnaire and advertised the chance to enter a prize draw for an Amazon online shopping voucher upon completion of the survey. A link to the survey was attached at the end of the message. A total of 283 predominantly female (71.7%) and English (71.1%) subjects participated in this study. The

relatively low mean age of 24.25 (SD = 8.60) reflects the finding that the majority of participants were students (80.6%).

3.2.2 Materials

This experimental study was built around faux newspaper articles that were aimed at framing climate change in various ways. These four articles (*Local adaptation*, *Local mitigation*, *Global adaptation*, *Global mitigation*) differed in whether they accentuated climate impacts at the local or global scale and whether they proposed adaptation or mitigation as response strategies. The articles were further adapted to reflect a Welsh or English local background (see appendices 3.2.1-6).

Various scales consisting of Likert-type scale items were employed as pre- and post-measures[19]. *Climate change scepticism* (α = .86[20]) was measured using a five-point scale (*strongly disagree* to *strongly agree*) and included five items (Q1.1-5) such as "I am convinced that climate change is happening and "The evidence for climate change is unreliable". *Environmental identity* (α = .83, five-point scale, *strongly disagree* to *strongly agree*) consisted of three items (Q2.1-3) including "I consider myself to be environmentally-conscious" and "I think of myself as someone who is concerned about the environment". Three single items (Q4.1-3, Q6.1-3) each were employed to measure *concern for the effects of climate change (CCC)* and *sea-level rise (SLRC) on the self*, *society* and *the world*. These items were combined into two separate climate change and sea-level rise concern-scales (α_{CCC} = .79, α_{SLRC} = .77, four-point scale, *not at all concerned* to *very concerned*). *Climate change efficacy beliefs* (α = .79, five-point scale, *strongly disagree* to *strongly agree*) were surveyed using 6 items (Q7.1-6) such as "There is no point in me doing anything about climate change

[19] Please see appendix 3.1 for the exact wording of items, answer options and topline results.
[20] For pre- post-measures reliability scores are averaged across both measurements.

because no-one else is" and "The actions of a single person don't make any difference in tackling climate change". The *emotional engagement with climate change* scale ($\alpha = .81$, four-point scale, *not at all* to *to a great extent*) presented five emotions (anger, disappointment, guilt, fear, sadness; Q8.1-5) and asked respondents to indicate how intensely they felt each emotion when thinking about climate change. Furthermore, two slider items (Q3, Q5) measuring perceived social distance of climate change and sea-level rise asked participants to indicate whether they thought that it was rather themselves and their families that were going to be affected by climate change and sea-level rise respectively, or other people. These measure asked respondents to place a sliding indicator over a scale from 0 (*oneself and family*) to 100 (*other people*), where 50 indicates that both groups are going to be affected equally. The same type of measure (Q23) was used to ask individuals to indicate their political orientation on a political continuum from 'left wing' (0) to 'right wing' (100). This political orientation measure was used to split the sample into right and left-leaning participants.

The experimental manipulation was followed up by a question asking for immediate top of mind associations (Q10) and by two open-ended manipulation check questions (Q11, Q12), asking respondents what type of action the article had proposed in response to climate impacts and what area the article had been concerned with. Approximately two thirds identified the correct action (69%) and 87% correctly identified the area the article was concerned with. Towards the end of the questionnaire another item (Q27) asked subjects to rate the overall convincingness of the article (five-point scale, *very convincing* to *very unconvincing*). The convincingness of the articles was rated 2.51 ($SD = .84$,). Convincingness ratings did not significantly differ between experimental conditions.

Policy support measures asked individuals to indicate on a five-point scale (*definitely not* to *definitely yes*) how they would vote in a national referendum for a series of proposed mitigation and adaptation measures. Additionally participants were asked to rate the efficacy for each measure on a four-point scale (*not at all effective* to *very effective*). A supposed adaptation policy support item (Q13.4) was excluded from further calculations after a first exploratory factor analysis (see Appendix 3.3.1) found that negatively loaded on the same factor as two support for financial regulation measures. After this item had been removed, exploratory factor analysis (see Appendix 3.3.2) found a clear three factor solution, which translated into three policy support scales: *support for financial regulation* ($\alpha = .78$), *support for mitigation* ($\alpha = .59$) and *support for adaptation* ($\alpha = .64$). Analogous to findings presented in chapter 2.2.2 the support for financial regulation scale included five adaptation and mitigation items (Q13.2, Q13.8, Q14.1, Q14.4-5) that proposed to advance these efforts through financial regulation, such as increased taxes for diesel and petrol and higher prices for water. The support for mitigation scale consisted of four items (Q14.2-3, Q14.6-7) such as "More investments in safe cycling- and walking-routes" and "Subsidies for house insulation" and the support for adaptation scale included 6 items (Q13.1, Q13.3, Q13.5-7, Q13.9) such as "Stricter planning control in flood risk areas, to limit construction on flood plains" and "Build new flood- and coastal-defences". It has to be pointed out that reliability scores for the support for mitigation- and support for adaptation-scale were not satisfactory[21] and so subsequently reported results concerning these two constructs have to be interpreted with the necessary caution. In lieu of the intention measures applied in the study presented in

[21] Reliability analysis did not indicate that deleting any of the included items would increase the reliability score (see Appendix 3.4.1 and Appendix 3.4.2)

chapter 2.2.2, a set of two single item measures (Q33-34) (yes/no) asked respondents to indicate whether they wanted to obtain additional information on adaptation and/or mitigation. This followed the reasoning that, in particular with regards to adaptation, a lot of the proposed action would not come into consideration for students, who constituted a large share of the sample.

The current study also included a scale (Q26.1-6) measuring cultural orientation based on previous work by Capstick, Pidgeon, and Whitehead (2013) that aimed to measure adherence to one of the group grid typologies, as outlined in chapter 1.3.3. This scale was initially intended to measure ideology, in order to control for interaction effects with the experimental manipulations. Exploratory factor analysis however did not find a sensible two-factor solution (see Appendix 3.3.3) as reported by the original authors. Given these inconclusive results the scale was not included in any further calculations.

The remaining measures included: an item on UK party preferences (Q25), two items investigating previous experiences with floods (Q32.1-2) and questions asking participants to report their gender (Q28), age (Q29), occupational status (Q30) and one question asking participants whether they have recently donated to an environmental organisation (Q31)[22].

3.2.3 Design

This study employed a three way factorial design (local/global x adaptation/mitigation x right-leaning/left-leaning). Participants were categorized into *right* and *left-leaning* by applying a median-split to the political orientation measure. It is important to point out that due to the rather liberal orientation of the total sample ($M = 38.60$, $SD = 20.44$) half of the participants that were categorized as right-leaning were by definition of the scale left-leaning

[22] Q31, as well as Q32.1-2 and Q10 were included primarily for exploratory purposes and will not be analysed here.

or undecided. To analyse the data, spatial framing (local vs. global), climate change measure framing (adaptation vs. mitigation) and political orientation (left-leaning vs. right-leaning) were entered as between group variables into MANOVA.

The following dependent variables were investigated: mean change[23] in scepticism, mean change in perceived social distance of climate change- and sea-level rise, mean change in concern for the effects of climate change and sea-level rise, mean change in emotional engagement with climate change, support for; and efficacy of; financial regulation and adaptation.

3.2.4 Procedure

The start page of the survey provided general information regarding the survey, the responsible researchers, and information that was necessary for informed consent. Participants who gave consent to participate in the study, by clicking the appropriate button, were then able to access the questionnaire. Questionnaire sections and scales were presented in a randomized fashion where applicable. An initial screening question was put into place to determine whether participants were Welsh or English. Respondents who were neither were screened out at this point. The remaining participants were branched into two analogous versions of the questionnaire, which were adapted to an English or Welsh context. After completing the questionnaire participants were fully debriefed and provided with contact details again should they have any further questions or comments. At the end of the debrief webpage participants were presented with a link to participate in the prize draw, redirecting the web browser to a new and separate webpage where they were asked to submit their email address. This way any potentially identifiable data was stored separately

[23] Mean difference scores were calculated by subtracting the pre- from the post-score. A positive sign thus indicates an increase and a negative sign a decrease in the respective variable following the experimental manipulation.

from the answers participants had given. Data collection started the 2nd of May, 2014 and ended the 21st of May, 2014. Any partial responses that had not been completed by then were discarded. Participants were able to win one of three Amazon vouchers (£10, £20, £30,). After data collection had ended the winners were chosen randomly from the total collected sample using an online random number generator and were subsequently sent their Amazon vouchers via email.

3.2.5 Results

Descriptive Results

Climate change *scepticism* was not very prevalent in this sample (M = 1.93, SD = .76)[24]. For example, only 3.18% were "not convinced that climate change is really happening". As has been mentioned participants were skewed towards the left concerning their *political orientation* (M = 38.60, SD = 20.44) and exhibited rather high *environmental identity* scores (M = 3.69, SD = .69). *Efficacy beliefs* were also considerably high (M = 3.86, SD = .62). This rather liberal and environmentally concerned character of the sample was contrasted by only a small portion of respondents (13.43%), who reported being a member of, or regularly donating to, environmental organisations.

As can be seen in Figure 7, concern for the effects of climate change and sea-level rise showed a consistent pattern of lower proximal concern and higher distal concern with *concern for climate change effects on the self*, (M = 2.79, SD = .71) being lowest followed by *concern for climate change effects on society*, (M = 3.22, SD = .69) and *concern for climate change effects on the world,* (M = 3.51, SD = .65). Analogously *concern for SLR* increased as items moved from *effects on the self*, (M = 2.42, SD = .75) to higher order concerns

[24] Where pre- and post-measures existed descriptive statistics are reported for pre measures only.

for the effect of SLR on *society*, ($M = 2.96$, $SD = .73$) and *the world,* ($M = 3.31$, $SD = .75$).

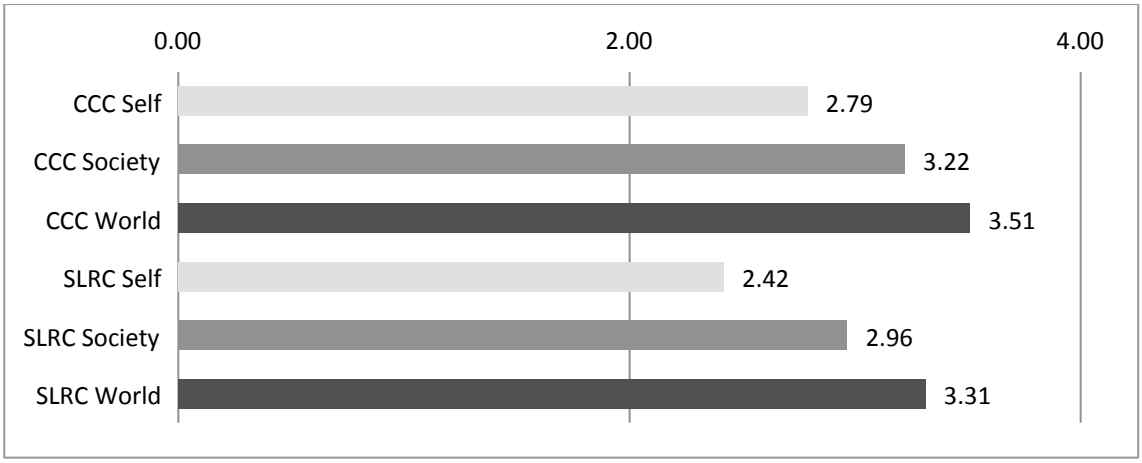

Figure 7. Mean concern ratings for the effects of climate change and sea-level rise on the self, society and the world. *Note*. Answers were given on 4 point scale ('1/not at all concerned' to '4/very concerned').

This pattern was further reflected in the measures to approximate whether respondents thought that climate change and sea-level rise affects them and their families as opposed to other people. Perceptions overall were rather distant than proximal, with sea-level rise ($M = 65.83$, $SD = 16.61$) being viewed as affecting others more than climate change ($M = 58.98$, $SD = 14.71$).

Emotional engagement overall was only marginally bigger than the middle point (2.5) of the scale ($M = 2.63$, $SD = .63$). As visible in Figure 8 the emotion which was rated to be felt most intensely in relation to climate change was *sadness* ($M = 2.90$, $SD = .82$), while *anger* ($M = 2.41$, $SD = .92$) was reported to be least intensely felt.

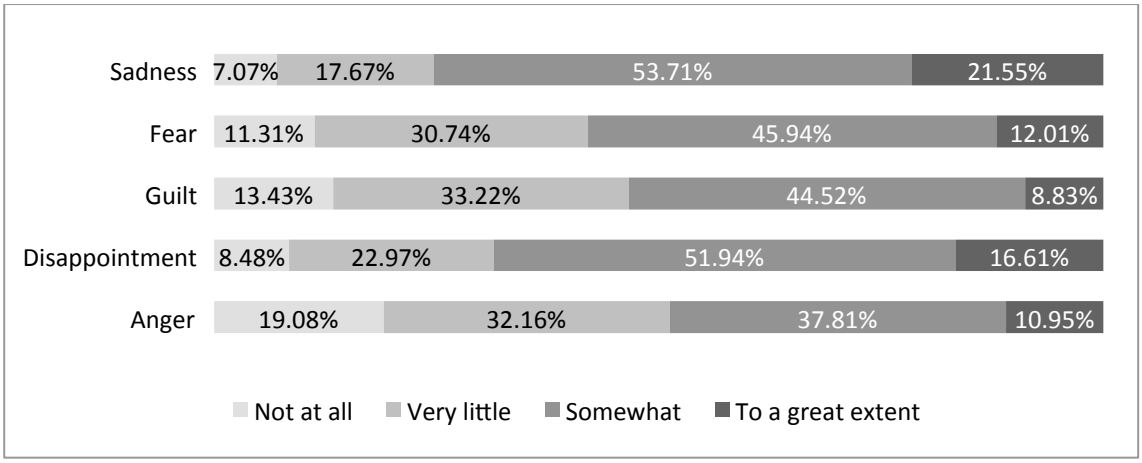

Figure 8. Distribution of responses for emotional engagement items.

Descriptive statistics yielded the expected discrepancy between support for financial regulation and mitigation. Financial regulation measures, such as encouraging people to save electricity ($M = 2.32$, $SD = 1.09$) or to consume less water ($M = 2.36$, $SD = 1.06$) through tax- and price-increases, were most unpopular. Mitigation policies like for example for the production of household green energy ($M = 4.30$, $SD = .83$) and investments in safe cycling- and walking-routes ($M = 4.26$, $SD = .90$) instead were most favoured by respondents. Overall *adaption* ($M = 3.98$, $SD = .52$) and *mitigation* ($M = 4.18$, $SD = .59$) were found to be similar in popularity trailed by *financial regulation measures* with nearly a 1.5 scale point drop ($M = 2.56$, $SD = .85$). Estimated efficacies of the measures yielded a very similar pattern. Mitigation ($M = 3.05$, $SD = .49$) and adaptation policies ($M = 3.08$, $SD = .37$) were judged to be approximately equally efficient, again trailed by financial regulation ($M = 2.36$, $SD = .56$). In terms of obtaining further information on climate change measures 25.44% were interested in such information on adaptation, compared to 31.10% for mitigation.

Concerning previous experiences with flooding 16.96% reported that flooding or erosion had directly affected them, their family, or a close friend. A larger share of 47.35% specified that flooding or erosion had indirectly affected them.

Effects of spatial framing, climate change measure framing and political orientation

Using Pillai's trace, multivariate testing results revealed that there was a significant overall effect of two between group variables: climate change measure framing, $V = .08$, $F(10, 232) = 2.12$, $p = .02$ and political orientation $V = .12$, $F(10, 232) = 3.23$, $p < .01$. Analysis also revealed a significant three way interaction of all independent variables, $V = .10$, $F(10, 232) = 2.62$, $p =$

.01. Hypotheses 2, 3 and 4 can thus already be rejected at this level of analysis. To follow up these basic results, ANOVAs were calculated to reveal a more nuanced picture.

Climate change measure framing

Mean change in climate change concern, $F(1, 241) = 4.12$, $p = .04$ differed between climate change measure framings. Participants showed an increase in climate change concern ($\Delta = .07$, $SD = .36$) in the mitigation condition and a less distinct decrease in concern ($\Delta = -.02$, $SD = .36$) in the adaptation condition. A similar pattern was visible in scepticism ratings, $F(1, 241) = 5.59$, $p = .02$, but with a less accentuated increase ($\Delta = .03$, $SD = .36$) in the mitigation framing and a more accentuated decrease ($\Delta = -.07$, $SD = .33$) in the adaptation framing. ANOVA for the other dependent variables did not yield any significant effect of climate change measure framing. Opposed to hypothesis 2, which postulated that the effect of the climate change measure framing is mediated by political orientation, the effect of climate change measure framing applied to left and right-leaning individuals equally.

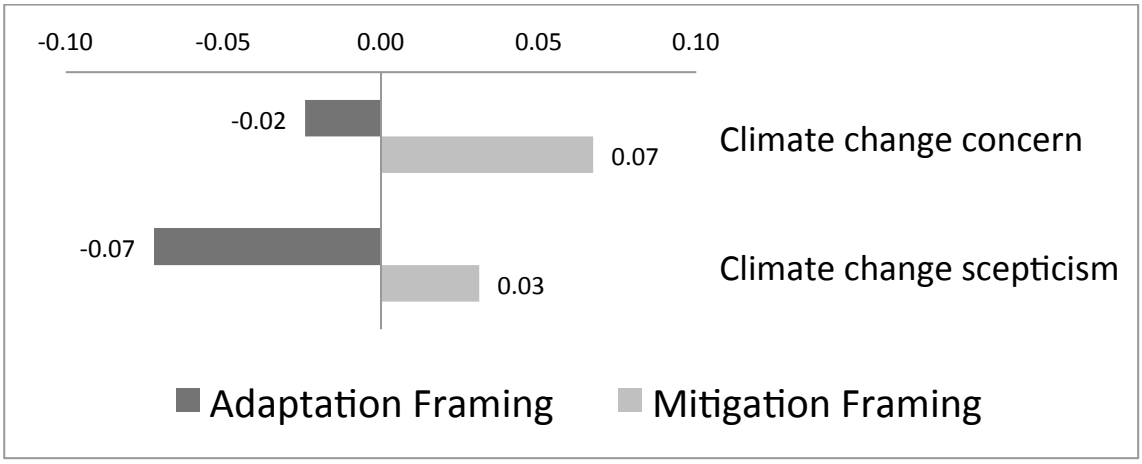

Figure 9. Change of climate change concern and climate change scepticism between adaptation- and mitigation-framing.

Political orientation

Political orientation significantly affected the change in perceived social distance of sea-level rise, $F(1, 241) = 4.25$, $p = .04$. Left-leaning participants in

fact showed a bigger decrease in perceived social distance of sea level rise (Δ = -5.21, SD = 11.6), when compared to right-leaning participants (Δ = -1.84, SD = 13.37). Support for financial regulation, $F(1, 241) = 19.96$, $p < .01$ and efficacy ratings of financial regulations, $F(1, 248) = 21.65$, $p < .01$ (Figure 10) also differed between right and left-leaning participants. As visible in Figure 10 left-leaning participants were more in favour of financial regulations, (M = 2.80, SD = .86) than their political counterparts (M = 2.33, SD = .76). Based on the similarity of support and efficacy estimates it was not surprising to find that accordingly left-leaning respondents rated the efficacy of financial regulations higher (M = 2.54, SD = .53) than right-leaning individuals (M = 2.22, SD = .54). The effects found are in line with hypothesis 1.

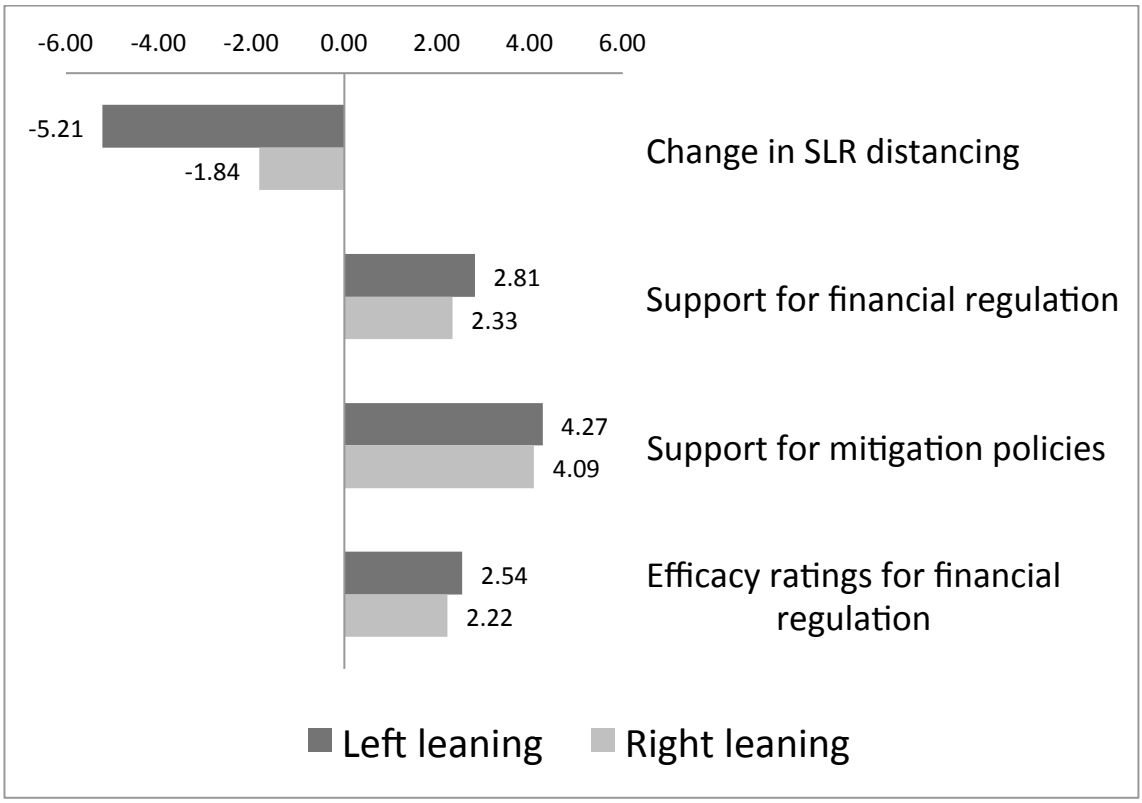

Figure 10. Change in perceived social distance of sea level rise; mean support for financial regulation and mitigation; and mean efficacy ratings for financial regulation between left and right-leaning participants.

Interaction effect for spatial framing, climate change measure framing and political orientation

Follow up analyses concerning the full three-way interaction effects found significant results for change in emotional engagement, $F(7, 241) = 4.25$, $p = .04$ and change in concern for sea-level rise $F(7, 241) = 5.26$, $p = .02$. Figure 11 clearly depicts how the local adaptation frame increased emotional engagement in right-leaning participants, whereas left-leaning respondents showed a decrease. This relationship was inversed and less pronounced for local mitigation but with a substantial increase for left-leaning participants. For global frames instead the picture differed significantly but was homogenous across climate change measure frames. Both climate change measure frames lead to an increase in emotional engagement in left-leaning and a decrease in right-leaning participants. For emotional engagement contrary to hypothesis 5 it is the local adaptation condition that is disengaging.

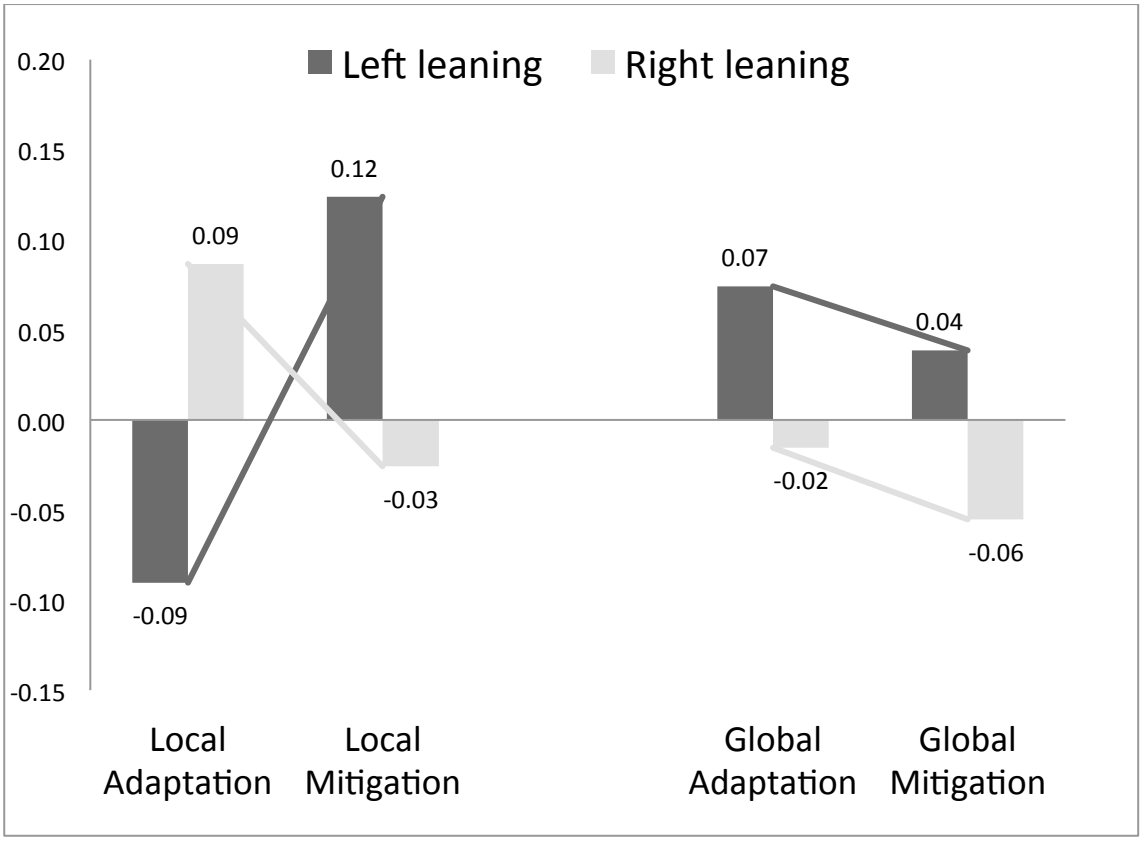

Figure 11. Change in emotional engagement between frames and political orientations.

Concern for the effects of sea-level rise showed a substantially different set of results. While the local frames yielded what appeared to be a ceiling effect, the magnitude of change in concern for the effects of sea-level rise strongly varied between global climate change measure frames as a function of political orientation. For left-leaning respondents there was no change in sea-level rise concern in the global adaptation frame but a .25 increase ($SD = .49$) in the global mitigation frame. The opposite trend was visible for right-leaning individuals with a .24 increase ($SD = .45$) in the global adaptation condition and only a marginal increase in the global mitigation condition ($\Delta = .03$, $SD = .43$). These results are not in line with hypothesis 5 either, even though the finding that the global adaptation condition was the only condition to yield no increase in sea level rise concern for left-leaning respondents could be interpreted as a disengaging effect.

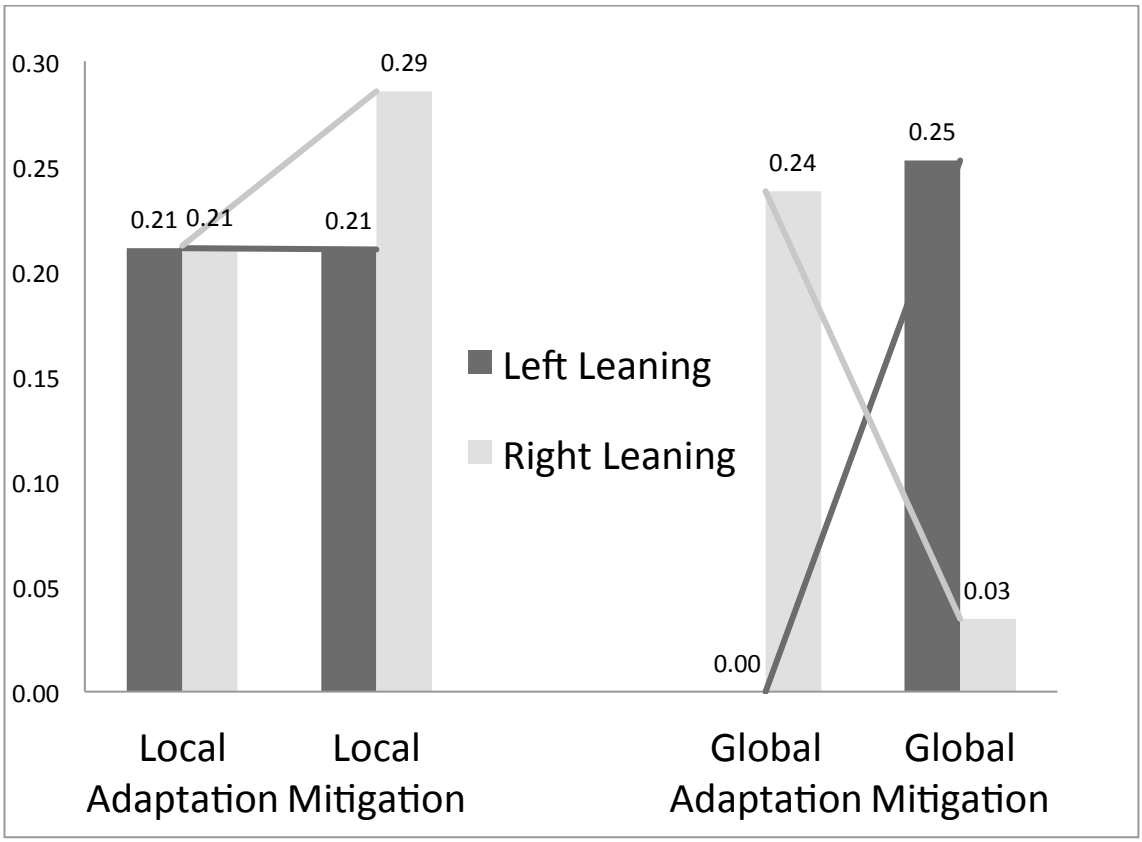

Figure 12. Change in concern for the effects of sea-level rise between frames and political orientations.

Answers to the single item outcome measures between political orientation and framing conditions were analysed on a descriptive basis. As can be seen in Table 1 the highest request for mitigation information among left-leaning respondents was generated by the local mitigation (42.86% yes) closely followed by the global mitigation frame (41,94%). Right-leaning respondents, despite a lower percentage (32.26% yes), equally were most interested in mitigation information after reading the local mitigation article. The local mitigation frame also induced the highest demand for adaptation information in left-leaning respondents (40.48% yes). Right-leaning demand for more adaptation was highest in the local mitigation condition (22.58%) but yielded similar percentages in all but the global mitigation frame, which yielded the lowest interest (16,67%) in supplementary materials overall. The lowest rate of affirmative responses for left-leaning individuals instead showed for adaptation and mitigation (18.52%) in the global adaptation condition. On a descriptive basis this is thus fully in line with hypothesis 5.

Table 7
Percentage of yes answers to the single item outcome measures in the 4 distinct framing conditions.

	Left-leaning		*Right-leaning*	
Mitigation information	**Adaptation Frame**	**Mitigation Frame**	**Adaptation Frame**	**Mitigation Frame**
Local Frame	40.63%	42.86%	18.42%	32.26%
Global Frame	18.52%	41.94%	23.08%	30.00%
Adaptation information	**Adaptation Frame**	**Mitigation Frame**	**Adaptation Frame**	**Mitigation Frame**
Local Frame	34.38%	40.48%	21.05%	22.58%
Global Frame	18.52%	29.03%	20.51%	16.67%

Note. **The table is split in order to allow for a comparison of left- and right-leaning participants.**

3.3 Discussion

This study investigated how different ways of framing climate change would affect engagement with climate change, with particular attention to differential effects for left- and right-leaning publics. MANOVA revealed that overall participants' responses were affected by whether they were presented with an adaptation- or mitigation-frame, by their political orientation and by a significant 3-way interaction effect including both experimental conditions and political orientation. Subsequent ANOVAs helped in painting a more detailed picture of the various effects.

Whether climate change was presented in terms of local or global impacts did not affect participants' responses. Hypotheses 3 and 4 were thus not confirmed. Admittedly the spatial framing manipulation was minimalist consisting merely in the substitution of a few words. This might explain why this kind of framing on its own did not yield an effect. Also it cannot be excluded that participants in the global conditions might have thought of a local background to the global faux newspaper article to better relate to it and as such would have superposed the experimental effect. This naturally would have a similar effect as providing a local reference frame.

Political orientation affected support for and efficacy ratings of financial regulation in the expected way. No significant difference was found for the adaptation measures. This finding further underpins the above-discussed idea of adaptation as a measure that does not seem to carry the same ideological baggage as mitigation does. Interestingly, and unexpectedly, left-leaning participants also showed a significantly higher decrease in perceived social distance of sea-level rise after the experimental manipulation. It is probable that for the potentially more receptive left-leaning audiences the tentative focus of the articles on flooding events might have triggered a stronger shift than in the potentially more dismissive right-leaning participants.

Contrary to hypothesis 2, adaptation frames decreased scepticism and mitigation frames increased it, irrespective of participants' political orientations. Climate change concern showed the identical pattern. Considering that climate change concern and scepticism are negatively correlated (r = -.462, $p < .001$) the finding that both variables are phased in how they were affected by the climate change measure frames constitutes a somewhat surprising result, as it would be reasonable to expect the variables to be diametrical in their response to a certain manipulation. It appears however that their negative relationship does not hold true for how they are affected by the framing manipulations. A closer inspection of the overall spread of the effects (Figure 9) indicates that the adaptation condition is in large part characterized by a decrease in scepticism, while concern for climate change yields a relatively smaller decrease. In the mitigation condition instead, the increase in climate change concern is central, as opposed to scepticism, which, in this case, increases by a comparably smaller margin. These findings suggest that, irrespective of political orientation, reference to adaptation measures decreases scepticism, while focusing on mitigation instead increases climate change concern.

The effect for scepticism could be explained referring to construal level theory. Adaptation as a measure in the here and now helps to create a more proximal construal of climate change overall, thereby increasing certainty. Contrary to hypothesis 2 this effect is not restricted to right-leaning audiences. Interestingly this result would suggest that the climate change measure framing carries more weight in creating such a shift in perceptions than whether one discusses climate change at the local or the global scale. One could argue, that the supposed threatening effect of mitigation, as a response contrary to many of the predominant consumerist tendencies in today's world, is not necessarily restricted to specific ideologies or political orientations. Dickinson (2009), for example, building on work by Becker (1997), discusses materialism as a form of

'immortality projects' that help humanity deal with its all-dominant fear of the inevitability of death. She describes the so-called 'people paradox', delineating how the very things that we rely on as symbols of immortality, such as material goods, often conflict with our prospects for survival. In this line of thought mitigation could be thought of as challenging some of these immortality projects, the freedom to travel, one's own car, etc. Adaptation, on the other hand, does not interfere with these aspects of life. Additionally, by proposing ways of preparing and protecting one-self for the impacts of climate change, it might actually mediate some of the anxiety induced.

Not only scepticism was affected the climate change measure framing, but equally climate change concern. Bearing in mind that the present measure of climate change concern is in fact a composite of concern for the effects of climate change on the self but more importantly on society and the world I hypothesize that the mitigation frame accentuates how individuals have to contribute their part to sustain the greater public good, invoking a certain sense of social responsibility, thereby increasing concern in both left- and right-leaning individuals. However, separate exploratory ANOVAs for the three concern components found no significant difference between climate change measure framings. Combined with a marginal p-value of .04 for the main effect these findings advise caution in conclusively interpreting the results

A full three-way interaction effect affected emotional engagement and change in concern for the effects of sea level rise. Right-leaning participants' emotional engagement increased in the local adaptation frame. In the local mitigation condition left-leaning emotional engagement increased. Contrary to hypothesis 5 it was in fact the local adaptation condition that appeared to be disengaging for left-leaning individuals, at least for emotional engagement. The global framing conditions instead did not yield a difference between climate change measure framing conditions. Left-leaning respondents increased their

emotional engagement in both the global mitigation and adaptation condition, whereas right-leaning participants' emotional engagement decreased in both global climate change measure frames. This finding would thus suggest that political orientation does not seem to play a role in how individuals react to adaptation or mitigation frames at the global scale. It is, however, noteworthy that the global adaptation frame shifted the cross-political mean change towards an increase rather than a decrease, as found in the global mitigation frame. This could hint at a positive effect of the adaptation framing counteracting some of the disengaging nature of the global framing. An interpretation that resonates with the previously discussed result that the adaptation framing decreases scepticism in both political camps.

This finding further suggests that there is an ideology-specific effect of the climate change measure framing on emotional engagement restricted to the local framing conditions. It is important to note that, beyond an increase in what could be called politically congruent local climate change measure frames, this effect equally consisted of a substantial decrease in engagement, rather than no change in engagement, in politically incongruent local climate change measure frames. This disengaging effect was particularly visible for left-leaning participants. One could speculate that the local frames convey some form of activation that is then provided with a positive or negative sign, depending on whether a politically congruent or incongruent climate change measure frame is presented. In this sense, an interpretation of these findings would be that the activation from local relevance boosts right-leaning participants' emotional engagement in the politically congruent adaptation frame but equally decreases it in the politically incongruent mitigation frame. In left-leaning participants instead, local relevance translates into an increase in emotional engagement in the climate change measure frame that fits their political narrative – mitigation – but induces a decrease in the adaptation framing.

Contrasting the result for emotional engagement, the effect of political orientation on concern for the effects of sea level rise concentrated in the global frames, whereas the local frames were characterized by what appears to be a ceiling effect. The local articles, possibly through the more immediate nature and urgency they conveyed, led to a virtually identical increase in concern for the effects of sea-level rise across ideologies and climate change measure frames. This pattern of results is in line with what hypothesis 3 proposed. A possible explanation for why this generally engaging effect of local frames appeared for concern for the effects of sea-level rise only could be that it capitalized on a sensitisation for local effects of sea-level rise and the associated impacts as a consequence of the major flooding events during in the UK during winter 2013/2014.

For global frames instead there is a clear interaction between political orientation and climate change measures frames with respect to the effect on change in concern for the effects of sea-level rise. The global adaptation frame succeeded in increasing concern for the effects of sea-level rise in right-leaning audiences. The global mitigation frame instead only marginally increased right-leaning concern. More interestingly the global adaptation frame seemed to consume any increase in concern that might have shown in left-leaning audiences, as opposed to the mitigation frame in the global condition, where concern increased analogously to the local frames. These results further underpin the idea of disengaging politically incongruent climate change measure framings.

The answer patterns for the two single item measures that asked respondents if they wanted to receive more information on mitigation and adaptation measures help complete a discussion of the effects of the various conditions. The distribution of yes answers suggests that the local conditions generated more interest for additional information on adaptation and mitigation

than did the global conditions. For right-leaning individuals the local adaptation condition seemed to be an exception as it generated a markedly lower interest in mitigation information. Overall interest for adaptation information was generally lower and interestingly the highest request for adaptation was found in left-leaning individuals for the local mitigation condition. Interest in adaptation information for right-leaning individuals was generally the lowest out of all information and political orientation combinations. This means that there is no preference for adaptation information among right-leaning respondents and that generally, framing climate change in terms of adaptation did not induce more interest. The global adaptation condition revealed the lowest percentages of yes answers in left-leaning individuals for additional adaptation and mitigation information.

This descriptive finding provides further tentative evidence for hypothesis 5. Framing climate change in terms of adaptation can be disengaging to left-leaning individuals and this particularly seems to be the case when this framing is contrasted by a description of climate change as a global issue. Interest in adaptation information among right-leaning individuals in the global mitigation condition yielded the lowest overall percentage of yes answers. This trend however did not apply to mitigation information, which yielded the second highest percentage of yes answers in right-leaning individuals. In summary, the pattern of results points to the idea that the main effect of the framing conditions manifests when individuals are presented with politically incongruent frames rather than congruent ones. As such it represents a warning notice for rashly made communication choices, which could do more harm than good.

Beyond these results the fact that the framing manipulations did not affect a substantial part of variables central to climate change perceptions represents an equally interesting finding of this study. As a possible explanation for this lack of findings and the generally lower effect size of the significant

effects I would like to underline the fact that both experimental manipulations were rather conservative. Only a few words distinguished the local from the global condition (compare for example Appendix 3.2.1 and 3.2.5); the main portion of the text was unaffected by the climate change measure framing and nearly a third did not manage to correctly recall the proposed climate change measure. Not only were the experimental manipulations weak but also the split between right- and left-leaning participants was problematic. In general a median-split, as I chose to perform here, brings with it a loss of variance, as the variable is transformed from an assumed continuous to a dichotomous level. Further, as a consequence of political orientation being skewed towards the left, the split sample did not capture an actual left-right split.

The repeated measures design despite an effort to randomize the sequence of items in order to obscure their recurrent nature might have prompted participants to seek for consistency in filling out the various items. This would be further aggravated by constructs that are of a rather stable nature. With climate change as an issue that has long entered public discourse and is commonly agreed to be an issue of importance it is reasonable to assume that most individuals have their mind made up about it, albeit on a very superficial level. As such there is little leverage for manipulations that try to alter perceptions concerning this issue. Sea-level rise on the other hand potentially represents a more volatile concept that people have not given much thought to yet and concerning which they are more easily swayed in their opinion, an assumption that finds tentative support in the two sea level rise-related measures that yielded significant effects.

In this respect it is interesting to note that, again, similar to the results presented in chapter 2.3.2, emotional engagement emerged in a more central role than some of the more established measures. Considering the importance of emotional engagement in predicting a variety of outcome measures, as shown in

chapter 2.3.2 it is encouraging to find that despite the weaknesses of this study's experimental manipulation this variable did in fact change considerably as a consequence of the two framing conditions and political orientation.

A few suggestions for future studies in this line of research can be made. Scholars should aim to ensure that the sample under investigation exhibits an adequate variation regarding the ideology dimension, which is expected to affect how participants react to the climate change measure- and spatial framing. Focusing on a non-student sample, for example, would certainly increase the likelihood for this to be true. Similarly, employing more pronounced experimental manipulations could help produce more distinctive effects. In particular, the spatial framing could be accentuated more strongly. Referring to localized impacts in geographical areas that are well-known to participants could for example help increase local relevance and the potency of this experimental manipulation. For the climate change measure framing, a longer and potentially interactive manipulation, e.g. involving some sort of learning goal, would probably trigger a more meaningful interaction and thus a stronger manipulation. However, even though these measures could ensure stronger effects, the difficulty of changing rather stable constructs that are being repeatedly affirmed in daily interactions still prevails.

3.4 Conclusion

Consistent with work by Evans et al. (2014) this research found tentative support for the idea that the engagement with climate change is affected by whether climate change is presented referring to either adaptation or mitigation as a solution. The results presented here, however, can add some valuable insights regarding the effect of adaptation and mitigation in communicating climate change. Following the lead of Carrico et al. (2015) the findings in this chapter clearly indicate that is important to consider the ideological and political orientation of an individual as the effect of adaptation will differ

accordingly. The evidence gathered here suggests that adaptation cannot be a panacea for increasing engagement with climate change in everyone. On contrary, it appears to be likely that adaptation in some cases will be as disengaging to some individuals, as mitigation is to others. This effect seems to be a function of politically congruent aspects of adaptation for right-leaning and of mitigation for left-leaning individuals. The present research additionally shows that this effect equally depends on whether climate change is framed as a global or local issue and on the outcome variable under investigation. An important insight gained from this study is that, beyond the chance to engage certain publics, there is unfortunately also a definite potential for negatively affecting communication efforts by presenting politically incongruent frames and messages. Critically this risk is not restricted to previously unengaged or dismissive publics, but equally applies to concerned publics that are in fact already positively engaged.

From what this study could gather, climate change measures seem to form an important factor in people's willingness to engage with the issue of climate change. This effect of climate change measures however hinges on political orientation and the local relevance of the issue at hand and is not the same for all issues at hand. As such, this study represents a first effort at pointing out how diverse the effects of framing climate change in terms of adaptation and mitigation can be. While more research has to be conducted to investigate the exact intricacies of the various effects the necessity to do so has certainly been confirmed here.

Chapter 4 - How Personal Experience of Flooding Affects Flood Adaptation and Mitigation Intention

4.1 Introduction

The studies presented in chapters 2 and 3 have broadly investigated the relationship between risk perceptions of climate change and climate change adaptation. Climate change adaptation was investigated as an independent variable that might alter these perceptions but equally as a dependent variable in the form of behaviour intentions and policy support for adaptation. These investigations have precluded an important factor that potentially plays a vital role in determining adaptation behaviour and support for related measures but equally in shaping climate change perceptions: personal experience of climate change impacts. Similar to the previously presented study which explored how experimental manipulations intended to paint a more proximal and salient picture of climate change affected engagement with climate change[25], this chapter does so for the specific case of personal experiences of flooding.

In terms of the theoretical background, this chapter builds heavily on literature and results outlined in previous chapters. As has been shown in chapters 2 and 3, public views of climate change are predominantly distant. Surveys consistently find that individuals think of climate change as something that affects other people and other places (Lorenzoni & Pidgeon, 2006; Nisbet &

[25] While in chapter 2 *engagement with climate change* included public perceptions of climate change but equally relevant behavioural and attitudinal outcomes, such as the intention to perform or support certain measures, this chapter focuses on flood adaptation and mitigation intentions only.

Myers, 2007; Pidgeon, 2012). Furthermore significant proportions of the population in certain countries are to a greater or lesser extent unsure whether it is happening at all (Leiserowitz et al., 2010a, 2010b; Poortinga et al., 2011). This set of results, often summarized as the *psychological distance of climate change*, describes an overall experience of climate change that is somehow removed from peoples' everyday lives (Spence et al., 2012). Weber (2010, p. 333), in discussing this set of findings and public perceptions of climate change in general, observes that climate change as a "statistical phenomenon" is not easily "detected by personal experience". Since individuals mostly lack personal experience with climate change, it is thus not surprising to find that the public's perceptions of climate change are of a distant risk. The implicit assumption in this line of reasoning is that experiences of climate change impacts in the here and now can increase the salience of climate change as an issue and lead to less distant perceptions and even higher engagement by individuals.

4.1.1 Experiences of climate change impacts

Before reviewing existing literature that has investigated the effect of experiences of climate change impacts an important problematic aspect concerning the direction of this proposed effect needs to be highlighted. The classic chicken and egg problem regarding this research question translates into two possible directions of effect, which can be described as the *experiential learning* pathway (see chapter 1.3.2) and the *motivated reasoning* pathway (Myers et al., 2013).

As mentioned in chapter 1.3.2, literature on the availability heuristic suggests that individuals' risk evaluation of a particular issue, such as climate change, is influenced by the ease of which they can think of or remember incidences of the hazard (Kahneman, 2003). As individuals are exposed to what they could interpret as a climate change impact, such as flooding, the salience of such an event in their personal memory should increase the recall availability of

such a risk, therefore, leading to higher risk evaluations. Work on the affect heuristic proposes that it is in fact the strong affective reaction such events can evoke, that constitutes a large portion of the effect an experience has on the individual (Finucane, Alhakami, et al., 2000). Applying this scholarly insight to the experience of flooding Keller, Siegrist and Gutscher (2006) found that both mechanisms do lead to heightened flood risk perceptions in individuals.

A drawback of most studies that have investigated the experiential learning pathway is that, as experiences of climate change, such as flooding, cannot be experimentally induced, this research often relies on self-report measures. This however implies the possibility that like for any other correlational analysis, where one measure is not clearly controlled by the experimenter, one cannot make a definite judgement regarding the direction of the effect. In other words, it cannot be precluded that, for example, pre-existing climate change beliefs make people more or less likely to report having experienced climate change impacts. This explanation is in line with what has been labelled *motivated reasoning* describing how individuals tend to focus on and attend to information in a way that confirms their a priori conclusions (Kunda, 1990). With regards to climate change perceptions Corner, Whitmarsh and Xenias (2012) for example showed that individuals evaluated the convincingness and reliability of fictitious editorials in a characteristically different way depending on whether they were sceptical of climate change or not. Other work similarly showed that cultural and political orientation is strongly associated with perceptions of scientific consensus on climate change, the interpretation of the Climategate[26] scandal and even the recall of recent

[26] Climategate describes the leaking of thousands of emails and computer files of the Climate Research Unit at the University of East Anglia and subsequent allegations of fraud or scientific misconduct which were dismissed by several committees (Nature, 2010).

temperatures (Goebbert, Jenkins-Smith, Klockow, Nowlin, & Silva, 2012; Leiserowitz, Maibach, Roser-Renouf, Smith, & Dawson, 2013; Leiserowitz, 2006).

Myers et al. (2013) specifically addressed this issue of directionality and found causal evidence for both the *experiential learning* and *motivated reasoning* pathway. Their study thus demonstrated that individuals' belief certainty influences their reported climate change experiences and vice versa. It is furthermore important to point out that these authors just like Capstick and Pidgeon (2014a) have found that motivated reasoning affects both extreme groups of a certain belief or identity, i.e. very sceptical as well as very convinced individuals will be inclined to interpret weather phenomena in a manner that is or is not consistent with climate change.

From a psychological research perspective it is this unexplained direction of effect, which makes it methodologically challenging to investigate the effect of personal climate change experiences on climate change perceptions. As has been mentioned, it is virtually impossible and certainly ethically objectionable to experimentally induce personal experiences of certain climate impacts. To circumvent this, researchers would have to rely on longitudinal studies of participants' responses before and after they have experienced a certain climate change impact. This kind of research design however is highly complex and laborious, and so most of the research up to date relies on correlational data. When relying on this type of study one would ideally want to eliminate, or at least limit, any subjective bias of the experience measure, which is what the subsequently presented research aimed to achieve.

In this regard it is crucial to theoretically examine and distinguish how research in this line operationalizes personal experience of climate change. Broadly two categories of experience measures can be described. One group of studies asks individuals to indicate whether they have experienced climate change in their lifetime or similar (e.g. Myers et al., 2013). A second research strand in this field addresses specific events or weather phenomena such as floods, heat waves or temperature anomalies (e.g. Spence et al., 2011). Both of these approaches so far carry significant drawbacks.

The first research strand, in asking individuals if they have experienced climate change, faces the inevitable critique aimed at the ambiguity of what participants might understand as experiences of climate change (Reser, Bradley, & Ellul, 2014). One can easily imagine how a process, such as motivated reasoning can have considerable bearing on what a person does or does not report or interpret as signs of climate change. And even if this measure is not affected by this sort of process, in the absence of a clear definition, the ambivalence of what actually constitutes a sign of climate change means that individuals will most likely respond to this sort of question in a rather inconsistent manner. This is aggravated by the fact that different types of phenomena, such as drought or flood, are experienced in different ways (Dessai & Sims, 2010) and will therefore most likely differ in how they affect the individual.

The second group of studies addresses this ambiguity by focusing on specific events and aspects, such as floods or abnormal temperatures. This, supposedly, clearly specifies the phenomenon the researcher is interested in. A drawback of this type of operationalization however is that these measures usually do not include any reference to climate change. It thus remains unclear whether respondents place the issue in question in a climate change reference frame or not. With regards to the present research question, however, of how

flooding as a personal experience of climate change influences engagement with climate change, it is sensible to hypothesize that whether respondents interpret flooding as a climate change impact, or a non-climate change related event, like a one-off freak weather event, will make quite a difference to the effect this sort of experience has.

Summarizing the above, three important methodological hurdles can be highlighted when studying the impact experiences of climate change have on engagement with climate change: first, to move beyond a basic detection of an association between the two constructs it is of paramount importance to ensure that the measure of a particular experience offers as little as possible room for subjective biases. Second, to ensure that respondents respond in a consistent manner the measure in use should refer to a particular type of experience rather than generically referring to an experience of climate change. Third, it is then equally important to account for differences in how individuals interpret the experience. Since this chapter is interested in the effect that personal experience of climate change has, it is essential to capture whether respondents understand the experience this chapter focuses on, namely flooding, as a climate change impact.

4.1.2 Experiencing flooding

A considerable amount of literature has dealt with risk perception and personal experiences of flooding (see Kellens, Terpstra, & De Maeyer, 2013 for a review) but there appears to be only a handful of papers that have investigated the link between this type of experience and climate change related responses. Whitmarsh (2008) found no difference between flood and non-flood victims regarding their understanding of, and responses to, climate change. By contrast, Spence et al. (2011) did find more concern over climate change, greater certainty regarding climate change and greater personal efficacy concerning actions on climate change among flood-victims. A mediation analysis further

showed that all of these variables translate into greater willingness to save energy to mitigate climate change. Capstick et al. (2013) obtained similar results and further showed, that spontaneous associations of flooding and climate change were more frequent among individuals who had experienced flooding.

Expanding this inconsistent evidence basis with articles that have looked at other climate change impacts and less clearly defined experiences of climate change paints a more consistent picture. Analogous to Spence et al.'s (2011) research on flooding, other forms of personal experiences of climate change are associated with less uncertainty and higher belief in climate change (Lujala, Lein, & Rød, 2014; Myers et al., 2013; Taylor, de Bruin, & Dessai, 2014). And again, in accord with Spence et al.'s (2011) work, research has also demonstrated that this type of experience can translate into greater intentions to act on climate change (Broomell, Budescu, & Por, 2015; M Siegrist & Gutscher, 2008).

While the literature has discussed the direction of the effect, the sign of this effect has been seemingly unchallenged. According to the experiential learning approach experiences of climate change are probably best described as facilitative or stimulating. In doing so however, this theory gives little credit to the potentially overwhelming and traumatic nature of these events. As the earlier discussion of the cognitive theory of stress in chapter 3.1.1 highlighted, it is easily imaginable how the experience of extreme weather may not necessarily create more engagement but may instead constitute a stressful event that forces individuals into rather passive psychological states, such as denial and thus very low engagement. Some literature on exposure to flooding events does in fact address the question of non-protective responses such as denial and fatalism and a few studies have confirmed this sort of effect for personal experiences of

flooding on flood adaptation intentions (Lin, Shaw, & Ho, 2008; Zaalberg et al., 2009).

Insight into this type of effect can come from the environmental stress literature. Applying a classification of environmental stressors by Evans and Cohen (1987) flooding is best described as falling into the category of cataclysmic events. These events are characterized by high coping requirements. Flooding further has certain qualities that in environmental stress studies have been shown to have detrimental effects on subjects' intention to engage the stressor. Above all, the uncontrollability or loss of control flood victims experience, must be highlighted, as by definition it entails that there is very little a person can do other than to endure the event. Control over a stressor has been shown to remedy some of the negative effects the stressor has, whereas sustained experiences of uncontrollable stressors can lead to what is called *learned helplessness* (Averill, 1973; Cohen, Evans, Krantz, & Stokols, 1980; Cohen, 1980). The controllability of a flooding event naturally is determined by whether a person feels that he/she uses problem focused coping strategies to address it. It is thus reasonable to assume that coping ability with regards to flooding will have an effect on whether individuals proactively engage with the stressor, as measured through their flood adaptation intentions. This chapter further addresses the question whether coping ability, equally determines mitigation intentions. This particular research interest builds on the assumption that individuals, who are unable to cope with future flooding, will have little resources left to address climate change.

This relates directly to a series of studies specific to the UK context, which have qualitatively explored the experience of individuals in the aftermath of the floods of June 2007 in Hull, UK (Medd et al., 2015; Whittle, Walker, Medd, & Mort, 2012). The insights gained from this research highlight the importance of the recovery process as a major stressful component of being

flooded. In fact, the researchers find that the floods themselves frequently do not represent the most stressful component of the entire process of recovery in individuals' accounts (Medd et al., 2015). The researchers (Medd et al., 2015; Whittle et al., 2012) find that, rather than steady improvement to a state of normalisation, recovery is characterized by ups and downs towards an end state that is not necessarily a return to a 'normal', or ideally, 'regenerated' living conditions (The Cabinet Office, 2008). This characterization of recovery as a tedious, lengthy and discontinuous process is important as it implies that the process of recovering itself can leave affected individuals more vulnerable to future instances of the disaster than they were in the first place.

Whittle et al. (2012) attribute a central role in defining this taxing and strenuous nature of recovery to emotion work (Hochschild, 1979). Analysing diary entries by respondents in the aftermath of flooding, they are able to show that focusing on physical and economic recovery neglects an important emotional component and hidden vulnerabilities. They highlight a number of insights that a focus on the emotional experience of affected individuals can produce. The concept of emotional labour and emotion work can help create a fuller account of what constitutes the experience of long-term disaster recovery and the various actors that are involved. Their data also underline how the emotional and physical aspects of recovery are tightly interwoven. The insights gained from a focus on emotion are also very relevant to inform practices and politics in disaster management. Particularly relevant to this thesis' focus on adaptation are the insights regarding the protracted nature of recovery and the direct implications of how this process shapes existing vulnerabilities and will also create new ones, actually impeding adaptation (Whittle et al., 2012).

The experience of flooding in general, however, is considered to be positively engaging in terms of flood adaptation. White's (1945) fundamental

research on human adjustments to floods in the US has in fact been some of the first risk perception research, finding that individuals' past experiences of flooding influenced their preparations for future flooding. Various studies since then have found a positive relation of previous experiences of flooding and flood-related behaviour (Kellens et al., 2013). What is absent in this kind of studies though, is the question of how climate change perceptions affect the intention to adapt to extreme weather events. As adaptation has firmly established its place alongside mitigation it seems necessary to equally include specific adaptation intentions. Belief in climate change for example should implicate some form of expectation of more frequent and intense extreme weather events and so even individuals, who did not experience flooding, should in some way be more willing to prepare for flooding. It is thus reasonable to expect that the effect of experiencing flooding on intentions to adapt to future flooding specifically, should be to some extent moderated by whether respondents interpret it as a sign of what is to be expected in the future of climate change. This chapter thus presents an integrated research effort that looks at the experience of flooding and climate change perceptions as predictors of mitigation intentions and flood adaptation intentions.

4.1.3 Summary and research questions

In summary, the above-mentioned theoretical aspects translate into two main research questions this chapter addresses:

- Does the personal experience of flooding serve as predictor of flood adaptation and mitigation intentions, and if yes, what is the sign of these effects?
- Is this potential effect of personally experiencing flooding moderated by whether individuals attribute flooding to climate change or not?

4.2 Method

Between December 2013 and February 2014 the UK saw an extraordinary sequence of storms and heavy precipitation events. The UK Met

Office (2014) reported that in Scotland the wettest December in history was recorded and the same applied to January in southern England. These weather phenomena led to widespread flooding across the UK that triggered responses at national and local levels, by environmental and public health agencies as well as various NGOs, voluntary organisations and the private sector. Media at the national and international level equally covered these events extensively.

The data presented here were collected in a large research project funded by an 'Urgent' grant from the Economic and Social Research Council (ESRC), which was carried out by a research team from Cardiff University and Nottingham University in response to these events. I was employed as a research assistant in this project and collaborated with my colleagues on the development of the survey instrument, data analysis and the final project report (Capstick et al., 2015). This presented me with an excellent opportunity to collect nationally representative data relevant to the research question presented here. The study and questionnaire in particular were developed by the research team (Capstick et al., 2015) in cooperation with the social research company Ipsos MORI that carried out the data collection and an advisory panel composed by representatives from NGOs, government departments, and research groups. My particular input consisted in aiding with the collection of relevant scales and items through a literature review and involvement in a theory-guided discussion to establish the sequence of the constructs in the questionnaire.

4.2.1 Participants

The sample studied consists of a nationally representative sample (NS) of 1002 respondents. Additionally, approximately 200 individuals from each of the following five areas were added for a total sample size of 1997. These oversampling areas were: the City of Hull next to the river Humber (n=200), an area between Sunbury and Windsor (n=199) along the River Thames, a region

between Tewkesbury and Gloucester (n=198) along the River Severn, in the town and region of Aberystwyth (n=200) in Ceredigion, Wales, and finally the area along the coast at Dawlish in Devon (n=198). Relying on media reports and input from the advisory panel and Ipsos MORI, these areas were identified by the research team as disproportionately affected by the winter floods. The five oversampled areas were further chosen to allow for a depiction of the diverse geographical and physical (e.g. riverine, coastal) characteristics of the floods experienced during winter 2013/2014.

Participants more generally were chosen from so-called Double Output Areas. An Output Area is defined as the lowest level at which census information is available. Combining the geographically closest Output Areas within a local authority, which are further within the same electoral ward and connected by a road, then creates double Output Areas. Further, participation of all respondents was conditional upon having established residence prior to February 2014.

Out of the total of 995 participants in the oversampled areas, 135 were classified as having had a direct experience of flooding. This flooded sample (FS) included approximately 10% more male participants, was marginally younger and yielded a more than 10% larger group of respondents who fell into the highest social grade.

Table 8
Distribution of gender, age group and social grade in the NS (N=1002) and FS (N=135)

Gender

	NS	FS
Female	48.6%	35.6%
Male	51.4%	64.4%

Age groups

	NS	FS
16-24	14%	16.3%
25-34	12.2%	10.4%
35-44	15.1%	18.5%
45-54	19%	16.3%
55-64	15.4%	11.9%
65-74	14.5%	17.8%
75+	10%	8.9%

Social grade[27]

	NS	FS
AB	29.1%	45.2%
C1	31.3%	31.9%
C2	18.4%	8.9%
DE	21.2%	14.1%

4.2.2 Materials

The survey instrument used for the purpose of this study can be divided into three sections. The first section was concerned with general climate change perceptions, including a series of so-called tracker items that had also been used in previous nationally representative studies (Capstick, Pidgeon, & Whitehead, 2013; Capstick & Pidgeon, 2014a; Spence et al., 2011). The following section examined how participants had experienced the flooding. Some measures were only presented to respondents who indicated that they had been affected by flooding in some way and explored their experience in more detail. The last section then focused more generally on individual perceptions of the flooding. Additionally the survey included measures that probed participants' cultural and environmental values, questions regarding newspaper readership and a

[27] The social grades are based on definitions by the Institute of Practitioners in Advertising and reflect the occupation of the chief income earner. The grades are defined as: A: higher managerial, administrative or professional; B: intermediate managerial, administrative or professional; C1: supervisor or clerical and junior, administrative or professional; C2: skilled manual workers; D: semi and unskilled manual workers; and E: state pensioners and similar with no other earnings at the lowest levels of subsistence.

series of socio-demographic variables. The statistical analysis presented here only used a selection of these measures and so the following more detailed description will focus on this only. Table 9 provides an overview of these measures and their origin. The exact item wording and topline results are presented in Appendix 4.1.

Table 9
Measures used; their corresponding question number, reliability score where applicable and origin of the scale/items.

Measure	Type	α	Origin
Flooding experience	Q25	n.a.	Capstick et al., (2015)
)Personal flood risk	Q47	n.a.	Capstick et al., (2015)
Flooding emotions	Q41.1-6, 41.10	.81	Capstick et al., (2015)
Mental health consequences	Q38.1-3	n.a.	Adapted from Paranjothy et al., 2011
Flood coping belief	Q48.1	n.a.	Capstick et al., (2015)
Attribution	Q44.1;Q45.1/ 3/7/11	.85	Capstick et al., (2015)
Psychological distance	Q7.1-3	.81	Spence, Poortinga, and Pidgeon, (2012)
Climate change concern	Q4	n.a.	Capstick, Pidgeon, and Whitehead, (2013)
Personal efficacy	Q14.3	n.a.	Capstick et al., (2015)
Collective efficacy	Q14.4	n.a.	Capstick et al., (2015)
Climate change belief	Q11.2	n.a.	Capstick, Pidgeon, and Whitehead, (2013)
Environmental Identity	Q50.7/8	.82	Whitmarsh and O'Neill (2010)
Individualism	Q50.4/5/6	.39	Capstick, Pidgeon, and Whitehead, (2013)
Egalitarianism	Q50.1/2/3	.57	Capstick, Pidgeon, and Whitehead, (2013)
Flood adaptation intentions	Q49.1-6	.85	Capstick et al., (2015)
Mitigation intentions	Q13.1-6	.75	Capstick et al., (2015)

Personal experience of flooding

This block of measures contained measures to better describe the personal experience of flooding individuals had. Most importantly it contained the variable used to categorize the FS. *Flooding Experience* (Q25). This question was central to defining the FS. It asked participants whether the 2013/2014 flooding had affected their current or previous property[28]. It was further specified that this could include any land surrounding their home such as a garden or drive, or communal areas such as a car park or hallway. Participants were further instructed to answer yes if they stopped the water from flooding their property by using some form of flood defence. This measure was dichotomous in nature, comparing participants (n=135) who had indicated that their property had been flooded and who also lived in the oversampled areas (1) with participants (n=1002) from the national sample (2)[29]. The reported statistics for *flooding experience* thus describe the effect that having one's property flooded has on the outcome measure in question.

Further *personal flood risk* (Q47) as a standard risk perception item measured whether participants agreed (5-point scale, *strongly agree* to *strongly disagree*) with a statement, which indicated that they believed that their property is at risk of flooding in the next 10 years.

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[28] The exact question wording was as follows: 'Was your current or previous property affected by the floods between November 2013 and February 2014? This could include any land surrounding your home such as a garden or drive. If you live in a flat it might include communal areas such as a car park or hallway. Please also answer yes if you stopped the water from flooding your property by using some form of flood defence such as sand bags or a flood gate'.

29 It is important to note that the national sample also included a small number of respondents (n=27, 2.69%) who indicated that their property had been flooded. These individuals were retained in the national sample and were not added to the flooded sample. This was done to preserve the representativeness of the national sample. The reported results thus constitute a rather conservative test of the effects of *flooding experience* because adding the individuals with flooding experience from the national sample to the flooded sample most likely would have accentuated any differences between respondents with and without flooding experience.

To assess participants' emotional experience with regards to the 2013/14 flooding *flooding emotions* (Q41.1-6, 41.10) were measured using a list of five emotions ($\alpha = .81$) such as 'sadness', 'anxiety' and 'distress'[30]. Participants had to indicate on a 10-point scale (*I have not felt this at all* to *I have felt this extremely*) to what extent they had felt each emotion when the 2013/14 flooding occurred.

Two variables were employed to investigate whether the 2013/14 flooding represented a considerably stressful event to participants. *Mental health consequences* (Q38.1-3) of the 2013/14 flooding were assessed asking respondents to indicate whether, as a consequence of the flooding, they had experienced one or more out of a list of three conditions. The list included: 'anxiety when it rains heavily', 'increased stress levels' and 'sleeping problems'. The more of these were confirmed, the higher the score on this scale. *Flood coping belief* (Q48.1) was measured using a single item asking respondents whether they agreed (5-point scale, *strongly agree* to *strongly disagree*) with a statement indicating that they felt that they would be able to cope if flooding was to affect their property this year.

Lastly, an *Attribution* scale ($\alpha = .85$) was used to capture the belief that the 2013/14 flooding can be attributed to climate change. Five of the constituting items (Q45.1/3/7/11/12) measured *attribution* as agreement (5-point scale, *strongly agree* to *strongly disagree*) with a set of statements such as: 'The floods were a sign that the impacts of climate change are happening now.' and 'The floods were caused, in part, by climate change'. Additionally, exploratory factor analysis (see Appendix 4.2.2) indicated that, the extent to which participants thought that climate change contributed to the 2013/14 flooding and the impact it had (Q44.1) out of a list of possible causes including

[30] Exploratory factor analysis for the flooding emotion items can be found in Appendix 4.2.1

aspects such as *poor river and coastal management* or *insufficient investment in flood defences* (4-point scale, *not at all* to *a great deal*) also formed part of this scale.

Key climate change perceptions

Key climate change perception variables largely corresponded to measures used in previous chapters, the difference being that some were operationalized as single-item measures as a result of constraints to the total survey length. *Psychological distance* (Q7.1-3). This three-item scale ($\alpha = .81$) asked respondents to judge how serious a threat they thought climate change was to: the UK as a whole, them and their family and people in developing countries. Answer options were provided on a 5-point scale (*extremely serious* to *not at all serious*) [31].

Climate change concern (Q4) was measured with the following item: 'How concerned, if at all, are you about climate change, which is sometimes referred to as global warming.' Answer categories ranged from *very concerned* to *not all concerned* on a 4-point scale.

Personal efficacy (Q14.3). To measure this respondents were asked to indicate their agreement (5-point scale, *strongly agree* to *strongly disagree*) with the statement: 'Changing my lifestyle will make little difference with regards to climate change."[32]

Collective efficacy (Q14.4). Analogously to personal efficacy this was measured as the level of agreement (5-point scale, *strongly agree* to *strongly disagree*) with the statement: 'If everyone does their bit we can tackle the causes of climate change'

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[31] In addition to the answer categories reported in the following paragraphs all items also included a 'Don't know' answer option and some also provided a 'Refused' option.

[32] All negatively worded items were recoded so that a high number corresponded to a high on the corresponding variable.

Climate change belief (Q11.2) was assessed by asking respondents whether they agreed (5-point scale, *strongly agree* to *strongly disagree*) with a statement indicating that it was clear to them that climate change is really happening.

Identity measures

The study also included identity measures for reasons outlined in the procedure section. *Environmental Identity* (Q50.7/8) was assessed using a scale (α = .82) which measured participants' agreement (5-point scale, *strongly agree* to *strongly disagree*) with two statements: 'Being environmentally friendly is an important part of who I am' and 'I think of myself as someone who is very concerned with environmental issues'.

Individualism (Q50.4/5/6)[33]. This cultural cognition dimension was measured using a three-item scale (α = .39) including items such as 'When I have problems I try to solve them on my own' and asked individuals to indicate their agreement with these on a 5-point scale (*strongly agree* to *strongly disagree*).

Egalitarianism (Q50.1/2/3). This cultural cognition scale (α = .57) analogously to the 'Individualism' scale asked respondents to indicate their agreement (5-point scale, *strongly agree* to *strongly disagree*) with 3 statements including the following: 'The world would be a better place if its wealth were divided equally among nations'.

Socio-demographic variables included were *gender*, age *group* and *social grade*.

Outcome variables

[33] Both cultural cognition measures had very low reliability values. The reported results concerning these two scales, or rather, their non-significant contribution to the regression models reported here, therefore have to be interpreted with the necessary caution.

Flood adaptation intention was measured using a scale (α = .85) consisting of six items (Q49.1-6) and it was one of two outcome measures that were investigated in this study. The six items proposed actions asking individuals which answer category best expressed what they thought about this particular measure. The following answer options were provided: 'I don't think this is relevant to me'; 'It is very unlikely I would do this'; 'I would possibly consider doing this'; 'I would definitely consider doing this'; 'I am intending to do this'; and 'I've done this'. Proposed actions included: 'Buying flood protection products such as flood boards or sand bags'; 'Making sure I have insurance cover for flooding'; and 'Attending meetings or joining a community group related to flooding'.

Mitigation intention analogously was measured using a scale (α = .75) containing 6 actions (Q13.1-6). For these, participants were asked to indicate on a 5-point scale (*very likely* to *very unlikely*) how likely they thought they were to perform or continue performing said action in the next few years. The suggested measures included cutting down travel by car, reducing the amount of energy used at home and signing a petition about climate change.

4.2.3 Design

As the paragraphs in the introduction highlighted, self-report measures of experiences can be affected by biases. The survey and study design incorporate a few key aspects that were intended to limit these biases:

- Oversampling was carried out in areas that had been heavily affected by the 2013/14 flooding to ensure that the final sample included a sufficiently large FS for meaningful statistical analyses to be carried out.
- Questions regarding climate change perception were asked before any reference to flooding was made. This way no potential link between climate change and flooding was made salient to respondents before they reported their climate change perceptions. The assumption behind this choice of order is that the flood experience measure chosen here is more robust to motivated reasoning biases then the climate change perceptions items.

- Finally, flooding experience was in fact surveyed in a variety of ways. Measures explored rather objective physical exposure to the floods but also asked respondents if they felt the 2013/14 flooding had personally affected them. In this chapter participants that experienced flooding are defined as those who lived in one of the oversampled areas and indicated that their property was affected by the 2013/14 flooding. Out of all measures of flooding experience included in the survey, I argue that this is the one that leaves the least scope for interpretation and will thus limit biases, such as motivated reasoning, best.

4.2.4 Procedure

Once the School of Psychology, Cardiff University, granted ethical approval, Ipsos MORI collected data using computer assisted personal interviews, which took 35 minutes on average to be completed. Ipsos MORI conducted both the sampling and the remuneration of participants. While being considerate of practical and ethical limitations, fieldwork was conducted as close to the flooding event as possible. Data collection started the 28th of August, approximately half a year after the floods had occurred, and ended the 31st of October.

Data analysis carried out consisted of two multiple regression models using the *Enter* procedure. The investigated outcomes measures are *flood adaptation intentions* and *mitigation intentions*. Both models are identical in terms of the predictors entered, which were: *psychological distance of climate change*, *climate change concern*, *personal* and *collective efficacy*, *climate change belief*, *individualism*, *egalitarianism* and *environmental identity*[34], *personal flood experience*, *attribution*, *mental health consequences*, *flooding emotions*, *flood coping belief*, *personal risk perception*, the interaction term *attribution X flood*

[34] Identity measures were included as an additional way to account for motivated reasoning biases. By including these variables in the model I aimed to warrant that any identity-related variance in the regression model would be explained by these variables as to cancel any effect by flood experience measures that might exist as a consequence of an association mediated by identity measures.

experience, *social grade*, *gender* and *age*. To ensure the stability of the regression model and to avoid multicollinearity the interaction terms were calculated applying residual centring (Little, Bovaird, & Widaman, 2006). Missing values were deleted *listwise,* resulting in a final sample size of n=354[35] for *flood adaptation intention* and n=1763 for *mitigation intention*.

Predictor variables that did not yield significant regression weights in a first exploratory regression were excluded from further calculations. Non-significant predictors were excluded to minimize the likelihood of multicollinearity issues. In three cases predictors[36] with marginal *p*-values were kept to run a second exploratory regression, to account for the fact that some of the variables potentially split up explained variance among them resulting in non-significant contribution to the model, while the single strongest predictor by itself does yield a significant effect. The final regression models as presented here were then run applying boot strapping with bias corrected accelerated confidence intervals. For ease of comparison standardized beta weights are reported together with significance values from the bootstrapping procedure. Intercorrelations of the significant predictors[37] and the outcome variables in the two regression models can be found in the table presented in Appendix 4.3.

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[35] The relatively small sample size is explained by a high number of missing values for the *mental health consequences* variable (n=1176) and the excluded participants (n=860) in the oversampled areas that had reported no flooding on their property.

[36] Gender(p = .069) for flood adaptation intentions and flood coping belief (p = .066) and climate change belief (p = .057) for mitigation intentions.

[37] For both the correlation matrix and the subsequently presented regression models the following variables' answer scales were recoded by inversing the scores so that higher values reflected a higher score for the variable in question: *mitigation intentions*, *Personal flood risk*, *Flooding experience*, *Climate change concern*, *Environmental identity*, *Collective efficacy*, *Climate change belief* and *Social grade*.

4.3 Results

4.3.1 Flood adaptation intention

The regression model for flood adaptation intentions explained 41.9% of the total variance and included 5 significant predictors. The strongest predictor of flood adaptation intentions was personal flood risk ($\beta = .38$, $p = .001$) followed by *flooding emotions* ($\beta = .20$, $p = .001$), flooding experience ($\beta = .19$, $p = .001$), mental health consequences ($\beta = .12$, $p = .015$) and social grade ($\beta = .11$, $p = .008$). Answering the first research question this means, that, yes, personal experience of flooding does have a positive effect on intentions to adapt to future flooding. Regarding research question two, however, no direct or moderating effect of attribution beliefs is evident for adaptation intentions.

Table 10
Linear model of predictors of flood adaptation intention

Flood adaptation intention	B	SE B	β	adj. R^2	p ≤
Model 1 (n=354)				.419	.001
Constant	2.12 (1.69, 2.56)	.211			.001
Personal flood risk	.369 (.279, .466)	.051	.377		.001
Flooding emotions	.191 (.084, .298)	.051	.195		.001
Flooding experience	.408 (.209, .615)	.110	.194		.001
Mental health consequences	.471 (.091, .822)	.197	.119		.015
Social grade	.104 (.017, .187)	.040	.111		.008

Note. **95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples ($df_{Regression}$=5, $df_{Residual}$=348, df_{Total}=353)**

4.3.2 Mitigating intention

Table 3 displays the results of the multiple regression analysis for mitigation intentions. As can bee seen the seven significant predictors included in the regression model accounted for 43.7% of variance. Climate change

concern ($\beta = .24$, $p = .001$) yielded the strongest regression weight. The other significant predictors in order of the magnitude of their beta weights are: environmental identity ($\beta = .24$, $p = .001$), collective efficacy ($\beta = .23$, $p = .001$), climate change belief ($\beta = .16$, $p = .001$), age ($\beta = .13$, $p = .001$), flooding emotions ($\beta = .72$, $p = .001$) and flood coping belief ($\beta = .43$, $p = .024$). Relating back to research question one and two, no evidence for an effect of flooding experience on mitigation intentions was found here, even after considering attribution beliefs.

Table 11
Linear model of predictors of mitigation intention

Mitigation intention	B	SE B	β	adj. R^2	p ≤
Model 1 (n=1763)				.437	.001
Constant	-2.08 (-2.24, -1.93)	.073			.001
Climate change concern	.254 (.208, .305)	.025	.241		.001
Environmental identity	.229 (.181, .271)	.023	.236		.001
Collective efficacy	.188 (.149, .228)	.020	.226		.001
Climate change belief	.138 (.099, .177)	.022	.159		.001
Age	.060 (.044, .077)	.009	.131		.001
Flooding emotions	.069 (.033, .106)	.020	.072		.002
Flood coping belief	.030 (.002, .056)	.013	.043		.022

Note. **95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples ($df_{Regression}$=7, $df_{Residual}$=1755, df_{Total}=1762)**

4.4 Discussion

This chapter focused on exploring the association between the experience of flooding and flood adaptation and mitigation intentions. Similar research questions have fuelled a series of studies in recent years investigating the role of

extreme weather events and personal experiences of climate in shaping climate change perceptions and engagement with climate change. Many of these however carry significant methodological and conceptual drawbacks that further limit the researcher's ability to study the effect of these experiences, beyond the existing limitation of not being able to causally interpret correlational data, which most of these studies rely on. The present study was designed to address three major critiques that can be directed at these research efforts: (1) The absence of study-design aspects aimed at limiting the potential for motivated reasoning and similar biases affecting how individuals report experiences of climate change. (2) The conceptual ambiguity introduced by asking about 'signs' or 'experiences' of climate change rather than asking about specific extreme weather events or climatic aspects. (3) Lack of control over whether individuals actually link specific events to climate change when asking them about the experience of those. The research presented here was designed to address these issues in analysing the association between personal flooding experience and intentions to perform flood adaptation and mitigation measures as outcome measures. These issues were remediated by the flood experience measure, which was designed to measure personal exposure to such events as soberly as possible, by the order the measures were presented in, putting climate change relevant items before any mentioning of flooding was made and by controlling for whether participants attributed the flooding to climate change.

Flooding experience was found to be a significant positive predictor of flood adaptation intentions. Participants who indicated that the 2013/14 floods had affected their property showed more intentions to take actions to prepare for future flooding. This is not a particularly surprising result as it appears logical that individuals who experienced such an event are more likely to prepare for this type of occurrences and is in line with previous research

(Kellens, Zaalberg, Neutens, Vanneuville, & De Maeyer, 2011; Terpstra, 2011; Zaalberg et al., 2009). Whether respondents attributed the flooding to climate change did not make a significant difference to how much flood adaptation intentions they reported. Equally the interaction term for these two variables did not significantly contribute to the regression model, indicating that intentions to adapt to future flooding are not affected by how much individuals thought climate change contributed to the 2013/14 flooding.

This set of findings clearly contradicts the hypothesis that the experience of flooding serves as a disengaging factor, in that it causes individuals to withdraw into passive states such as denial and learned helplessness. Related to this, statistical analysis found that the more mental health consequences individuals reported, the higher their intentions to prepare for future flooding. This further underlines the stimulating character experiencing flooding seems to possess, as even individuals, who report considerable psychological distress are more inclined to adapt to future flooding than those who do not.

The strongest significant predictor of flood adaptation intentions is personal flood risk. So, more than having experienced flooding in the past, it is the expectation of future flooding that is most strongly associated with flood adaptation intentions. Analysis found the second largest regression weight for flooding emotions. The stronger participants indicated feeling various flooding emotions with regards to the 2013/14 flooding, the higher their flood adaptation intentions were. Again, this goes to show how tightly emotional experiences and behaviour intentions are linked and is in line with previous research (Terpstra, 2011).

Finally, social grade also significantly predicted flood adaptation intentions. Respondents from higher social grades reported higher flood adaptation intentions. It might not be surprising to find this association as two of the proposed measures to prepare for flooding involve costs, which might act

as a barrier to engagement for lower income families. Factor analysis of the scale however did not highlight these two items as particularly representative of the scale and the other four measures in fact did not involve any costs. Therefore, I would speculate that the economic aspect alone might not be the sole driving force behind this association and that other aspects, such as lacking awareness, might help to explain this relationship. This interpretation is underpinned by a UK study which found that class is the most influential factor in predicting flood risk awareness (Burningham, Fielding, & Thrush, 2008). In terms of civil protection this is a rather worrying result. Individuals and families from lower social grades are more vulnerable to begin with, just by virtue of being more likely to live in zones at risk of flooding (Fielding, 2012). The idea that there is an additional vulnerability aspect beyond this existing inequality is particularly disconcerting and illustrates the limitations of addressing inequality issues on a purely economic level, without raising awareness in the relevant social groups.

The regression model for mitigation intentions with regards to the effect of flooding experience yielded no significant contribution. According to the data presented there, whether an individual was affected by the 2013/14 flooding makes no difference to how much he or she intends to mitigate. Two significant predictors related to the 2013/14 flooding however yielded significant regression weights. The stronger individuals reported feeling emotions with respect to the 2013/14 flooding the higher their intentions to mitigate. One could hypothesize that the strong emotional experience the flooding events triggered motivates people to act on climate change. This reasoning to some extent presupposes that individuals link the flooding to climate change and therefore see personal mitigation as an appropriate answer. The fact that neither the flooding experience by itself, nor the combined interaction term for attribution and flooding experience had a significant impact on mitigation intentions does

however put this proposed causal chain into question. Alternatively, one could explain this finding arguing that respondents who intend to mitigate are also more likely to experience stronger emotions regarding the flooding, which explains the positive association found here. As shown in chapter 2.3.2 there is a strong link between emotional engagement, identity constructs, such as environmental identity, and higher mitigation intentions. A proposed mediation effect of environmental identity, however, can be ruled out here, as environmental identity was included in the model as a significant predictor alongside flooding emotions. This points to a potential effect of experiencing flooding on mitigation intentions, mediated through emotions that is apparently decoupled from actually experiencing flooding, or attributing it to climate change, or any ideological component.

An interesting finding with respect to a proposed link of flooding experience and mitigation is the positive association between flood coping belief and mitigation intentions. This finding indicates that a lower perceived ability to cope with future flooding events is related to lower mitigation intentions. In other words, participants who think that future flooding events will potentially pose a considerable challenge for them to overcome, are less inclined to mitigate. One could argue that respondents who fear that future flooding events might overwhelm their ability to cope turn their attention to preparative actions, flood adaptation measures that is, and thus show lower intentions to mitigate. The non-significant contribution of flood coping belief in the flood adaptation intentions regression model and an exploratory test of mean differences for the ratio of flood adaptation to mitigation intentions score between respondents high and low in flood coping belief that finds no difference ($t(1731) = -1.00$, $p = .319$), however, makes this a rather implausible proposition. The exact pathway via which this happens cannot be satisfactorily investigated here and the relatively small beta weight for flood coping belief

cautions against any definite conclusion regarding this association. Future studies must aim to confirm this finding and investigate it in more detail.

The predictor that best explained mitigation intentions was concern for climate change. Unsurprisingly the more concerned individuals indicated they were about climate change, the stronger their intentions to mitigate were. Environmental identity ($r(1896) = .419$, $p < .01$) and belief in climate change ($r(1896) = .482$, $p < .01$) analogously were positively associated with mitigation intentions.

Collective efficacy yielded the third largest regression weight. It is somewhat surprising that collective efficacy rather than personal efficacy is significantly associated with personal mitigation intentions. This result suggests that individuals who intend to mitigate also share a stronger belief in the ability of society to address the issue of climate change. This illustrates how individual intention to act is linked to the belief that a collective effort to address climate change will be possible and effective. Similar to the finding for flooding emotions one could argue that potentially this type of efficacy belief is linked to a broader mind set that generally includes a more optimistic view of collective efforts, in line, for example, with communitarian convictions regarding the importance and power of collective action and that it is therefore linked to mitigation intentions. Again, however, the fact that variables associated with this type of mind set are included in the model as significant predictors challenges this assumption, supporting an interpretation of collective efficacy beliefs as an independent correlate of mitigation intentions.

Lastly, age was significantly associated with mitigation intentions. The younger participants were, the stronger their intentions were to mitigate. This is in line with studies that have found an analogous relationship and generally lower engagement with climate change among older respondents (Hersch & Viscusi, 2006; Spence, Venables, Pidgeon, Poortinga, & Demski, 2010).

4.5 Conclusion

This study's main goal was to investigate whether the personal experience of flooding combined with the attribution of such events to climate change was linked to mitigation intentions but also flooding adaptation intentions. The experience of flooding is clearly associated with intentions to prepare for future flooding events. Flood adaptation overall is associated with various flood related variables, such as the perceived risk of future flooding affecting one's property and negative emotional consequences of flooding. It is perhaps unsurprising that no climate change related measures predict flood adaptation intentions but it illustrates a considerable mismatch, in that preparative actions for future flooding – a phenomenon intrinsically linked to climate change – are determined by experiences in the past rather than projections of and beliefs about the future climate change will bring. This evidently harbours a disadvantage in terms of the appropriateness of flood preparedness on a population level, as individuals, who have not been affected yet by flooding lack a substantial number of drivers towards preparedness. Those who have experienced flooding instead, as Green, Tunstall, and Fordham (1991) note, will most likely base their actions on past experiences rather than projections of what could be and will thus be ill prepared.

Consistent with existing literature (Whitmarsh, 2008; Zaalberg et al., 2009) the evidence presented here strongly suggests that experiencing flooding is only relevant to individuals' intention to prepare for future flooding. This rebuts any speculation around a potentially disengaging effect, such as learned helplessness, induced by experiencing flooding. Mitigation intentions on the other hand are not related to flooding experience. For personal experiences of flooding the effect described by the experiential learning pathway thus seems to apply to flood adaptation measures but does not extend to mitigation measures. It is reasonable to infer from these findings that flooding is not sufficiently

strongly linked to climate change, as to influence individuals' engagement with climate change once they experience it. Participants who link the flooding to climate change, as measured through the attribution variable, do not show any difference regarding their mitigation intentions either and qualifying the flooding experience with participants' tendency to attribute the flooding to climate change also does not yield any significant contribution for both flood adaptation intentions and mitigation intentions. In other words, the effect that flooding experience does or does not have on flood adaptation and mitigation intentions is unaffected by whether participants believe that the flooding was in part caused by climate change.

These results challenge previous findings that have linked the experience of climate change impacts and/or extreme weather events and engagement with climate change. A major criticism of previous research in this area concerns the various operationalizations of experiences of climate change that exist. Myers et al. (2013) for example asked participants to rate their agreement with the statement 'I have personally experienced the effects of global warming' to measure perceived personal experience of global warming. The introduction has highlighted the issues this sort of formulation raises, in particular with regards to addressing the question of directionality[38] between experiences and climate change engagement, but also beyond that in terms of what type of experience is retrieved. The study presented here included a similar measure, which asked respondents whether they had noticed any sign of climate change during their lifetime. This measure was only very weakly related to the main flooding experience measure ($r(1126) = .07$, $p < .05$). An exploratory regression for mitigation intentions that included this alternative experience measure, yielded a significant contribution of this variable to the regression model, indicating

[38] Ironically it is precisely this issue the above-mentioned authors intend to address.

that respondents who had noticed signs of climate change in their lifetime, exhibited higher intentions to mitigate.

While 'noticing signs of climate change' contributes to explaining mitigation intentions and is also significantly related to other climate change perceptions such as belief in climate change ($r(1906) = .48$, $p < .01$), the measure used in this study, which could be argued to measure a very similar, albeit more specific, experience finds no association. I would argue that this finding illustrates how there is a strong value/identity component in measurements that ask for 'experiences' or 'signs' of climate change and that, to a large extent, it is this component in fact that drives the significant association between personal experiences of climate change and the various outcome measures found in previous studies.

This study carried certain shortcomings. Due to constraints to the overall length of the survey, some of the constructs included were measured using single items only. Future studies to verify the results presented here should aim to incorporate scale measurements for all the relevant variables. Only intention measures were included and so comparisons with the results gathered for policy support measures in chapter 2 and 3 cannot be made. This could be crucial measures to consider for future studies, in particular if one assumes that certain individuals did not intend to adapt to future flooding or to mitigate because the felt that it was essentially someone else's, such as the state's, responsibility to act in response to the flooding.

The design of the survey tried to limit the issues regarding the question of directionality as outlined in the introduction to a minimum. Still this research relied on correlational data and as such is open to similar criticisms. To better address the question of directionality future studies would have to employ a longitudinal research design with measurements before and after a flood has occurred. The long-term unpredictability of extreme weather events

and the potentially futile recurrent measurement of certain variables for large sample sizes that comes with such a research project, however, present a serious challenge to this type of scholarly effort.

A potential limitation to the results presented here is the fact that the national sample included 27 respondents that had experienced flooding. In order to retain the representativeness of the national sample, however, these individuals were not added to the flooded samples. This could mean that the flood experience measure's effect is potentially weakened by the fact that the non-flooded nationally representative sample includes a minor percentage (2.7%) of participants who experienced flooding on their property.

The results presented here challenge various previous studies that have linked the experience of climate change and engagement with climate change. I find that the experience of flooding is unrelated to mitigation intentions, even after controlling for whether respondents attribute the flooding to climate change. The fact that this study used an experience measure markedly different from previously used indicators goes to show how different operationalizations of 'experiencing climate change' can lead to very different results. This underlines the importance of carefully designing the experience measure, as well as the survey overall. Future studies directed at investigating the relationship of experiences of climate change and engagement with climate change should seek to incorporate a measure similar to the measure used here.

In terms of insights regarding the predictors of flood adaptation and mitigation intentions one variable should be highlighted. The *emotional reaction to flooding*, that is, how intensely participants indicated feeling certain emotions with regards to the 2013/14 flooding predicted both flood adaptation and mitigation intention. This result falls into a consistent pattern established in this thesis which attributes a strong role to the affect heuristic in determining behaviour, both for a variety of climate change actions, as well as very specific

protective actions aimed at a single type of climate change impact. Risk communicators would thus be very well advised to transmit this type of affective experience in trying to motivate relevant behaviour. While caution with regards to scaring individuals into in/action are justified, the findings presented here strongly suggest that the tolerance for this kind of effect is considerably high, as even participants who report suffering from several mental health issues as a consequence of the 2013/14 flooding are still more inclined to prepare for future flooding than those who do not.

Chapter 5 - Conclusions

This chapter summarizes and discusses the findings presented in this thesis. First I draw on the main findings to answer the three principal research questions that guided this work. I then discuss applied, theoretical and methodological implications of the studies presented here. A brief conclusion completes this chapter.

5.1 The research questions

5.1.1 What is the relationship between adaptation and mitigation in public perceptions?

This question was answered on multiple levels of analysis. Correlational data indicated that public perceptions of adaptation and mitigation were positively connected. At this very basic level of analysis this points to the understanding that, at least in terms of public intentions and support, there are no trade-offs between adaptation and mitigation. Since correlations do not allow any causal inferences one should not, however, expect to find that increasing adaptation intentions, through public awareness campaigns for example, automatically increases mitigation intentions.

Investigating the results of the multiple regression analyses for the various outcome measures helped further elucidate the relationship of adaptation and mitigation and allowed for a more nuanced picture. In terms of explained variance, all the regression models performed comparably well, except the regression model for support for financial regulation. Predictor patterns yielded some parallels. For both adaptation and mitigation intentions for example, personal efficacy and emotional engagement with climate change were positive predictors – results that are in line with previous research (Gifford, 2011; Stern, 2000).

Overall, however, differences between predictor patterns for adaptation and mitigation predominated. The single most striking result in this regard was that adaptation intentions and scepticism were positively associated. Contrary to what has been assumed in work on predictors of climate change engagement (Akter et al., 2012; Lorenzoni et al., 2007) this result hints at the idea that climate change adaptation at the individual level and in terms of psychological correlates does not depend on belief in climate change. This leads to the next research question the present thesis addressed. If being sceptical about climate change is linked to greater climate change adaptation intentions, can climate change adaptation then be understood as a catalyst to help engage this typology of previously unengaged publics?

5.1.2 In what way does focusing on one or the other climate change action affect the public's engagement with climate change overall?

To address this question I investigated how framing climate change as an issue of adaptation vs. mitigation affected people´s engagement with climate change. Overall the effects on participants' engagement with climate change were significant for climate change action frames and political orientation. Following up these main effects, however, revealed that a large share of the effects for the individual variables were small and non-significant. Mitigation frames increased climate change concern and adaptation frames decreased scepticism, supporting an understanding of an adaptation framing as a corrective to a dismissive stance towards climate change. Further analysis found that significant effects of the climate change action framing for emotional engagement and concern for the effects of sea level rise depend on the political orientation of the individual and whether climate change was presented as a local or global issue.

The adaptation frame led to more emotional engagement in right-leaning and less engagement in left-leaning participants. For the mitigation condition the effect was inversed. This difference proved true only when climate change was presented as a local issue. In both global conditions emotional engagement dropped among right-leaning individuals and increased among left-leaning. Change in concern for the effects of sea-level rise was also affected by an interaction of climate change action framing, spatial framing and political orientation. Contrary to emotional engagement, interaction effects were concentrated in the global conditions. The effect of the climate change action framing, however, roughly followed the direction of effects found for emotional engagement, with the adaptation condition increasing right-leaning concern and the mitigation doing so for left-leaning individuals.

In summary, this study found preliminary support for how focusing on one or the other climate change action can have a differential effect on individuals' engagement with climate change in line with existing research (Evans et al., 2014). Beyond this, however, the current research proved that it was important to consider the political orientation of the target audience and at which scale climate change was presented. In line with similar work on cultural cognition (Braman et al., 2012) adaptation frames were engaging to right-leaning participants and mitigation frames were disengaging to them. The opposite was true for left-leaning individuals. Whether climate change was presented as a local or a global issue seemed to interact with the type of outcome measure that was being analysed.

Overall, however, a majority of the outcome variables were unaffected by the experimental manipulations. This lack of significant findings must not necessarily mean that framing climate change in terms of adaptation and mitigation does not affect individuals' engagement with climate change. It is possible that the conservative nature of the experimental manipulations, the

skewedness of political orientation in the sample and the repeated measures design, which potentially prompted participants to seek consistency in responding to the survey contributed to this weak set of outcomes. In spite of this the significant effects that this study did find, and the fact that these were in line with the theoretical assumptions made beforehand, represent a promising foundation for further research in this line.

Due to restrictions to the investigated samples an important predictor was precluded in the above-mentioned analyses: personal experiences of climate change. Personal experiences with a particular hazard have been highlighted very early on in risk literature as relevant predictors of self-protective action (White, 1945) and, increasingly so, in literature dealing with mitigation intentions (e.g. Spence et al., 2011). This research question was addressed here for the specific case of personal flooding experiences and their effect on adaptation and mitigation intentions.

5.1.3 What influence does the experience of flooding have on intentions to perform flood adaptation and mitigation?

To answer this question I relied on a data subset from a nationally representative study, which was launched in the aftermath of severe flooding events in the UK in winter 2013/14, investigating the effects of experiencing flooding on engagement with climate change.

The analysis presented here found that experiencing flooding was strongly associated with flood adaptation intentions but not connected to mitigation intentions. Results yielded very distinct predictor patterns for flood adaptation and mitigation intentions. In line with what one would expect from previous research (Kellens et al., 2013) individuals who had their property flooded showed stronger intentions to prepare for future instances of flooding. Whether participants attributed the flooding to climate change, however, did not make any difference to their flood adaptation intentions.

This dissociation from any climate change related constructs was an overall characteristic of the predictor pattern for flood adaptation intention. Personal flood risk and the amount of negative emotions felt regarding the 2013/14 flooding were more strongly associated with flood adaptation intentions than the actual experience of flooding on one's property. Further, the more mental health consequences due to the 2013/14 flooding respondents reported, the higher their intentions to adapt to future flooding were. This last finding in particular contradicts any speculations about a potentially disengaging effect of flooding experience as a consequence of psychological processes such as learned helplessness or cognitive coping.

Mitigation intentions on the other hand were more strongly associated with climate change-related constructs. The experience of flooding instead was not directly linked to mitigation intentions. This contrasts with some of the existing literature in this research area, which has linked personal experience of flooding and other extreme weather events with climate change engagement (e.g. Spence et al., 2011). One could speculate that there is an indirect effect of flood experience on mitigation intentions as negative flooding emotions significantly predicted mitigation intentions. It is questionable though, whether flooding emotions are linked to mitigation intentions via the actual experience of flooding. Attributing the flooding to climate change, a reasoning that one would assume to be an essential premise, connecting flooding experience and action on climate change, did not help explain mitigation intentions, nor did it help moderate the non-significant influence of flooding experience on mitigation intentions. It thus seems more plausible that the association of flooding emotions with mitigation intentions constitutes an independent aspect, unrelated to whether one was affected or not.

Low coping belief significantly predicted lower mitigation intentions. It is tempting to suggest that it is the associated expectation of being excessively

challenged by future flooding that reduces intentions to mitigate, as attention and motivation to act are more strongly focused on flood-adaptation. Additional analysis, however, found no difference in the ratio of flood adaptation intentions and mitigation intentions between respondents high and low in coping belief. In any case, the relatively small contributions of these latter two flood-related variables in explaining mitigation intentions cautions against any overly confident interpretations of these effects.

In summary, the body of evidence gathered here clearly indicates that the intention to adapt to future flooding has a very strong experiential component but lacks any association with climate change related constructs. Mitigation intentions, on the other hand, are not directly related to the experience of flooding even after controlling for attribution beliefs that could potentially moderate such associations (cf. Clayton et al., 2015).

5.2 Implications

5.2.1 Engaging the public

The evidence collected in this thesis shows that, in terms of psychological correlates, adaptation and mitigation share more dissimilarities than similarities. Based on this insight, it is not advisable to treat these two adaptation and mitigation as equal in communication efforts. Doing so harbours a considerable potential for ill-informed strategies. The one major finding to illustrate this is that, contrary to what one would expect, statistical analysis showed that climate change scepticism is a positive predictor of adaptation intentions.

For professionals who aim to engage the public in action on climate change, this finding should serve as a warning against efforts to promote individual adaptation and mitigation conjointly. The opposite effect of climate change scepticism on adaptation intentions clearly demonstrates that what

might work for mitigation, may well not work for adaptation. Applying the same formula to adaptation could in fact do more harm than good.

This result for scepticism hints at how certain individuals might engage quite differently with adaptation as opposed to mitigation. Tentative support for these differential aspects of climate change actions comes from the distinct effects that mitigation and adaptation frames have on individuals' emotional engagement and concern for sea-level rise as a function of political orientation and the spatial frame in which climate change is presented. The results found here regarding political orientation but also regarding certain value orientations, I argue, can be interpreted as outputs of mechanisms outlined in chapter 1.3.3 discussing cultural theory of risk (Douglas & Wildavsky, 1983; Wildavsky & Dake, 1990). The study presented in chapter 3 did not follow the established group-grid classification in measuring cultural orientations but despite relying on a crude categorization, such as 'left-leaning' and 'right-leaning', it was able to show that whether individuals do increase or decrease their engagement in reaction to one or the other climate change action is a function of ideological orientation. Speaking of local or global climate change further adds variance to create a very fragile network of interdependent communication aspects. Similar to Brügger et al. (2015) I can thus conclude that public engagement campaigns can quickly yield unwanted effects if the subtleties of the involved publics and various message aspects are not sufficiently understood and observed. A highly problematic aspect this thesis raises and one that warrants particular attention and caution is that misguided campaigns do not only run the risk of further disengaging an already disengaged audience but also risk disengaging those previously engaged.

It is also important to point out that while the processes and mechanisms in cultural theory of risk (Douglas & Wildavsky, 1983; Wildavsky & Dake, 1990) are highly relevant in this regard, the original group-grid classification

need not necessarily be. This latter conclusion is based on the results for the cultural orientation scales presented here. For one study I was not able to confirm the intended factor structure (see chapter 3.2.2) and while I was able to find a clear factor structure in the other study, the achieved scales were characterized by unacceptable reliability scores (see chapter 4.2.2). Cultural theory of risk and the associated group-grid classification and scales are theoretically rooted in an American context and in line with existing literature (cf. Brenot, Bonnefous, & Marris, 1998; Kahan, Silva, Tarantola, Jenkins-Smith, & Braman, 2014) it is not overly surprising to find that the associated measurement scales do not work comparably well in a British context.

Based on the evidence presented here one could speculate that communication focusing on climate change mitigation, in particular if discussed at the local level, has the potential to drive right-leaning publics into even more disengagement. This contradicts some of the literature that generally assumes and has found a positive effect of 'localizing' climate change (Scannell & Gifford, 2011). From the results presented here it is in fact reasonable to assume that existing undifferentiated campaigns to increase public engagement with climate change in combination with the predominant focus on mitigation might have already made certain publics more dismissive of climate change, inadvertently contributing to the deeply polarized positional play on climate change, as it exists in some contexts today. This could be particularly relevant to NGOs that have a track record in promoting climate change mitigation, as their role is strongly associated with this type of perception. A stronger focus on adaptation would thus not only help to communicate more successfully to the kind of publics described above, but could equally help to change an overly one-sided image of these NGOs, increasing the efficacy of communication efforts overall.

An adaptation frame could be equally beneficial to governmental communication efforts that accompany the introduction of new policies aimed at reducing the population's carbon footprint, especially if these policies require potentially inconvenient behaviour changes or additional financial commitments. An adaptation frame in this scenario could again increase engagement in previously unengaged audiences but also help to highlight additional benefits and thereby increase compliance.

A crucial advantage of adaptation in is that, as a more recent climate change response category, it has not yet been associated with the specific ideological triggers that surround climate change mitigation and that make it simply less restricted in terms of the impartial engagement it can attract. Also, adaptation has been a constant in human evolution, long before climate change became an issue. So, even as adaptation gets increasingly associated with climate change, this legacy as an "anthropological constant" (Stehr & von Storch, 2005, p. 538) could, at least for some time, prevent an all too one-sided engagement with it. This is visible in the results on flood adaptation intentions, where climate change related constructs are strikingly absent. This should not, however, invalidate the applicability of these results to the issue of climate change engagement. Flood adaptation is clearly relevant in a climate-changed future, even if these findings indicate that the intentions to adapt might not be associated with climate change. Following this logic, I would argue that promoting specific adaptation actions need not necessarily be embedded within a climate change context either, especially if this type of framework is likely to turn certain audience segments away. Even if individuals then do not consciously address climate change, the design of the actions could still accommodate the various climate change projections to ensure that this important aspect is accounted for.

Considering the format these communication efforts and engagement activities should take is an important issue. Messages focusing on adaptation as a climate change measure that is rather novel would certainly benefit from more in depth communication modes. I would argue that larger campaigns, including participatory and two-way communication efforts, would be most useful and effective. This could include workshop formats and public discussions on the wider implications of climate change, starting from a discussion of the necessary future adjustments as exemplified by the various outlined adaptation measures.

Adaptation could play an important role as a catalyst for audiences that struggle with the existing focus on mitigation. The positive aspect of an initial focus on adaptation is that one potentially does not have to completely renounce mitigation. On the contrary, there is research (Furth & Gantwerk, 2013), which shows that focusing on adaptation naturally leads to consideration of mitigation, even among climate change sceptic individuals. This is a promising indicator of the potential for adaptation to serve as a gateway to attracting audiences that would otherwise not engage with climate change. A focus on adaptation would not only create positive effects in terms of simply engaging more individuals in addressing climate change, but in doing so it could also make climate change a less divisive issue, which ideally would lead to a situation where climate change legislation and the associated policies and interventions become less contested.

In light of the results described here, the current shift in climate change policy towards a more balanced representation of mitigation and adaptation holds opportunities and risks. Focusing on adaptation could serve as an antidote to sceptical beliefs and potentially increase engagement in audiences that are turned away by communication efforts that focus on mitigation. Unfortunately the study presented in chapter 3 found that this focus is equally disengaging to publics that respond well to mitigation, as focusing on mitigation is to their

ideological counterparts. To resolve this catch-22 situation the differentiation between transformative and incremental adaptation might be of great value.

It is in fact important to point out that the various adaptation-related actions were based on an incremental adaptation definition. Incremental adaptation broadly describes efforts geared at maintaining a given status quo under changing environmental conditions. The results presented here regarding adaptation accordingly concern this form of adaptation. Transformative adaptation on the other hand describes an approach that, rather than preserving things as they are, aims to address the aspects that create vulnerabilities, and thus the need to adapt, in the first place. As the scholarly dialogue on climate change adaptation is increasingly pointing to transformative adaptation in order to avoid heading down an unsustainable and maladaptive pathway, a transition to a much stronger focus on this adaptation category appears inevitable. Some authors suggest that to do so, existing power relations and social structures have to be challenged (Bassett & Fogelman, 2013; Ribot, 2011). This stands in stark contrast to incremental adaptation's main goal to conserve the status quo. This discrepancy constitutes a major limitation to this thesis' discussion of focusing on adaptation as a way to engage an audience whose cultural orientation conflicts with mitigation. It is conceivable that individuals who oppose mitigation for the reasons discussed in chapter 2.4 will most probably be equally reluctant to engage with transformative adaptation.

In summary, incremental adaptation can serve as an access point to the wider climate change debate, which then necessarily must focus on mitigation and transformative adaptation. If this transition is communicated in a fashion that is mindful of the publics it seeks to address, transformative adaptation could play a key mediator role in this. After incremental adaptation facilitates a positive first engagement with climate change for individuals who oppose mitigation, transformative adaptation, by means of focusing more on *adaptation*

than on *transformation*, could represent a less ideologically charged policy option compared to mitigation. For audiences that positively engage with mitigation instead, transformative adaptation could apprehend the risk of disengaging the engaged by focusing on *transformation*, rather than on *adaptation*, which in multiple ways resonates much more with mitigation than incremental adaptation.

Regarding mitigation, this thesis finds a clear pattern. Mitigation, to a large part, resonates with individuals, who hold pro-environmental and self-transcendence values; who believe in climate change and are concerned about it; and who feel that mitigation is something they and society as a whole can accomplish. Efforts geared at promoting mitigation at the individual level, will thus most likely fall on fertile ground if this type of audience is targeted. It is questionable, however, whether it is cost-effective to communicate to these audiences to further engage them. I would suggest that it is in fact more important to concentrate efforts on not disengaging this audience, as outlined above.

The rather global character of mitigation intention and the lack of an experiential component in particular do in fact represent a major disadvantage to efforts geared at promoting individual mitigation actions. From this point of view increasing individual mitigation intentions represents a constant uphill battle against more immediate and specific needs, needs on which adaptation intentions seem to feed. Following this line of reasoning the question of trade-offs between adaptation and mitigation might have to be revisited. Climate change is not yet perceived to be a particularly pressing issue on the public agenda. Once it is however, or more importantly, once the increasing intensity and frequency of climate impacts shifts public attention to more immediate instances, it is reasonable to assume that adaptation will assume a more prominent role, further pushing away mitigation.

Considering the historical dominance of mitigation as the prototypical climate change response, it is a question of significant importance how adaptation as an alternative and equally important climate change response will influence overall public engagement with climate change. To illustrate the potential consequences this shift in policy focus can have it is informative to imagine a future policy scenario that is dominated by adaptation. From the tentative evidence this thesis gathered, such a dramatic shift in policy emphasis would potentially lead to disengagement in audience segments that have identified, or better, *identified with*, mitigation as the method of choice to address climate change. The somewhat paradoxical situation that could follow from this would see some of the former supporters and opponents of timely and extensive action on climate change swap sides.

I believe, however, that if the necessary caution and diligence is used to manage this transition it could be equally plausible that climate change adaptation can serve to depolarize the current climate change debate and simultaneously attract new audiences to engage in addressing climate change. An essential premise for turning the current policy reorientation into a success story, rather than a sequel to the current situation, is knowledge of how individuals react to the various elements that characterize the new policy mix. This thesis provided some of these necessary insights that should help avoid engaging audiences at the expense of disengaging others but more research in this line is needed to better understand the subtle interdependencies of the various aspects that define public engagement with climate change, such as the various climate change actions and the scale at which climate change is presented.

Equally important will be to further our understanding of how experiences of climate change affect individuals' engagement with climate change. Regarding the role of personal experiences of flooding the research

presented here was not able to replicate existing literature which has shown that a significant link exists with mitigation intentions (e.g. Spence et al., 2011). Based on the results that were gathered here it is thus doubtful whether communication efforts can harness extreme weather to induce greater mitigation intentions, when even individuals who were directly exposed to this sort of events do not intend to mitigate more. Consistent with existing risk perception literature (Kellens et al., 2013) statistical analysis did, however, confirm a direct link between the experience of flooding and greater flood adaptation intentions. Flood adaptation in turn was not associated with any climate change-related construct. This result means that adaptation essentially depends on experiences of past events, as opposed to projections of what could be, in particular with regard to future climate change scenarios. This could prove problematic, as it creates the potential to underestimate or falsely identify actual adaptation needs.

Also worth mentioning here is the finding that higher social grades were found to be associated with higher adaptation intentions, pointing to another important constraint on individual flood preparedness. The fact that only two out of six proposed flood adaptation actions were actually associated with costs indicates that influence of class goes beyond the mere economic aspect. This would mean that, in addition to existing vulnerabilities, lower social classes are burdened with an additional vulnerability factor that is not necessarily linked to economic inequality, or at least won't be remedied by eliminating it. This combination of vulnerabilities illustrates how efforts to guarantee appropriate adaptation have to operate on multiple levels, from addressing the monetary disadvantages to providing education and building awareness. This further underlines the importance of transformative adaptation as a key policy objective for the future that does not conserve the existing status quo and its inherent inequalities but instead creates a more favourable situation for everyone.

5.2.2 Theoretical and methodological implications

Climate change adaptation does not seem to fall victim to the above-mentioned one-dimensionality of climate change engagement. This thesis found clear indications for specific constructs that seem to be of particular relevance to climate change adaptation only, or constructs that, concerning their role as predictors of climate change engagement, do not behave, as one would expect based on previous findings for mitigation intentions. Compared to mitigation intentions, adaptation intentions are characterized by a strong egocentric and experiential component. Adaptation intentions are linked to specific concerns, concern for the self rather than the world as a whole and concerns for the specific issue of sea-level rise rather than climate change as a whole. Further, personal experiences seem to play a central role with regards to adaptation intentions not directly linked to climate change. Summarizing this set of results one could speak of a more immediate quality pertaining to correlates of adaptation intentions. This immediate quality might also help to explain the previously discussed finding for climate change scepticism, which turned out to be a positive predictor of adaptation intentions. This result needs to be replicated and explored in more detail in future studies to fully validate and better understand this first exploratory finding here. I would, however, hypothesize that, applying a cultural cognition understanding (Kahan, Jenkins-Smith, & Braman, 2011), the association between sceptical beliefs and adaptation intentions is an expression of this immediate quality of adaptation that appeals to people with specific cultural orientations, such as individualists, which have been found more frequently among climate change sceptical audiences (cf. Capstick & Pidgeon, 2014b).

For mitigation, egocentric concerns and an experiential component were not found to be significant predictors. To this effect, the lacking predictive value of flood experiences for mitigation intentions needs to be highlighted.

Various articles have suggested that this type of link exists for mitigation intentions (e.g. Spence et al., 2011). While some contrary evidence (Whitmarsh, 2008) does exist, the majority of studies has found that the experience of extreme weather events, specific climate change impacts and similar is connected to more engagement with climate change. Personal experiences of flooding are connected to greater concern for climate change and stronger personal efficacy beliefs, which mediate greater willingness to mitigate climate change (Capstick et al., 2013; Spence et al., 2011). I would argue that the contrasting result found here, to a large extent, can be traced back to the experience measure used. As argued by Demski, Pidgeon, Sposato and Spence (2016, manuscript submitted for publication) asking respondents whether they had had water in their property provided a very stringent measure of personal experience, limiting the room for interpretation and thus potential biases such as motivated reasoning. Inspecting the existing research on personal experiences of climate change impacts (e.g. Myers et al., 2013) it is relatively evident that this does not apply to many of the measures used. It should be obvious that individuals who respond more positively to climate change in general will more frequently answer questions about experiences of climate change in the affirmative. To then reason that this positive association proves that experiences of climate change can induce more engagement with climate change is highly misleading. The results presented here can be interpreted as prolonging the scholarly debate on whether motivated reasoning or experiential learning best explain the links that have been found for experiences of climate change impacts and climate change engagement (cf. Reser et al., 2014). This work now raises the question of whether findings supportive of linking personal experiences and more climate change engagement are not just artefacts of motivated reasoning processes after all, facilitated by insufficiently stringent experience measures. Further research is needed to resolve the long-standing

debate on whether an experiential pathway exists, connecting experiences of climate change impacts and engagement with climate change.

Future research in this line should rely on a narrowly defined measure, as was used here. This type of measure can shield against finding the type of redundant correlations motivated reasoning provokes, as it only allows for a very limited scope of interpretation. As such, it should be less likely to trigger what appear to be quite well established associative networks, when it comes to how people engage with climate change-related measures. While it is precisely these associative networks that psychologists are interested in, the one-dimensionality – either 'for climate change' or 'against climate change' – that seems to surround this issue, is a serious methodological challenge limiting the predictive value of many of the variables investigated. This is somewhat symptomatic of this research area and major efforts should be investigated into finding variables and measurement forms that do not encounter this problem.

A variable that deserves attention in this regard is emotional engagement. A constant that emerged from the results presented in this thesis is the central role the emotional experience of individuals assumed clearly pointing to the affect heuristic as a central theoretical construct.

Emotional engagement with climate change was a significant predictor of both mitigation and adaptation intentions and, more importantly, support for financial regulation. In comparison to the support for adaptation and mitigation policy scales these three measures share one distinct characteristic: they all imply some form of costs. Emotional engagement is the only measure that shows a consistent contribution to all the regression models of this set of outcomes measures. Further contributing to emotional engagement's unique position is the fact that out of all variables it is also the best predictor for support for financial regulation, for which the regression model, and thereby the other variables that were studied here, yielded the lowest predictive value. This

set of findings thus clearly supports the affect heuristic's principal assumption that feelings influence our risk decisions (Slovic, Finucane, Peters, & MacGregor, 2007). Beyond that, it actually illustrates the limits of the other constructs investigated here in yielding a consistent association with this cluster of 'costly' engagement measures. The strong correlation between the emotional engagement measure and the intention measures, but equally the support for financial regulation measures, position the affect heuristic as a central construct when it comes to predicting some of the essential support and intentions relevant to tackling climate change.

Negative emotional responses to flooding were equally associated with flood adaptation intentions and mitigation intentions. The link for mitigation intentions and for flood adaptation intentions, again, points to the importance of emotional experience and the affect heuristic as a predictor of behavioural intentions alongside conventional risk perception constructs. In the framing study emotional engagement with climate change was the only climate change related action that was affected by the experimental manipulations. One could conjecture that this latter result is to some extent a consequence of the immediate and often unconscious mechanisms of the affect heuristic (Slovic et al., 2004), which could prevent efforts to consciously and consistently respond to pre- and post-measures. This in turn could mean that response patterns emerge, which are no longer masked by ambitions to give uniform answers before and after. This is of course highly speculative but the multiple regression results do clearly indicate that the affect heuristic even at the very abstract level it was operationalized here, provide a valuable addition in terms of explained variance. The effect of emotional engagement appears to be largely independent of the other variables included, further accentuating the particular role our feelings seem to play in informing our engagement with various climate change related issues.

In summary, these outcomes suggest that emotional engagement is a good indicator of committed climate change engagement for both adaptation and mitigation. I hypothesize that this is a consequence of the specific quality of the affect heuristic, which seems to be less susceptible to pressures from pre-existing biases. Just like has been found for simple risk judgement and decision making tasks (Damasio, 1996) there is evidence here that individuals do crucially rely, whether consciously or unconsciously, on their emotions when engaging with climate change. Researchers should follow suit, relying on emotional engagement as a valuable diagnostic tool that allows them, at least to some extent, to break free of the one-dimensional space that climate change engagement constructs seem to be spanning otherwise. In doing so it would be commendable to reproduce some of the effects found here. Relying on alternative measures of emotional engagement would add further strength to this type of study – in particular, if physiological measures of arousal, such as skin conductance levels, could be collected alongside the more conventional psychometric scale measurements, as were used here.

In terms of studying the effect that an increasing policy focus on adaptation has on public engagement with climate change a few key methodological aspects can be highlighted. If future research efforts rely on a similar methodological approach scholars must pay attention to the strength and quality of the experimental manipulations. Researchers should try, as far as possible, to ensure that manipulations are strong and that participants are motivated to meaningfully engage with these. This should be done to ensure that experimental manipulations are not potentially superimposed by confounding factors, such as social desirability pressures, or efforts to answer in a consistent manner. Concerning this latter source of interference, the suitability of the pre-post design chosen here needs to be critically reviewed. Since the effects of the experimental manipulations used here hinge on

ideological and political orientation, the investigated sample should ideally be split equally regarding these latter dimensions.

This last aspect relates to a potential limitation of any framing study similar to the one presented here that is carried out in a UK context. It could be argued that polarization regarding the issue of climate change, compared to an US-context is not sufficiently pronounced in the UK and that this has contributed to small effect sizes. Recent research has shown that on a European level polarization regarding climate change is in fact less pronounced even though a left-right divide still exists (McCright, Dunlap, & Marquart-Pyatt, 2016). The question this raises is whether the effect of an adaptation frame relies on a polarized discussion, or whether the specific characteristics of adaptation, which individuals from different ideological camps will react to differently, are sufficient. To fully address this question it would be commendable to rerun the survey in an US context comparing it to results from a less polarized context, as can be found in many European countries. The results presented here from a UK background, where climate change certainly is a less contested issue, suggest that there is something distinct about adaptation and mitigation that does not necessarily rely on a polarized public debate to prepare the ground. Similar results from New Zealand, where the public debate on climate change should be comparable to that in the UK further support this assumption (Evans et al., 2014)

In light of a new change of course in the IPCC's policy discourse (IPCC, 2014b), from incremental to transformative adaptation, looming on the horizon, it is important to point out that the results and discussion presented here concern one adaptation category only. This thesis investigated adaptation actions that are best described as incremental adaptation. In doing so it precluded transformative adaptation as an alternative form of adaptation. Critical climate change literature has highlighted how this type of adaptation

response will play a central role in preparing for climate change in the future (O'Brien, 2012). A focus on this adaptation category is thus strongly recommended for future research efforts investigating public perceptions of climate change.

I propose that focusing more strongly on transformative adaptation is important for two reasons. First, in studying incremental adaptation only, researchers run the risk of falling behind yet again in relation to current policy developments, which increasingly highlight the importance of transformative adaptation. A quick change of course regarding the research focus could guarantee a more prompt evaluation of public views on this new form of adaptation as the policy discourse changes, thus providing timely input for communicators and policy-makers, as it is needed.

Second, I hypothesize that existing research on incremental adaptation will be of little value to research focusing on transformative adaptation. It is reasonable to expect that research will find that this novel adaptation category is substantially different from mitigation and incremental adaptation in particular. In fact, it would not be surprising to find that more parallels can be drawn between mitigation and transformative adaptation, than between the two adaptation categories. Future research efforts will have to explore these differences. The novelty of transformative adaptation and its disjunction from non-climate change related adaptation forms in terms of its strong socio-political focus are two major aspects to consider. In this respect it might prove most fruitful to qualitatively explore how the public engages with transformative adaptation first. Initial insights from qualitative research could then be followed up with framing studies, as were used here.

5.3 Concluding remarks

This thesis has shown that a considerable difference exists between climate change adaptation and mitigation perceptions in terms of the variables

associated with intentions to perform and support these climate change responses. Equally differential is the effect that messages focusing on one or the other action have on people's engagement with climate change. More research is needed for replication and to investigate some of the findings reported here in more detail. The present work has demonstrated that this type of research could prove to be critical as the policy discourse focuses more on adaptation. What is clear from this research is that this change opens a window of opportunity to steer the public debate on climate change into a less polarized and thus more constructive direction. This thesis, however, has shown that uninformed communication choices equally hold the potential for worsening the current situation. The findings reported here can provide some preliminary guidance to avoid this. Predictors of intention to perform and support for adaptation actions are to some extent characterized by what I have described here as an immediate quality. Generalizing, one could state that adaptation seems to be engaging to right-leaning and disengaging to left-leaning individuals. As such, it can potentially serve to engage climate sceptic audiences. The opposite is true for mitigation. The effect of focusing communications on a certain climate change response category is further affected by whether climate change is presented as an issue of local or global relevance. Personal experience of flooding is linked to flood adaptation intentions but not to mitigation intentions. Whether individuals attribute flooding to climate change does not make a difference to any of these effects.

These results also provide some more general theoretical input for research in this line. Environmental psychology literature on climate change related perceptions and behavioural outcomes has built heavily on scholarly work on pro-environmental attitudes and behaviour. This has narrowed the focus on a limited number of constructs that are tightly interlinked: value orientations and ideologies, such as benevolence and individualism, more specific

identity aspects, such as environmental identity, climate change specific constructs such as climate change scepticism and concern and finally behavioural outcome measures, such as mitigation intentions. The research presented here has highlighted that this narrow focus on constructs in a pro-environmentalist research tradition is only of limited value to research on adaptation. Even for mitigation, this one-dimensionality of the investigated variables is potentially limiting a comprehensive understanding of the various determinants of climate change relevant behaviour. In this respect the value of the emotional engagement measures has to be highlighted. They play a central role in all the studies presented here and represent a valuable and original addition to the set of existing climate change engagement measures.

Specific adaptation actions in particular seem more closely related to the experiences of the phenomenon they are aimed at, than they are to any climate change-related, or value- and identity-related construct. This underlines the detached quality of adaptation relating to mitigation and what has been discussed here as the one-dimensionality of the variables studied in this context. Adaptation up until now appears to have been somewhat resistant to getting entangled in the strong associative networks that have established around mitigation and climate change in general. This lacking association, however, is somewhat problematic, in that any adequate adaptation planning must consider projections of future climate change.

In summary, the potential effects of a policy shift towards a more balanced focus on both climate change adaptation and mitigation to replace the long lasting dominance of mitigation are characterized by both opportunities and risks. Adaptation holds the potential to engage audiences that mitigation cannot, or that mitigation will actually disengage. The relative novelty of adaptation and its dissociation from climate change provide a less biased access point to the wider debate on climate change. This comes at a cost however.

Audiences that have positively engaged with mitigation so far are potentially equally disengaged by adaptation. The dissociation of adaptation from climate change related constructs and the findings that individuals strongly rely on past experiences with climate impacts for future planning constitute another drawback. This means that the various climate change-related projections, which should have a significant bearing on appropriate preparations for future climate impacts are not considered. This creates the risk of being ill-prepared, or worse, creating additional vulnerabilities. Professionals should therefore take care in designing and promoting adaptation with a 'built in' consideration of climate change so that communications must not necessarily be placed in a climate change reference frame.

The final discussion has further highlighted the category of transformative adaptation as a potential mediator between traditional incremental adaptation and mitigation. Transformative adaptation carries aspects of both climate change response categories and can thus, if carefully communicated, help to provide a neutral ground for individuals who adhere to one or the other climate change action. It also does not rely on a strong climate change focus and will not lead to maladaptive responses, even if foresight regarding future climate change projections is lacking. More research however has to be invested to develop additional strategic approaches that exploit the current policy change to turn it into the beginning of comprehensively, adequately and sustainably addressing climate change. This thesis has provided some initial input in this regard, highlighting some of the challenges ahead for research, policy development and communication.

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Appendices

Appendix Chapter 2

2.1 Study 1 survey items and topline results

Q1. Please indicate your level of agreement for the following statements by clicking the corresponding answer option.

Please choose the appropriate response for each item:

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree
1	I am convinced that climate change is really happening (N=288)	31%	38%	17%	9%	5%
2	I do not believe climate change is a real problem (N=284)	30%	36%	17%	11%	6%
3	Claims that human activities are changing the climate are exaggerated (N=287)	21%	35%	17%	18%	9%
4	I am uncertain about whether climate change is really happening (N=286)	26%	37%	12%	20%	5%
5	The evidence for climate change is unreliable (N=286)	16%	32%	21%	25%	7%
6	Too much fuss is made about climate change (N=285)	24%	31%	20%	17%	8%

Q2. Please use the scale below to indicate to what extent you agree with the following statements. Climate Change will affect ...

Please choose the appropriate response for each item:

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree
1	... myself (N=287)	5%	11%	24%	32%	28%
2	... my family (N=287)	4%	11%	21%	38%	27%
3	... the local community (N=286)	3%	12%	20%	35%	30%

4	... the UK (N=286)	2%	5%	15%	42%	36%
5	... Europe (N=285)	3%	5%	13%	41%	39%
6	... the world (N=288)	2%	4%	11%	36%	47%
7	... plants and animal species (N=288)	2%	3%	9%	39%	47%
8	... my local area (N=286)	4%	8%	20%	37%	32%
9	... developing countries (N=286)	3%	4%	13%	41%	39%
10	... my children and grandchildren (N=286)	4%	5%	18%	35%	37%

Q3. Please answer the following questions by clicking the corresponding answer option.

Please choose the appropriate response for each item:

		Not at all concerned	Not very concerned	Fairly concerned	Very concerned	Don't know
1	How concerned, if at all, are you about climate change? (N=287)	8%	25%	44%	21%	0%
2	How concerned, if at all, are you about sea-level rise? (N=284)	7%	25%	45%	18%	4%

		Very negative	Fairly negative	Neither positive nor negative	Fairly positive	Very positive
3	On a purely emotional level, how do you personally feel about climate change? (N=285)	10%	30%	47%	10%	4%
4	On a purely emotional level, how do you personally feel about sea-level rise? (N=284)	9%	34%	43%	11%	4%

Q4. To what extent do you feel each of the following emotions when thinking about climate change?

Please choose the appropriate response for each item:

		Not at all	Very little	Somewhat	To a great extent	Don't know
1	Joy (N=286)	76%	16%	2%	0%	6%
2	Interest (N=287)	11%	19%	46%	18%	5%
3	Fatigue (N=288)	49%	27%	13%	2%	9%
4	Attentiveness (N=285)	25%	25%	31%	8%	9%

5	Serenity (N=284)	52%	24%	11%	1%	11%
6	Disgust (N=286)	37%	24%	23%	10%	6%
7	Contempt (N=284)	50%	23%	13%	5%	8%
8	Outrage (N=287)	33%	25%	29%	7%	6%
9	Anger (N=287)	33%	25%	30%	8%	4%
10	Disappointment (N=287)	29%	17%	38%	10%	6%
11	Regret (N=288)	27%	24%	35%	8%	6%
12	Sadness (N=286)	21%	18%	39%	18%	3%
13	Sympathy (N=286)	33%	23%	30%	7%	7%
14	Guilt (N=287)	33%	30%	28%	4%	5%
15	Shame (N=286)	37%	26%	27%	5%	5%
16	Fear (N=285)	27%	27%	32%	11%	2%
17	Hopelessness (N=286)	29%	25%	34%	8%	4%
18	Worry (N=286)	17%	26%	42%	13%	2%

Q5. How concerned, if at all, are you about any potential effects of climate change which there might be on ...

Please choose the appropriate response for each item:

		Not at all concerned	Not very concerned	Fairly concerned	Very concerned	Don't know
1	... YOU personally (N=282)	15%	32%	35%	14%	1%
2	... SOCIETY in general (N=283)	11%	21%	43%	21%	3%
3	... the WORLD (N=282)	8%	17%	41%	30%	2%

Q6. How concerned, if at all, are you about any potential effects of sea-level rise which there might be on ...

Please choose the appropriate response for each item:

		Not at all concerned	Not very concerned	Fairly concerned	Very concerned	Don't know
1	... YOU personally (N=287)	17%	32%	33%	14%	4%
2	... SOCIETY in general (N=287)	10v	22%	45%	19%	4%
3	... the WORLD (N=282)	8%	16%	47%	27%	4%

Q7. The following questions focus on values, attitudes and world views. Please remember that all answers are completely anonymous.

In the following questions we briefly describe some people and ask you to think about how much each person is, or is not like you. These questions are available in either a female or a male

version. Please indicate by clicking the appropriate button which version you would like to be provided with.

Please choose only one of the following:

Male version	Female version
41%	58%

Q8. Here we briefly describe some people. Please read each description and think about how much each person is, or is not like you. Then please click on the answer option that indicates best how much the person in the description is like you.

Please choose the appropriate response for each item:

		Not at all like me	Not like me	A little like me	Somewh at like me	Like me	Very much like me
1	Thinking up new ideas and being creative is important to him/her. He/She likes to do things in his own original way. (N=283)	3%	15%	20%	27%	24%	11%
2	It is important to him/her to be rich. He/She wants to have a lot of money and expensive things. (N=284)	22%	32%	23%	15%	6%	2%
3	He/She thinks it is important that every person in the world be treated equally. He/She wants justice for everybody, even for people he/she doesn't know. (N=285)	3%	5%	15%	25%	27%	25%
4	t is very important to him/her to show his/her abilities. He/She wants people to admire what he/she does. (N=282)	6%	18%	25%	23%	24%	4%
5	It is important to him/her to live in secure surroundings. He/She avoids anything that might endanger his safety. (N=288)	1%	6%	16%	24%	30%	23%

6	He/She likes surprises and is always looking for new things to do. He/She thinks it is important to do lots of different things in life. (N=283)	5%	21%	22%	27%	16%	9%
7	He/She believes that people should do what they're told. He/She thinks people should follow rules at all times, even when no one is watching. (N=284)	5%	15%	27%	22%	22%	9%
8	It is important to him/her to listen to people who are different from him/her. Even when he/she disagrees with them, he/she still wants to understand them. (N=284)	1%	5%	15%	27%	34%	17%
9	He/She thinks it's important not to ask for more than what you have. He/She believes that people should be satisfied with what they have. (N=285)	2%	18%	21%	28%	21%	9%
10	Having a good time is important to him/her. He/She likes to “spoil” him/herself. It is important to him/her to make his own decisions about what he/she does. He/She likes to be free to plan and to choose his activities for him/herself. (N=285)	10%	19%	27%	24%	15%	5%
11	It is important to him/her to make his own decisions about what he/she does. He/She likes to be free to plan and to choose his activities for him/herself. (N=284)	0%	2%	13%	23%	36%	26%
12	It's very important to him/her to help the people around him/her. He/She wants to care for other people. (N=283)	2%	5%	14%	27%	31%	22%
13	Being very successful is	19%	24%%	25%	17%	12%	3%

	important to him/her. He/She likes to impress other people. (N=282)						
14	It is very important to him/her that his country be safe from threats from within and without. He/She is concerned that social order be protected. (N=284)	1%	5%	17%	24%	25%	27%
15	He/She looks for adventures and likes to take risks. He/She wants to have an exciting life. (N=283)	16%	28%	22%	18%	12%	4%
16	It is important to him/her always to behave properly. He/She wants to avoid doing anything people would say is wrong. (N=285)	1%	12%	17%	25%	26%	19%
17	It is important to him/her to be in charge and tell others what to do. He/She wants people to do what he/she says. (N=284)	20%	26%	29%	16%	7%	3%
18	It is important to him/her to be loyal to his friends. He/She wants to devote him/herself to people close to him/her. (N=283)	1%	4%	11%	24%	29%	31%
19	He/She strongly believes that people should care for nature. Looking after the environment is important to him/her. (N=283)	1%	5%	15%	23%	28%	28%
20	Religious belief is important to him/her. He/She tries hard to do what his religion requires. (N=284)	41%	21%	17%	8%	6%	9%
21	He/She seeks every chance he/she can to have fun. It is important to him/her to do things that give him/her pleasure. (N=283)	6%	15%	31%	22%	19%	7%

Q9. Please indicate your level of agreement for the following statements by clicking the corresponding answer option.

Please choose the appropriate response for each item:

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree
1	I consider myself to be environmentally-conscious (N=287)	1%	10%	18%	48%	22%
2	Being environmentally-friendly is an important part of who I am (N=287)	5%	13%	28%	35%	20%
3	I think of myself as someone who is concerned about the environment (N=287)	2%	11%	18%	46%	23%
4	I would be embarrassed to be seen as having an environmentally-friendly lifestyle (N=287)	1%	7%	18%	33%	41%

Q10. How would you vote if there were a General Election tomorrow?
Which party would you be most inclined to support?[39]

Please choose only one of the following:

N=288

1	Conservative	18%
2	Labour	22%
3	Liberal Democrats (Lib Dem)	5%
4	Plaid Cymru	6%
5	Green Party	5%
6	UK Independence Party	13%
7	Other; would not vote; refused; undecided	32%

Q11. Please click the button next to the picture that best describes your relationship with your community.

Please choose only one of the following:

[39] The two questions were collapsed into one outcome variable and the "other", "would not vote", "refused" and "undecided" answer categories were collapsed into one here.

N=286

1 disconnected -	2 barely touching	3 slight overlap	4 1/3 overlap	5 2/3 overlap	6 nearly full inclusion	7 full inclusion
19%	23%	21%	26%	2%	5%	5%

Q12. Please click the button next to the picture that best describes your relationship with the Severn Estuary.

Please choose only one of the following:

N=284

1 disconnected -	2 barely touching	3 slight overlap	4 1/3 overlap	5 2/3 overlap	6 nearly full inclusion	7 full inclusion
45%	25%	16%	8%	2%	3%	3%

Q13. Please click the button next to the picture that best describes your relationship with nature.

Please choose only one of the following:

N=286

1 disconnected -	2 barely touching	3 slight overlap	4 1/3 overlap	5 2/3 overlap	6 nearly full inclusion	7 full inclusion
8%	15%	20%	26%	14%	9%	9%

The following sections are concerned with responses to climate change and sea-level rise.

Q14. To what extent do you agree or disagree with each of the following statements?

Please choose the appropriate response for each item:

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree
1	I can personally help to reduce climate change by changing my behaviour (N=286)	6%	15%	26%	43%	10%
2	A variety of external factors make it difficult for me to take actions that help to reduce climate change (N=286)	8%	35%	36%	17%	5%
3	It is hard to take action against climate change even if I want to (N=287)	12%	37%	27%	21%	3%
4	I personally feel that I can	9%	22%	33%	28%	8%

	make a difference with regard to climate change (N=285)					
5	I feel a sense of urgency to change my behaviour to help to reduce climate change (N=285)	11%	19%	38%	23%	8%
6	It is my responsibility to help to do something about climate change (N=286)	5%	7%	32%	42%	15%

Q15. To what extent do you agree or disagree with each of the following statements?

Please choose the appropriate response for each item:

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree
1	People in our society can personally help to reduce climate change by changing their behaviour (N=284)	3%	8%	20%	45%	24%
2	A variety of external factors make it difficult for people from our society to take actions that help to reduce climate change (N=285)	10%	37%	34%	17%	3%
3	For people from our society it is hard to take action against climate change even if they want to (N=287)	6%	32%	34%	23%	5%
4	Our society can make a difference with regard to climate change (N=287)	3%	7%	20%	46%	24%
5	There is a feeling of urgency in our society to change our behaviour to help to reduce climate change (N=285)	6%	25%	32%	28%	8%
6	It is our responsibility to help to do something about climate change (N=285)	3%	7%	30%	46%	24%

Q16. Which one, if any, of these do you think should be mainly responsible for taking action against sea-level rise?

Please select at most one answer
Please choose all that apply:

N=281

1	Environmental groups	1%
2	Individuals and their families	10%
3	Industry/ Companies	19%
4	Local authorities	1%
5	National Governments and Agencies	31%
6	The European Union	3%
7	The international community	17%
8	Everyone	4%
9	Don't know	13%
10	Other (please specify): Everyone	4%

Q17. Which one, if any, of these do you think should be mainly responsible for taking action against climate change?

Please select at most one answer
Please choose all that apply:

N=283

1	Environmental groups	5%
2	Individuals and their families	2%
3	Industry/ Companies	7%
4	Local authorities	0%
5	National Governments and Agencies	37%
6	The European Union	4%
7	The international community	21%
8	Everyone	3%
9	Don't know	21%
10	Other (please specify): Everyone	3%

Q18. Below are some steps we might take as a society to decrease the amount of greenhouse gases (e.g. CO2) released to the atmosphere. Keeping in mind that all these proposals might be associated with considerable costs and/or inconveniences, please indicate for each of these steps how you would vote in a national referendum.

Please choose the appropriate response for each item:

		Definitely	Probably	Unsure	Probably	Definitely

		yes	yes		no	no
1	Congestion charging for cars in all city areas (N=287)	23%	19%	26%	23%	9%
2	Ban the production of vehicles with petrol/diesel mileage below 75 miles per gallon (very fuel efficient) (N=288)	8%	18%	33%	27%	14%
3	Increased petrol and diesel taxes (N=286)	40%	27%	22%	8%	3%
4	Increased household electricity taxes (N=287)	43v	31%%	20%	6%	1%
5	Use iron to boost sea plankton growth (absorbs CO2 from the atmosphere) (N=286)	2%	3%	47%	30%	18%
6	Place a limit on personal air travel (N=287)	22%	26%	27%	16%	10%
7	Use overseas aid for the protection of tropical rain forests (N=288)	6%	4%	30%	37%	23%
8	Increased general taxation to pay for public transport (N=285)	30%	25%	32%	10%	4%
9	Subsidies for electric (emission-free) vehicles (N=287)	2%	7%	25%	41%	25%
10	Subsidies for house insulation (N=286)	1%	1%	15%	46%	36%
11	Teach children about the causes, consequences and potential solutions to climate change (N=288)	2%	1%	13%	31%	55%
12	Subsidies for the household production of green energy (e.g. solar panels) (N=288)	1%	7%	16%	37%	39%
13	More investments in safe cycling- and walking-routes (N=287)	2%	7v	16%	42v	33%

Q19. How likely are you to take the following actions in the future to combat climate change?

Please note: If you are already taking or already took an action and intend to continue to do so, please choose "likely" or "very likely". In addition to that, click the button on the far right, indicating that you are already taking or took this action.

Please choose the appropriate response for each item:

		Very likely	Likely	neither	Unlikely	Very unlikely	I am already taking this action/ I already took this action
1	Choose a car that gets good petrol/diesel mileage (high mpg) (N=286)	3%	4%	19%	37%	25%	19%
2	Install more insulation at home (N=286)	4%	9%	15%	32%	18%	31%
3	Car sharing (N=287)	20%	18%	24%	22%	8%	14%
4	Using public transport (more often) (N=287)	17%	20%	18%	21%	13%	19%
5	Walking and cycling (more often) (N=287)	11%	10%	16%	31%	18%	26%
6	Replace older appliances with more energy efficient new models (e.g. refrigerators) (N=288)	4%	9%	16%	37%	21%	23%
7	Join an environmental group (N=288)	35%	30%	19%	12%	3%	4%
8	Restrict the number of flights you take per year (N=288)	15%	15%	22%	18%	15%	25%
9	Eat less meat (N=283)	23%	24%	18v	17%	10%	17%
10	Reduce the number of new things you buy (N=284)	9%	16%	25%	24%	15%	20%

Q20. Scientists argue that due to past emissions of greenhouse gases the planet is already committed to a certain amount of climate change over the next couple of decades. This makes adaptation to the positive and negative impacts of climate change unavoidable.

There are many steps we can take as a society to adapt to climate change. Keeping in mind that each of these proposals might be associated with

considerable costs and/or inconveniences please indicate for each of these steps how you would vote in a national referendum.

Please choose the appropriate response for each item:

		Definitely yes	Probably yes	Unsure	Probably no	Definitely no
1	Reduce pressure on systems or areas at risk (e.g. less fishing and hunting licenses) (N=286)	5%	9%	32%	36%	19%
2	Protection and creation of wetlands (improves flood protection and contributes to biodiversity) (N=286)	1%	2%	23%	45%	30%
3	Requirement to fit houses with water resistant door and window frames in flood risk areas (N=287)	2%	6%	24%	43%	25%
4	Relocation of smaller towns away from flood risk areas (N=286)	7%	19%	41%	22%	12%
5	Increase prices for water consumption (N=287)	30%	31%	29%	7%	3%
6	Increase national development assistance to help developing countries to adapt to climate change (N=288)	8%	9%	41%	32%	9%
7	Produce and distribute guidance on how people can avoid heat stress (averse health effects suffered during heat waves) (N=287)	5%	9%	34%	34%	17%
8	Improvement and better maintenance of existing flood defences (N=288)	0%	2%	14%	51%	33%
9	Build new flood defences (N=286)	0%	2%	20%	47%	30%
10	A new tax to establish a fund to alleviate unavoidable climate impacts in the UK (N=287)	18%	17%	40%	20%	5%
11	Creation of habitat corridors for animals (e.g. bridges over motorways) (N=287)	2%	5%	25%	40%	28%
12	Increased financial	1%	6%	22%	48%	24%

	support for better flood prediction, emergency planning and warning in the case of a flood event (N=288)					
13	More funding for research and monitoring to better understand sea-level rise on the Severn Estuary (N=288)	2%	5%	29%	44%	20%

Q21. How likely are you to take the following actions in the future to adapt to climate change?

Please note: If you are already taking or already took an action and intend to continue to do so, please choose "likely" or "very likely". In addition to that click the button on the far right, indicating that you are already taking or took this action.

Please choose the appropriate response for each item:

		Very unlikely	Unlikely	Neither	Likely	Very likely	I am already taking this action/ I already took this action
1	Repaint your house in a brighter colour (less heat absorption in the summer) (N=288)	27%	21%	26%	16%	4%	8%
2	Buy flood insurance (N=288)	33%	19%	29%	12%	4%	6%
3	Install a water re-use system at home (avoid water shortages during droughts) (N=287)	19%	22%	31%	21%	6%	5%
4	Persuade relatives or friends to move away from flood risk areas (N=287)	24%	19%	32%	18%	6%	1%
5	Read about how to avoid heat stress during heat waves (N=286)	14%	18%	25%	31%	10%	5%
6	Fit water saving device in your cistern to save when	10%	13%	14%	33%	13%	26%

	flushing (N=287)						
7	Buy purpose-built flood boards that can be installed when flooding is imminent (N=287)	31%	22%	30%	12%	5%	1%
8	Put irreplaceable or valuable items on high mounted shelves (N=288)	15%	17%	24%	29%	9%	8%
9	Use horizontal plaster board or lime-based plaster instead of gypsum (N=287)	24%	20%	40%	11%	5%	1%
10	Lay tiles rather than fitted carpets, which often need to be replaced after a flood (N=288)	22%	23%	26%	16%	6%	10%
11	Raise electrical sockets, fuse boxes, controls and wiring above floor level (1.5m) (N=287)	26%	24%	25%	16%	7%	5%

The following questions will ask you about your general knowledge of climate change. If you do not know an answer, this does not matter - just give it your best shot.

Q22. The following list contains statements about Climate Change that are either true or false. Please indicate by ticking the appropriate answer option whether you believe the corresponding statement to be true or false. If you do not know the answer, please indicate by ticking the Don't know answer option.

Please choose the appropriate response for each item:

		Correct	Incorrect	Don't know
1	The increase of green house gases is mainly due to human activity (N=288)	63%	17%	21%
2	It is very likely that the increase of carbon dioxide (CO2) in the atmosphere is the main cause of climate change (N=286)	56%	14%	30%
3	Today's global carbon dioxide (CO2) concentration has already occurred in the past 650,000 years (N=287)	11%	33%	56%
4	The global carbon dioxide (CO2) (concentration in the atmosphere has increased during the past 250 years	68%	6%	26%

	(N=287)			
5	The ozone hole is the main cause of the greenhouse effect (N=285)	26%	47%	27%
6	At the same quantity, carbon dioxide (CO2) is more harmful to the climate than methane (N=287)	21%	22%	57%
7	Carbon dioxide (CO2) is a greenhouse gas (N=288)	70%	6%	24%
8	Carbon dioxide (CO2) is harmful to plants (N=287)	56%	18%	26%

Q23. For the next few decades, the majority of climate scientists expect ...

Please choose the appropriate response for each item:

		True	False	Don't know
1	... an increase in extreme events, such as droughts, floods and storms (N=287)	82%	4%	14%
2	... a warmer climate, increasing the melting of polar ice, which will lead to an overall sea-level rise (N=285)	81%	5%	14%
3	... a precipitation (e.g. rain) increase in every region worldwide (N=287)	20%	52%	28%
4	... a cooling down of the climate (N=287)	46%	23%	31%
5	... increased acidification of oceans (N=282)	53%	5%	42%

The final questions are designed to make sure that we have asked a range of people to allow us to compare responses between different groups.

Q24. Please indicate the age bracket you are in.

Please select at most one answer
Please choose all that apply:

N=287

1	18-24	7%
2	25-34	14%
3	35-44	22%
4	45-54	25%
5	55-64	18%
6	64-74	13%
7	75+	1%
8	Don't know; Refuse	0%

Q25. Please indicate your gender.

Please select at most one answer
Please choose all that apply:

N=283

1	Male	41%
2	Female	59%
3	Prefer not to say	0%

Q26. Do you have ...

Please choose the appropriate response for each item:

		Yes	No	Don't know/Refuse
1	... children? (N=284)	60%	37%	1%
2	... grandchildren? (N=279)	27%	69%	1%

Q27. Please indicate which of the following represents your household's total income, before tax and any other deductions. This includes earnings from employment or self-employment, income from benefits and pensions, and income from other sources such as interest from savings.

Please select at most one answer
Please choose all that apply:

N=288

1	< £15,000	19%
2	£15,000 - £19,999	10%
3	£20,000 - £29,999	23%
4	£30,000 - £39,999	14%
5	£40,000 - £49,999	9%
6	£50,000 - £59,999	5%
7	£60,000 - £69,999	4%
8	£70,000 - £99,999	2%
9	£100,000 - £149,999	0%
10	> £150,000	0%
11	Don't know/Refuse	13%

Q28. Please indicate your working status.

Please select at most one answer

Please choose all that apply:

N=286

1	Working – full time (30+ hours per week)	44%
2	Working – part time (9-29 hours per week)	14%
3	Unemployed – seeking work	5%
4	Unemployed – not seeking work	0%
5	Not working – retired	18%
6	Not working – looking after the house/children	8%
7	Not working – disabled	7%
8	Student	4%
9	Don't know; Refuse	0%
10	Other (please specify):	0%

Q29. How many return flights have you taken last year (2012)?

Please choose the appropriate response for each item:

		none	1-2	3-4	5-6	7-8	>9	Don't know /Refuse
1	Flights within Europe (N=283)	57%	30%	7%	2%	0%	0%	2%
2	Transcontinental flights / long distance flights (N=277)	72%	19%	2%	0%	0%	0%	3%

Q30. Please indicate which, if any, is the highest educational or professional qualification you have obtained.

Please select at most one answer

Please choose all that apply:

N=286

	No formal qualifications	21%
1	GCSE/O-level/CSE	8%
2	Vocational quals (=NVQ1+2)	22%
3	A level or equivalent (=NVQ3)	31%
4	Bachelor Degree or equivalent (=NVQ4)	9%
5	Masters/PhD or equivalent	6%
6	Still studying	3%
7	Don't know/Refuse	1%

Q31. Please fill in your postcode.

Please write your answer here:

Q32. In which of these ways does your household occupy this accommodation?

Please select at most one answer
Please choose all that apply:

N=284

1	Buying with mortgage/loan	40%
2	Own it outright	30%
3	Part rent/part mortgage	1%
4	Rents (including rents paid by housing benefit)	25%
5	Living here rent free	1%
6	Don't know/Refuse	1%

Q33. Roughly at what distance do you live from the coastline?

Please select at most one answer
Please choose all that apply:

N=284

1	Less than 1 mile	12%
2	More than 1 mile but less than 5 miles	26%
3	5-10 miles	26%
4	More than 10 miles	32%
5	Don't know	4%

Q34. How long have you lived in the area?

Please select at most one answer
Please choose all that apply:

N=285

1	Less than 6 months	2%
2	6 months –less than 1 year	4%
3	1 year – less than 3 years	6%
4	3 – less than 5 years	8%
5	5 – less than 7 years	10%
6	7 – less than 10 years	7%
7	10 years or more	63%

8	Don't know/Refuse	0%

Q35. Do any of the following apply to you? This question refers to your experiences in the last 15 years, either around the Severn Estuary or elsewhere.

Please choose the appropriate response for each item:

		Yes	No	Don't know/Refuse
1	My home or other property has been damaged by flooding or erosion (N=285)	2%	94%	2%
2	I have been directly affected by flooding or erosion (e.g. through travel disruption or my ability to work) (N=285)	10%	85%	4%
	Other people within 5 miles of where I live have experienced property damage from flooding or erosion (N=284)	30%	54%	15%

2.2 Factor analyses for scale constructs

2.2.1 Factor analysis human values scale

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Q8.8	.841				
Q8.3	.716				
Q8.19	.714				
Q8.12	.646				
Q8.18	.565				
Q8.14	.465				.341
Q8.1	.439				
Q8.11	.333				
Q8.20					
Q8.13		.775			
Q8.17		.734			
Q8.2		.712			
Q8.4		.644			
Q8.21			.782		
Q8.10			.753		
Q8.15			.686		
Q8.6			.554		
Q8.7				.774	
Q8.16				.596	
Q8.9				.532	
Q8.5					.548

2.2.2 Factor analysis environmental identity scale

	Factor 1
Q9.3	.923
Q9.1	.900
Q9.2	.888
Q9.4	.306

2.2.3 Factor analysis emotion engagement scale

	Factor 1	Factor 2
Q4.18	.911	
Q4.12	.906	
Q4.10	.867	
Q4.16	.849	
Q4.11	.799	
Q4.2	.750	
Q4.15	.734	
Q4.14	.716	
Q4.9	.680	
Q4.17	.665	
Q4.4	.650	
Q4.8	.633	
Q4.6	.610	.308
Q4.13	.555	
Q4.7		.629
Q4.5		.613
Q4.1		.567
Q4.3		.462

2.2.4 Factor analysis personal efficacy scale

	Factor 1	Factor 2
Q14.5	.847	
Q14.1	.807	
Q14.4	.790	
Q14.6	.741	
Q14.3		.998
Q14.2		.543

2.2.5 Factor analysis collective efficacy scale

	Factor 1	Factor 2
Q15.4	.904	
Q15.6	.876	
Q15.1	.867	
Q15.5		
Q15.3		1.019
Q15.2		.581

2.2.6 Factor analysis adaptation intentions scale

	Factor 1
Q21.7	.851
Q21.9	.814
Q21.11	.800
Q21.10	.739
Q21.8	.731
Q21.4	.679
Q21.1	.669
Q21.3	.658
Q21.5	.633
Q21.2	.554
Q21.6	.508

2.2.7 Factor analysis mitigation intentions scale

	Factor 1	Factor 2
Q19.3	.685	
Q19.4	.670	
Q19.10	.649	
Q19.9	.616	
Q19.8	.554	
Q19.5	.545	
Q19.7	.520	
Q19.6		.700
Q19.2		.663
Q19.1		.509

2.2.8 Factor analysis support adaptation policies scale

	Factor 1	Factor 2
Q20.9	.796	
Q20.8	.780	
Q20.12	.771	
Q20.2	.701	
Q20.13	.649	
Q20.3	.563	
Q20.7	.527	
Q20.11	.441	
Q20.4		
Q20.10		.765
Q20.5		.668
Q20.6		.529
Q20.1		.450

2.2.9 Factor analysis support mitigation policies scale

	Factor 1	Factor 2
Q18.10	.707	
Q18.12	.668	

Q18.13	.662	
Q18.11	.637	
Q18.9	.588	
Q18.5	.439	
Q18.7	.417	
Q18.2	.326	
Q18.4		.845
Q18.3		.813
Q18.8		.718
Q18.1		.608
Q18.6		.479

2.2.10 Factor analysis support for financial regulation

	Factor 1
Q18.4	.849
Q20.5	.772
Q18.3	.770
Q18.8	.717
Q20.10	.618
Q18.1	.585

2.3 Correlation Matrix outcome measures and predictors

	CC concern	SLR concern oneself	Age	Income	Distance from coast	Pers. effic.	CC scept.	Env. Ident.	Emot. Engagem.	Self-transc.	Conserv.
Adapt. policies	.307**	.326**	.218**	-0,05	0,1	.296*	-.325**	.365**	.308**	.392**	.266**
Financial regulation	.438**	.269**	-.133*	-.146*	-0,01	.329*	-.370**	.290**	.435**	0,1	0,07
Mitigation policies	.455**	.387**	0,01	0	-0,02	.415*	-.529**	.461**	.412**	.379**	.175**
Adapt. intentions	.392**	.464**	0,02	-0,03	-0,05	.424*	-.196**	.388**	.406**	.327**	0,08
Mitigation intentions	.499**	.406**	-0,07	-.204**	-0,06	.500*	-.434**	.386**	.490**	.300**	-0,06
CC concern	1	.635**	-0,11	-0,09	0,06	.630*	-.736**	.579**	.737**	.398**	0,09
SLR concern oneself	.635**	1	-.123*	-0,09	-0,05	.522*	-.507**	.385**	.570**	.353**	0,1
Age	-0,11	-.123*	1	-0,02	-.215**	-.169*	.148*	0,06	-.168**	-0,05	0,05
Income	-0,09	-0,09	-0,02	1	0,12	-0,05	0,1	-0,1	-0,11	-0,08	0,02
Distance from coast	0,06	-0,05	-.215**	0,12	1	-0,03	-0,12	0	0,04	0,05	0,08

Pers. efficacy	.630**	.522**	-.169**	-0,05	-0,03	1	-.603**	.585**	.595**	.411**	.136*
CC scepticism	-.736**	-.507**	.148*	0,1	-0,12	-.603*	1	-.509**	-.661**	-.317**	-0,06
Env. identity	.579**	.385**	0,06	-0,1	0	.585*	-.509**	1	.486**	.551**	.227**
Emot. engagement	.737**	.570**	-.168**	-0,11	0,04	.595*	-.661**	.486**	1	.460**	0,1
Self-transcendence	.398**	.353**	-0,05	-0,08	0,05	.411*	-.317**	.551**	.460**	1	.298**
Conservatism	0,09	0,1	0,05	0,02	0,08	.136*	-0,06	.227**	0,1	.298**	1

Correlation Matrix for outcome measures and significant predictors (** $p < .01$; * $p < .05$)

2.4 Stepwise regression adaptation intentions

Adaptation intention	B	SE B	β	adj. R^2	p ≤
Scepticism	-.227	.061	-.228	.048	.001
Scepticism	.100	.076	.101	.182	.187
Emotional engagement	.477	.074	.494		.001
Scepticism	.217	.077	.218	.248	.005
Emotional engagement	.344	.076	.357		.001
Personal efficacy	.358	.075	.350		.001
Scepticism	.259	.076	.261	.276	.001
Emotional engagement	.316	.075	.328		.001
Personal efficacy	.269	.078	.264		.001
Environmental identity	.220	.066	.225		.001
Constant				.313	.001
Scepticism			.297		.001
Emotional engagement			.248		.002

Personal efficacy	.207	.007
Environmental identity	.215	.001
Concern for the effects of SLR on oneself	.252	.001

Appendix Chapter 3

3.1 Study 2 survey items and topline results

Q1. To what extent do you agree or disagree with each of the following statements?

		Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1	The evidence for climate change is unreliable (N=283)	28%	47%	14%	10%	1%
2	I am convinced that climate change is really happening (N=283)	1%	3%	9%	42%	46%
3	I do not believe climate change is a real problem (N=283)	48%	41%	6%	4%	2%
4	Too much fuss is made about climate change (N=283)	40%	41%	9%	9%	1%
5	Claims that human activities are changing the climate are exaggerated (N=283)	30%	41%	10%	15%	4%

Q2. To what extent do you agree or disagree with each of the following statements?

		Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1	I consider myself to be environmentally-conscious (N=283)	1%	3%	18%	65%	12%
2	Being environmentally-friendly is an important part of who I am (N=283)	2%	21%	28%	41%	9%
3	I think of myself as someone who is concerned about the	1%	6%	13%	66%	14%

	environment (N=283)					

Q3. Using the sliders below please indicate who you think will be more affected by sea-level rise.

The closer you move the slider to the left, the more you think that you and your family will be affected. The closer you place the slider to the right, the more you think other people will be affected.
If you think that everyone will be affected equally place the slider at the middle point (50). If you think no one will be affected click "Neither".

		... myself and my family 0 10 20 30 40 50 60 70 80 90 100 ... other people	
	Sea-level rise will affect ... (N=278)	----------*M*=65.83, *SD*=16.61----------	Neither

Q4. How concerned, if at all, are you about any potential effects of sea-level rise which there might be on ...

		Not at all concerned	Not very concerned	Fairly concerned	Very concerned
1	... YOU personally (N=283)	9%	48%	36%	7%
2	... SOCIETY in general (N=283)	3%	20%	56%	22%
3	... the WORLD (N=283)	1%	13%	39%	47%

Q5. Using the sliders below please indicate who you think will be more affected by sea-level rise.

The closer you move the slider to the left, the more you think that you and your family will be affected. The closer you place the slider to the right, the more you think other people will be affected.
If you think that everyone will be affected equally place the slider at the middle point (50). If you think no one will be affected click "Neither".

		... myself and my family 0 10 20 30 40 50 60 70 80 90 100 ... other people	
	Climate change will affect ... (N=276)	----------*M*=58.98, *SD*=14.71----------	Neither

Q6. How concerned, if at all, are you about any potential effects of climate change which there might be on ...

		Not at all concerned	Not very concerned	Fairly concerned	Very concerned
1	... YOU personally (N=283)	2%	31%	52%	15%
2	... SOCIETY in general (N=283)	1%	12%	52%	36%
3	... the WORLD (N=283)	1%	6%	35%	59%

Q7. To what extent do you agree or disagree with each of the following statements?

		Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1	It is my responsibility to act on climate change (N=283)	2%	4%	16%	63%	16%
2	It is already to late to do anything about climate change (N=283)	19%	57%	17%	6%	2%
3	There is no point in me doing anything about climate change because no-one else is (N=283)	31%	52%	10%	6%	1%
4	The actions of a single person don't make any difference in tackling climate change (N=283)	18%	48%	14%	15%	5%
5	Climate change is so complicated that there is very little politicians can do about it (N=283)	32%	46%	9%	12%	2%
6	I can personally help to do something about climate change by changing my behaviour (N=283)	2%	7%	15%	59%	18%

Q8. To what extent do you feel each of the following emotions when thinking about climate change?

		Not at all	Very little	Somewhat	To a great extent
1	Anger (N=283)	19%	32%	38%	11%
2	Disappointment (N=283)	9%	23%	52%	17%
3	Sadness (N=283)	7%	18%	54%	22%
4	Fear (N=283)	11%	31%	46%	12%
5	Guilt (N=283)	13%	33%	45%	9%

The following text is taken from a newspaper and discusses climate impacts. (Note: we cannot show logos or other illustrations associated with the text and newspaper for copyright reasons.)
Please read the following text carefully as you will be asked a number of questions about it afterwards.

Q9. I have understood that I need to read the following text carefully.

Yes	No
100%	0

Frames

Q10. Now please spend some time thinking about what you've just read. What thoughts came to mind when you were reading the information?

Q11. What type of actions did this article propose in response to climate impacts.

Q12. Which country or area was the article concerned with?

Q13. Below are some steps we might take as a society to prepare for climate impacts.

Please indicate for each of these steps:
1. How you would vote if these steps were proposed in a national referendum (Please keep in mind that these proposals might be associated with considerable costs and/or inconveniences for you and other citizens)
2. How effective you think these measures would be in preparing for climate impacts

		Definitely	Prob	Unsur	Prob	Defini	Not at	Not ver	Quite	Very

		no	ably no	e	ably yes	tely yes	all effective	y effective	effective	effective
1	Artificial maintenance of beach levels through beach nourishment (adding sand from other sources to replace sand that has been lost to wind and waves over the years) (N=283/269)	2%	23 %	30 %	36 %	9%	7%	42%	44%	7%
2	Increase prices for water use to encourage people to save water (N=283/272)	21%	41 %	22 %	12 %	4%	17%	55%	23%	6%
3	Build new flood- and coastal-defences (N=283/271)	0%	3%	11 %	53 %	34 %	1%	9%	59%	32%
4	Managed realignment - Allowing the shoreline to move naturally, but managing the process to direct it in certain areas (N=283/270)	3%	12 %	28 %	42 %	15 %	3%	28%	61%	8%
5	Protection and creation of wetlands - Improves flood protection and contributes to biodiversity (N=283/272)	1%	4%	10 %	48 %	38 %	1%	13%	56%	31%
6	Increased financial support for better flood prediction, emergency planning and warning in the case of a flood event (N=283/271)	1%	5%	13 %	47 %	35 %	1%	13%	51%	34%
7	Stricter planning control in flood risk areas, to limit construction on flood plains (N=283/271)	1%	3%	8%	39 %	49 %	1%	8%	46%	45%
8	A new tax to establish a fund to alleviate unavoidable climate impacts in the UK (N=283/267)	10%	28 %	29 %	23 %	10 %	8%	42%	40%	10%
9	More funding for research and monitoring to better understand sea-level rise (N=283/270)	1%	10 %	16 %	47 %	26 %	1%	17%	59%	23%

Q14. Below are some steps we might take as a society to decrease the extent of climate change that drives climate impacts.

Please indicate for each of these steps:

1. How you would vote if these steps were proposed in a national referendum (Please keep in mind that these proposals might be associated with considerable costs and/or inconveniences for you and other citizens)

2. How effective you think these measures would be in decreasing the extent of climate change that drives climate impacts

		Definitely no	Probably no	Unsure	Probably yes	Definitely yes	Not at all effective	Not very effective	Quite effective	Very effective
1	Increased general taxation to pay for public transport (N=281/269)	16%	27 %	22 %	25 %	10 %	14 %	42 %	30 %	13 %
2	Subsidies for house insulation (N=282/268)	1%	5%	10 %	45 %	40 %	1%	14 %	62 %	24 %
3	Subsidies for electric (emission-free) vehicles (N=282/269)	1%	7%	15 %	46 %	31 %	4%	19 %	52 %	25 %
4	Increased petrol and diesel taxes to encourage people to drive less (N=282/269)	30%	35 %	17 %	12 %	6%	18 %	41 %	29 %	12 %
5	Increased household electricity taxes to encourage people to consume less electricity (N=282/269)	25%	39 %	19 %	14 %	3%	13 %	47 %	34 %	7%
6	More investments in safe cycling- and walking-routes (N=282/270)	0%	7%	7%	37 %	48 %	3%	23 %	49 %	25 %
7	Subsidies for households to produce their own green energy (e.g. through solar panels) (N=282/270)	0%	5%	7%	39 %	48 %	2%	13 %	51 %	34 %

Q15. To what extent do you agree or disagree with each of the following statements?

		Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1	The evidence for climate	30%	46%	15%	9%	1%

	change is unreliable (N=283)					
2	I am convinced that climate change is really happening (N=283)	0%	3%	7%	49%	41%
3	I do not believe climate change is a real problem (N=283)	47%	43%	6%	2%	2%
4	Too much fuss is made about climate change (N=282)	36%	45%	11%	7%	1%
5	Claims that human activities are changing the climate are exaggerated (N=283)	31%	44%	9%	15%	1%

Q16. To what extent do you agree or disagree with each of the following statements?

		Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1	I consider myself to be environmentally-conscious (N=283)	1%	7%	13%	64%	15%
2	Being environmentally-friendly is an important part of who I am (N=283)	3%	21%	29%	38%	10%
3	I think of myself as someone who is concerned about the environment (N=283)	1%	5%	13%	66%	16%

Q17. Using the sliders below please indicate who you think will be more affected by sea-level rise.

The closer you move the slider to the left, the more you think that you and your family will be affected. The closer you place the slider to the right, the more you think other people will be affected.

If you think that everyone will be affected equally place the slider at the middle point (50). If you think no one will be affected click "Neither".

		... myself and my family 0 10 20 30 40 50 60 70 80 90 100 ... other people	
	Sea-level rise will affect ... (N=280)	----------*M*=62.42, *SD*=16.27----------	Neither

Q18. **How concerned, if at all, are you about any potential effects of sea-level rise which there might be on ...**

		Not at all concerned	Not very concerned	Fairly concerned	Very concerned
1	... YOU personally (N=283)	6%	39%	47%	9%
2	... SOCIETY in general (N=283)	1%	11%	56%	32%
3	... the WORLD (N=283)	18%	33%	39%	10%

Q19. **To what extent do you feel each of the following emotions when thinking about climate change?**

		Not at all	Very little	Somewhat	To a great extent
1	Anger (N=280)	18%	33%	39%	10%
2	Disappointment (N=280)	11%	19%	51%	19%
3	Sadness (N=280)	8%	19%	53%	21%
4	Fear (N=280)	12%	26%	45%	16%
5	Guilt (N=280)	14%	32%	43%	11%

Q20. **To what extent do you agree or disagree with each of the following statements?**

		Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1	It is my responsibility to act on climate change (N=281)	2%	3%	15%	58%	21%
	It is already to late to do anything about climate change (N=281)	33%	51%	10%	4%	1%
2	There is no point in me doing anything about climate change because no- one else is (N=280)	30%	54%	11%	4%	2%
3	The actions of a single person don't make any difference in tackling climate change (N=281)	22%	50%	13%	13%	3%
4	Climate change is so complicated that there is very little politicians can do about it (N=281)	37%	43%	8%	10%	1%
5	I can personally help to do something about climate change by changing my behaviour (N=281)	1%	5%	12%	64%	18%

Q21. Using the sliders below please indicate who you think will be more affected by climate change.

The closer you move the slider to the left, the more you think that you and your family will be affected. The closer you place the slider to the right, the more you think other people will be affected.

If you think that everyone will be affected equally place the slider at the middle point (50). If you think no one will be affected click "Neither".

		... myself and my family 0 10 20 30 40 50 60 70 80 90 100 ... other people	
	Climate change will affect ... (N=276)	----------*M*=57.65, *SD*=14.01----------	Neither

Q22. How concerned, if at all, are you about any potential effects of climate change which there might be on ...

		Not at all concerned	Not very concerned	Fairly concerned	Very concerned
1	... YOU personally (N=280)	3%	25%	58%	14%
2	... SOCIETY in general (N=280)	1%	10%	51%	37%
3	... the WORLD (N=280)	2%	6%	33%	59%

Q23. Please indicate your overall political orientation using the slider below.

The closer you move the slider to the left, the more you think of yourself as a left wing oriented person. The closer you place the slider to the right, the more you think of yourself as a right wing oriented person.

N=283

		Left wing 0 10 20 30 40 50 60 70 80 90 100 Right wing
	Political Orientation	---------- *M*=38.60, *SD*=20.44----------

Q24. How would you vote if there were a General Election tomorrow?

N=281

1	Conservative	11%
2	Labour	26%
3	Liberal Democrats (Lib Dem)	8%
4	Plaid Cymru	5%
5	Green Party	13%
6	UK Independence Party	4%

7	Other	1%
8	Would not vote	8%
9	Undecided	25%

Q25. Which party would you be most inclined to support?

N=86

1	Conservative	23%
2	Labour	34%
3	Liberal Democrats (Lib Dem)	14%
4	Plaid Cymru	7%
5	Green Party	13%
6	UK Independence Party	1%
7	Other	8%

Q26. To what extent do you agree or disagree with each of the following statements?

		Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1	The world would be a better place if its wealth were divided equally among nations (N=283)	6%	19%	27%	35%	13%
2	Discrimination against minorities is still a very serious problem in our society (N=283)	3%	10%	11%	44%	32%
3	People should be allowed to make as much money as they can for themselves, even if others are not able to (N=283)	7%	29%	28%	29%	6%
4	In my ideal society, all basic needs (food, housing, education, health care) would be guaranteed by the government for everyone (N=283)	3%	7%	13%	38%	40%
5	When I have problems, I try to solve them on my own (N=283)	0%	8%	7%	62%	23%
6	If the government spent less time trying to fix everybody's problems, we'd all be a lot better off (N=283)	18%	47%	22%	11%	3%

Q27. **Thinking back to the article you read please indicate how convincing you found it.**

N=283

Very convincing	Quite convincing	Neither convincing nor unconvincing	Quite unconvincing	Very unconvincing
6%	51%	31%	10%	2%

Q28. **Are you ...**

N=283

Female	Male
72%	28

Q29. **Please indicate your age in years.**
I am ...

N=281

Q30. **I am ...**

N=282

1	... working full time (30+ hours per week)	15%
2	... working part time (9-29 hours per week)	4%
3	Unemployed	0%
4	Not working – retired	0%
5	Not working - looking after the house/children	0%
6	Not working – disabled	0%
7	Don't know/Refuse	1%
8	Student – Bachelor	64%
9	Student – Master	12%
10	Student - PhD	5%

Q31. **Do you regularly donate to, or are you a member of, any environmental organisations (e.g., Friends of the Earth, Worldwide Fund for Nature)?**

N=283

Yes	No
13%	87%

Q32. Do any of the following apply to you? This question refers to your experiences in the last 15 years, either around the Severn Estuary or elsewhere.

Please choose the appropriate response for each item:

		Yes	No
1	Me and/or my family and/or close friends have been directly affected by flooding or erosion (e.g. through damage to the family's home, other accommodation and property) (N=283)	17%	83%
2	I have been indirectly affected by flooding or erosion (e.g. through travel disruption) (N=283)	47%	53%

Q33. Would you like to receive further information on measures to prepare for the impacts of climate change - Adaptation measures.

N=283

Yes	No
25%	75%

Q34. Would you like to receive further information on measures to reduce emissions that cause climate change - Mitigation measures?

N=283

Yes	No
31%	69%

3.2 Faux newspaper articles for framing conditions

3.2.1 English adaptation condition

Tuesday, 4th February 2014 News 4

Climate Change Adaptation

Adaptation involves procedures and actions that can help us prepare for climate impacts to protect the most vulnerable, our homes and livelihoods. Adaptation measures include actions such as buying purpose-built flood boards that can be installed when flooding is imminent or putting irreplaceable or valuable items on high mounted shelves.

Experts warn of climate threats

Recent extreme weather events in England have shown the dramatic consequences of a changing climate. Dr Michael Wright of the London Climate Advisory Panel (LCAP) warned this week that unusually heavy rain, storm surges and coastal erosion will have an increasing impact on England. The result could be millions of pounds in damage and detrimental effects on the health and well-being of many English citizens in the next 25-50 years, even more so as sea levels are rising. Not only will English residents be affected directly but also indirectly, through associated impacts, such as social disruption, homelessness, mental health effects and limited access to food and water.

Wright added "more frequent heavy rains will also increase pressure on sewer systems with the associated impacts on diffuse pollution and sewer flooding incidents. In fact, English infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion." This will inevitably lead to supply chain disruptions and interference with everyday business activities, and associated losses for the English economy.

These are only a few of the many climate impacts that will increasingly affect many aspects of our lives in England. Marissa Palmer of the English Climate Change Adaptation Committee (ECCAC) argues that this underlines the importance of building these consequences into how we think and act about our own future and the future of England as a whole. In responding to these changes, she explains, adaptation (see infobox) should take a very prominent role rather sooner than later.

"English infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion."

Scientists predict that what we are starting to see right now is just the beginning of a process that will intensify during the next few years. They all agree that while the full force of climate impacts has not hit us yet, the time to act is now!

3.2.2 English mitigation condition

Tuesday, 4th February 2014 News 4

Climate Change Mitigation

Mitigation involves procedures and actions that can help us reduce the extent of climate impacts to protect the most vulnerable, our homes and livelihoods. Mitigation measures include actions such as using one's car less or replacing older appliances with more energy efficient new models.

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Scientists predict that what we are starting to see right now is just the beginning of a process that will intensify during the next few years. They all agree that while the full force of climate impacts has not hit us yet, the time to act is now!

3.2.3 Welsh adaptation condition

Climate Change Adaptation

Adaptation involves procedures and actions that can help us prepare for climate impacts to protect the most vulnerable, our homes and livelihoods. Adaptation measures include actions such as buying purpose-built flood boards that can be installed when flooding is imminent or putting irreplaceable or valuable items on high mounted shelves.

Experts warn of climate threats

Recent extreme weather events in Wales have shown the dramatic consequences of a changing climate. Dr Eduard Rees of the Cardiff Climate Advisory Panel (CCAP) warned this week that unusually heavy rain, storm surges and coastal erosion will have an increasing impact on Wales. The result could be millions of pounds in damage and detrimental effects on the health and well-being of many Welsh citizens in the next 25-50 years, even more so as sea levels are rising. Not only will Welsh residents be affected directly but also indirectly, through associated impacts, such as social disruption, homelessness, mental health effects and limited access to food and water.

Rees added "more frequent heavy rains will also increase pressure on sewer systems with the associated impacts on diffuse pollution and sewer flooding incidents. In fact, Welsh infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion." This will inevitably lead to supply chain disruptions and interference with everyday business activities, and associated losses for the Welsh economy.

These are only a few of the many climate impacts that will increasingly affect many aspects of our lives in Wales. Marissa Trwellyn of the Welsh Climate Change Adaptation Committee (WCCAC) argues that this underlines the importance of building these consequences into how we think and act about our own future and the future of Wales as a whole. In responding to these changes, she explains, adaptation (see infobox) should take a very prominent role rather sooner than later.

"Welsh infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion."

Scientists predict that what we are starting to see right now is just the beginning of a process that will intensify during the next few years. They all agree that while the full force of climate impacts has not hit us yet, the time to act is now!

3.2.4 Welsh mitigation condition

Tuesday, 4th February 2014 News 4

Climate Change Mitigation

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"Welsh infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion."

Scientists predict that what we are starting to see right now is just the beginning of a process that will intensify during the next few years. They all agree that while the full force of climate impacts has not hit us yet, the time to act is now!

3.2.5 Global adaptation condition

Climate Change Adaptation

Adaptation involves procedures and actions that can help people prepare for climate impacts to protect the most vulnerable, their homes and livelihoods. Adaptation measures include actions such as buying purpose-built flood boards that can be installed when flooding is imminent or putting irreplaceable or valuable items on high mounted shelves.

Experts warn of climate threats

Extreme weather events around the world have shown the dramatic consequences of a changing climate. Dr Paolo Meerin of the World Climate Advisory Panel (WCAP) warned this week that unusually heavy rain, storm surges and coastal erosion will have an increasing impact on the globe. The result could be millions of pounds in damage and detrimental effects on the health and well-being of many citizens in the next 25-50 years, even more so as sea levels are rising. Not only will these people be affected directly but also indirectly, through associated impacts, such as social disruption, homelessness, mental health effects and limited access to food and water.

Meerin added "more frequent heavy rains will also increase pressure on sewer systems with the associated impacts on diffuse pollution and sewer flooding incidents. In fact, global infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion." This will inevitably lead to supply chain disruptions and interference with everyday business activities, and associated losses for the global economy.

These are only a few of the many climate impacts that will increasingly affect many aspects of people's lives worldwide. Marianne Rangan of the Global Climate Change Adaptation Committee (GCCAC) argues that this underlines the importance of building these consequences into how people think and act about their future and the future of this world as a whole. In responding to these changes, she explains, adaptation (see infobox) should take a very prominent role rather sooner than later.

Scientists predict that what the world is starting to see right now is just the beginning of a process that will intensify during the next few years. They all agree that while the full force of climate impacts has not hit yet, the time to act is now!

"Global infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion."

3.2.6 Global mitigation condition

Tuesday, 4th February 2014 News 4

Climate Change Mitigation

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"Global infrastructure as a whole – roads, railways, energy infrastructure and properties – will see a substantial increase in damage from flooding and coastal erosion."

3.3 Factor analyses for scale constructs

3.3.1 Factor analysis policy support measures

	Factor 1	Factor 2	Factor 3	Factor 4
Q13.2	.857			
Q14.5	.808			
Q14.4	.625			
Q13.6		.638		
Q13.9		.462		
Q13.3		.457		
Q13.1		.448		
Q13.7		.423		
Q13.5		.401		
Q14.6			.691	
Q14.2			.484	
Q14.7			.450	
Q14.3			.348	
Q14.1				.553
Q13.8				.530
Q13.4				-.329

3.3.2 Factor analysis final policy support measures

	Factor 1	Factor 2	Factor 3
Q13.2	.791		
Q14.5	.758		
Q14.4	.709		
Q14.1	.509		
Q13.8	.508		
Q13.6		.642	
Q13.3		.459	
Q13.9		.446	
Q13.1		.431	
Q13.7		.386	
Q13.5		.353	
Q14.6			.693
Q14.2			.474
Q14.7			.445
Q14.3			.340

3.3.3 Factor analysis cultural orientation

	Factor 1
Q26.6 Individualism	-.611
Q26.1 Egalitarianism	.562
Q26.5 Individualism	-.555
Q26.3 Egalitarianism	.537
Q26.2 Egalitarianism	.500
Q26.4 Individualism	-.178

3.4 Reliability analysis for scale constructs

3.4.1 Reliability analysis support for adaptation

	Cronbach's Alpha if item deleted
Q13.6	.562
Q13.3	.622
Q13.9	.589
Q13.1	.646
Q13.7	.587
Q13.5	.571

3.4.2 Reliability analysis support for mitigation

	Cronbach's Alpha if item deleted
Q14.3	.542
Q14.2	.497
Q14.7	.463
Q14.6	.552

Appendix Chapter 4

4.1 Study 3 survey items and topline results

Q4. How concerned, if at all, are you about climate change, which is sometimes referred to as 'global warming?

N=1002

Very concerned	18%
Fairly concerned	49%
Not very concerned	24%
Not at all concerned	7%
Don't know	1%

Q7. How serious a threat, if at all, is climate change to each of the following? Please read out the letter that applies.

		Extremely serious	Very serious	Fairly serious	Not very serious	Not at all serious	Don't know
1	You and your family (N=1002)	5%	13%	39%	34%	7%	1%
2	The UK as a whole (N=1002)	9%	26%	44%	17%	3%	2%
3	People in developing countries (N=1002)	23%	38%	26%	6%	1%	5%

Q11. To what extent do you agree with the following statements?

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	Don't know
2	It is clear to me that climate change is really happening (N=1002)	33%	45%	11%	6%	2%	2%

Q13. In the next few years, how likely or unlikely do you think you would be to do each of the following?

(If respondents say they have already taken action: How likely would you be to do this again or to continue to do this in the next few years?)

		Very likely	Fairly likely	About as likely as not	Fairly unlikely	Very unlikely	Don't know
1	Change to a 'green' energy supplier which would reduce the impact on the environment from	16%	33%	24%	14%	9%	5%

	the electricity you use in your home (Your answers will not be shared with any energy companies for marketing or any other purpose, and they have no involvement in this research, which is being conducted by Cardiff and Nottingham Universities.) (N=1002)						
2	Cut down the amount you travel by car (N=1002)	12%	28%	18%	21%	17%	4%
3	Buy appliances that are more energy-efficient (N=1002)	43%	41%	8%	5%	2%	1%
4	Reduce the amount of energy you use at home (N=1989)	31%	49%	12%	6%	2%	0%
5	Write letters, email, or phone your local MP about climate change (N=1002)	4%	10%	13%	27%	46%	0%
6	Sign a petition about climate change, either online or in person (N=1002)	17%	36%	14%	14%	19%	0%

Q14. To what extent do you agree or disagree with the following statements?

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	Don't know
3	Changing my lifestyle will make little difference with regards to climate change (N=1002)	12%	33%	21%	25%	7%	1%
4	If everyone does their bit we can tackle the causes of climate change (N=1002)	28%	47%	12%	8%	3%	1%

Q25. Was your current or previous property affected by the floods between November 2013 and February 2014?

This could include any land surrounding your home such as a garden or drive. If you live in a flat it might include communal areas such as a car park or hallway. Please also answer yes if you stopped the water from

flooding your property by using some form of flood defence such as sand bags or a flood gate.

N=1002

Yes	3%
No	97%
Don't know	0%

Q38. Which, if any, of the following have you experienced as a consequence of the flooding?

1	Anxiety when it rains heavily (N=821)	17%
2	Increased stress levels (N=821)	15%
3	Sleeping problems (N=821)	6%

Q41. When you think about the floods how strongly, if at all, have you felt each of the following emotions? Please rate each emotion on a scale of 1 to 10 where 1 means you have not felt it at all and 10 means you have felt it extremely.

(If you have experienced flooding at other times, please just think about the feelings you have experienced in relation to the floods, which occurred last winter, between November 2013 and February 2014. If you would like to say something about your other experiences then you will be able to do so towards the end of the interview.)

		1 I have not felt this at all	2	3	4	5	6	7	8	9	10 I have felt this extremely
1	Sadness (N=1002)	14%	7%	8%	5%	12%	9%	15%	13%	6%	11%
2	Anxiety (N=1002)	43%	15%	9%	6%	9%	7%	4%	3%	2%	3%
3	Pride (N=1002)	57%	8%	4%	4%	12%	5%	2%	3%	3%	2%
4	Gratitude (N=1002)	46%	7%	3%	5%	13%	6%	5%	5%	3%	6%
5	Anger (N=1002)	40%	10%	7%	5%	10%	7%	7%	6%	3%	5%
6	Helplessness (N=1002)	36%	8%	6%	5%	10%	5%	8%	9%	4%	8%
10	Distress (N=1002)	38%	12%	10%	5%	11%	7%	7%	5%	2%	3%

Q44. Thinking about the floods and the impact they had. To what extent do you think each of the following contributed to the floods?

		Not at all	Just a little	A fair	A great	Don't

				amount	deal	know
1	Climate change (N=1002)	7%	25%	40%	21%	7%

Q45. **To what extent do you agree or disagree with the following statements about the floods that happened between November 2013 and February 2014?**

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	Don't know	No opinion
1	The floods were caused, in part, by climate change (N=1002)	11%	52%	19%	8%	4%	5%	0%
3	The floods were a sign that the impacts of climate change are happening now (N=1002)	19%	47%	18%	8%	4%	4%	1%
7	The floods showed us what we can expect in the future from climate change (N=1002)	22%	50%	17%	6%	4%	1%	0%
11	People I know thought the floods were caused in part by climate change (N=1002)	8%	46%	24%	10%	3%	8%	1%

Q47. **Do you believe your property is at risk of flooding in the next 10 years?**

N=1002

Definitely at risk	2%
Probably at risk	10%
Probably not at risk	29%
Definitely not at risk	55%
Don't know	3%
Refused	0%

Q48. **To what extent do you agree or disagree with the following statements?**

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	Don't know	No opinion
1	If floods were to affect my property this year, I would feel able to cope	9%	36%	14%	24%	11%	3%	1%

	with this (N=1002)							

Q49. The following actions can be taken by individuals to help respond to the risks and the impacts of flooding. Which of the options best describes what you think about each of these?

		I don't think this is relevant to me	It is very unlikely I would do this	I would possibly consider doing this	I would definitely consider doing this	I am intending to do this	I've done this already	Don't know
1	Buying flood protection products such as flood boards or sand bags (N=1002)	39%	24%	22%	12%	1%	1%	1%
2	Making sure I have insurance cover for flooding (N=1002)	23%	10%	15%	19%	3%	26%	3%
3	Signing up for flood warnings from local agencies (N=1002)	30%	18%	24%	20%	2%	4%	2%
4	Seeking advice (for example, from a building surveyor) on how to protect my property against flooding (N=1002)	34%	24%	21%	16%	1%	1%	2%
5	Thinking through or preparing a plan of what I should do in a flood (N=1002)	31%	18%	28%	17%	2%	2%	2%
6	Attending meetings or joining a community group related to flooding (N=1002)	31%	29%	26%	11%	1%	0%	2%

Q50. To what extent do you agree or disagree with the following statements? (We are interested in people's wider beliefs about society and how these relate to attitudes on the environment.)

		Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	Don't know	No opinion
1	Discrimination against minorities is still a very serious problem in our society (N=1002)	27%	39%	18%	9%	2%	4%	1%
2	The world would be a	24%	33%	18%	15%	6%	3%	1%

	better place if its wealth were divided equally among nations (N=1002)							
3	In my ideal society, all basic needs such as food, housing, education and health care would be guaranteed by the government for everyone (N=1002)	37%	37%	10%	12%	4%	0%	0%
4	People should be allowed to make as much money as they can for themselves, even if others are not able to (N=1002)	17%	34%	19%	16%	10%	2%	1%
5	When I have problems, I try to solve them on my own (N=1002)	38%	47%	8%	5%	1%	0%	0%
6	If the government spent less time trying to fix everybody's problems, we'd all be a lot better off (N=1002)	19%	26%	22%	17%	10%	4%	1%
7	Being environmentally friendly is an important part of who I am (N=1002)	20%	47%	21%	8%	2%	1%	1%
8	I think of myself as someone who is very concerned with environmental issues (N=1002)	16%	42%	25%	12%	4%	0%	1%

4.2 Factor analysis for scale constructs

4.2.1 Factor analysis flooding emotions

	Factor 1	Factor 2	Factor 3
Q41.10	.812		
Q41.2	.750		
Q41.6	.687		
Q41.5	.623		
Q41.1	.549		.302
Q41.8			
Q41.3		.797	
Q41.4		.616	
Q41.7			.883
Q41.9			

4.2.2 Factor analysis climate change attribution

	Factor 1	Factor 2	Factor 3

Q45.3	.840		
Q45.7	.776		
Q45.1	.718		
Q44.1	.706		
Q45.12	-.445		.302
Q45.11	.436	.319	
Q45.10		.640	
Q45.8		.526	
Q45.4			.533
Q45.5			.479
Q45.2			.410
Q45.6			.407

4.3 Correlation Matrix outcome measures and predictors

	Flood adapt. intentions	Mitig. intentions	Pers. flood risk	Flood emot.	Flood exp.	Mental health conseq u.	CC concern	Env. Ident.	Collect. efficacy	CC belief	Flood coping belief	Social grade	Age
Flood adapt. intentions	1	0	0	.259**	.403**	.317**	.215**	.129**	.167**	.118**	.012	.104**	-.077**
Mitig. intentions	.252**	1	.148**	.213**	.037	.115**	.505**	.456**	.466**	.436**	-.008	.154**	-.143**
Pers. flood risk	.515**	.148**	1	.185**	.475**	.325**	.163**	.083**	.131**	.102**	.037	.013	-.153**
Flood emotions	.259**	.213**	.185**	1	.122**	.455**	.221**	.259**	.123**	.137**	-.168**	-.029	.091**
Flooding experience	.403**	.037	.475**	.122**	1	.311**	.070*	.045	.049	.041	.117**	.116**	-.012
Mental health consequ.	.317**	.115**	.325**	.455**	.311**	1	.175**	.098**	.059	.093**	-.105**	-.077*	.046
CC concern	.215**	.505**	.163**	.221**	.070*	.175**	1	.419**	.329**	.482**	.079**	.143**	-.008
Env. Identity	.129**	.456**	.083**	.259**	.045	.098**	.419**	1	.309**	.307**	<.001	.096**	.146**
Collect. efficacy	.167**	.466**	.131**	.123**	.049	.059	.329**	.309**	1	.319**	.043	.007	-.146**
CC belief	.118**	.436**	.102**	.137**	.041	.093**	.482**	.307**	.319**	1	.086**	.036	-.115**
Flood coping belief	.012	-.008	.037	-.168**	.117**	-.105**	.079**	<.001	.043	.086**	1	-.086**	.055*
Social grade	.104**	.154**	.013	-.029	.116**	-.077*	.143**	.096**	.007	.036	-.086**	1	.067**
Age	-.077**	-.143**	-.153**	.091**	-.012	.046	-.008	.146**	-.146**	-.115**	.055*	.067**	1

Correlation Matrix for outcome measures and significant predictors that were included in the two regression models (** $p < .01$; * $p < .05$, two tailed)