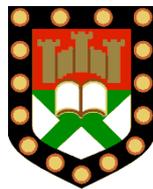


**Dynamics of Communicating Climate Change Information:
Using mixed methods to examine the perspectives of
scientists, communicators and publics**



Submitted by Hebba Haddad to the
University of Exeter as a thesis for the degree of
Doctor of Philosophy in Psychology
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Hebba Haddad

Abstract

The communication of anthropogenic climate change presents many challenges, for communicators, scientists, policymakers and publics alike. Particularly difficult is the issue of uncertainty, which can include ambiguity around the phenomenon of climate change, the possible impacts of this, and the timeframe within which such impacts will be seen. Previous research has established that audiences are often averse to uncertainty, and will disregard or ignore messages that contain it. This raises a theoretical and practical question of how best to manage uncertainty in climate change communication in order to maintain audience engagement. This question was the focus of this PhD research.

Specifically, the aim of this thesis was to explore the process of climate change communication from the perspectives of the scientists, communicators, and the recipient. I achieved this research goal by utilising a mixed methods design. I firstly interviewed the originators (i.e., scientists) and professional communicators of climate change information to explore the process from their side (Chapter 2). This revealed a number of themes connecting to the different ways scientists and communicators understand the process of communication (e.g., as information exchange versus relationship building), the challenges of climate change communication and uncertainty in particular, and the (appropriate) role of scientists when communicating with the public about climate change. Next, in a series of studies I experimentally explored how audiences respond to variations in the informational content of climate change messages (such as the level of uncertainty) and the role of different communicative styles in further shaping audience engagement (Chapter 3). Broadly, the results of these studies suggest that while uncertainty can undermine audience engagement with climate change

communications, the negative effects of uncertainty are buffered when the communicator is perceived to be high in morality and/ or when they use an open communication style. Interestingly, these effects of communication style were particularly evident among women, whereas men tended to react against this. Together, these studies show how relational factors (e.g., communication styles and perceptions of communication sources) can moderate the impact of informational content on audience responses. Finally, I ended this programme of research by looking in more detail at how audiences perceive a real scientific organisation engaged in climate change communication and the bases of their beliefs about organisation competence and morality (Chapter 4). This study combined qualitative and quantitative data to delve deeper into some of the insights gained in the experimental work, and to reconnect this to the real-world organisation context I began with. This study again showed how perceptions of communicator morality moderate responses to uncertainty, but also provide useful insights into the different origins of perceptions of morality and competence.

Chapter 5 concludes by summarising the research presented in this thesis, discussing its strengths, limitations and ways forward. Here, I also consider the theoretical, methodological and practical implications of the thesis' research findings. Briefly, it is argued that addressing the scientific uncertainties of climate change may not necessarily mean altering the form of information itself. Rather, modifying the language peripheral to the information that contains uncertainty, attending to the ways in which audiences perceive the sources of uncertainty, and considering variations amongst publics, may help to engage in effective communication around the complex issue of climate change.

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Chapter 1

Introduction

The Intergovernmental Panel on Climate Change (IPCC), established in 1988, is a world scientific body that assesses the latest scientific, technical and socio-economic information relevant for the understanding of climate change and its potential global impacts. Every five to six years since 1990 the committee has published comprehensive reports (termed ‘assessment reports’) of the latest understanding of climate change. These working group reports are technical and detailed in their content. There is, however, a summary for policymakers, which is written with non-scientist experts in mind. In summing up findings on the detection and attribution of climate change, the most recent Summary for policymakers states,

Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes [...]. This evidence for human influence has grown since AR4 [Fourth Assessment Report]. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.

IPCC Summary for Policymakers (2013, p.17)

For scientists, policymakers, social scientists, and publics alike, the take home message from the above extract is that climate change is occurring, and that it is “extremely likely” to be the result of human behaviour. Perhaps this inspired Barack

Obama's decision to cover this topic in his State of the Union address, 28 January 2014, saying, "the debate is settled. Climate change is a fact" (Obama, 2014). More recently, during a Prime Minister's Question Time session in the House of Commons the UK Prime Minister, David Cameron, stated, "I believe that man-made climate change is one of the most serious threats that this country and this world face" (26 February, 2014).

The threats, or impacts, of climate change are projected to include a global average temperature increase of 0.1°C to 0.4°C over the next two decades, an increase that goes beyond the 0.7°C increase that has already been observed since 1950. If humans continue producing greenhouse gas emissions at the current rate, the resulting changes in the climate system would be considerably more than has already been seen (IPCC, 2007). As a result of these temperature changes, the adverse impacts will be severe and irreversible. It is also projected that there will be an increase in wet and dry weather extremes, global sea temperature and decreases in arctic ice sheets and glaciers, leading to a global mean sea level rise (IPCC, 2013). Based on current projections, a 0.4°C rise in the global mean temperature would be irrecoverable for the climatic systems (IPCC, 2007).

Such changes will not only impact on the environment, but will also have consequences for all inhabitants of the Earth – including humans. For example, droughts, crop yields, climate migration, extreme weather conditions, and so on, will affect us all – globally and locally. Closer to home, in the UK there is some debate about whether the extreme winter storms¹ witnessed in England and Wales between December 2013 and February 2014, can be linked to climate change. While the UK

¹ This series of winter storms has been exceptional in its duration, and has led to the wettest December 2013 to February 2014 period in the UK since records began. Events consisted of heavy rains combined with strong winds and high waves led to extensive flooding and coastal damage, causing significant disruption to individuals, businesses and infrastructure.

Prime Minister believes these extreme weather patterns are linked to human-induced climate change², climate science experts cannot, and will not, definitively say whether there is any connection to anthropogenic climate change³. Writing an article in the Guardian⁴ (14 February 2014), however, the author of the influential 2006 report on the economics of climate change, Lord Nicholas Stern, stated the flooding and storms in the UK are a clear sign of the impacts of climate change.

Actions in response to climate change fall into two categories: mitigation and adaptation. Mitigation is generally viewed as human actions intended to reduce the magnitude and rate of climate change. Adaptation, in contrast, is seen as human actions taken to manage the impacts of global warming (IPCC – WGII, 2007).

Effective communication of the causes and consequences of climate change is therefore essential to encourage behavioural response to avoid its consequences (Roser-Renouf, 2010). However, there are many challenges that the communication of climate change information brings which may hinder effective communication on the issue. Such issues must be addressed so communicators, scientists and policymakers can engage the public in policy and behavioural remedies that will help avoid (and adapt to) the threat that climate change poses.

Before moving on to research that has specifically concerned climate change communication I will first introduce science communication more broadly.

1. Science communication

Broadly speaking science communication presents science-related topics to non-experts. The traditional perspective of this is the deficit knowledge frame whereby information is uniformly transmitted from ‘experts’ to ‘non-experts’. In

² <http://www.bbc.co.uk/news/uk-politics-25656426>

³ E.g., <http://www.bbc.co.uk/news/uk-25675937>, <http://www.bbc.co.uk/news/uk-politics-26084625>

⁴ <http://www.theguardian.com/environment/2014/feb/13/storms-floods-climate-change-upon-us-lord-stern>

response to its critiques, an interactive model is proposed whereby contextual factors and audience values are considered in the process of communication.

1.1 Deficit model. Traditionally communication of science has taken the view that the general the public are empty vessels waiting to be filled with knowledge (Gross, 1994; Ziman 1992). As such, this ‘deficit’ model is a process of transmission whereby communication is seen as a linear, one-way process whereby the message (e.g., climate information) moves straightforwardly from the source (e.g., scientists) to the recipients (e.g., publics). This view of communication is akin to Shannon and Weaver’s (1949) transmission model, also referred to as the information deficit model of communication (Gross, 1994; Nisbet & Scheufele, 2009).

But, this model of science communication has received a number of criticisms. For instance, for not taking into account the role of context and individual differences in shaping communication – even simply referring to lay audiences as ‘the public’ implies a certain homogeneity within the group (e.g., Sturgis & Allum, 2004; Burns, O’Connor & Stocklmayer, 2003). By conceptualising the public as deficient in knowledge (Wynne, 1991), the approach implies that scientific knowledge is superior to untrained forms of knowledge (Davies, 1998), and that any differences between lay and experts are caused by knowledge deficits of the public, rather than problems with the communicator (Irwin & Wynne, 1996; Whitmarsh, 2009). However, a meta-analysis study has shown that science literacy (as measured by general knowledge of science facts) only accounts for a small fraction of the variance in how lay publics form opinions about controversial areas of science (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008).

Research has shown that rather than science literacy, public opinion on (controversial) science issues derives from an individual’s ideology, political

preference and religious identity (Nisbet & Goidel, 2007). Furthermore, while some scientists believe the public's irrational fears around new technologies are the result of a lack of scientific understanding; such fears around new technologies, however, have been shown to do with their perceptions of risk hazards as well as how the technology impacts upon people's current social and cultural lives (Douglas & Wildavsky, 1982; Nisbet & Goidel, 2007).

As such the approach to science communication needs to recognise that science cannot be separated from its social and institutional contexts (Einsiedel & Thorne, 1999). Furthermore, audiences are not just passive recipients of information – they are active participants in a process of communication. The deficit model, for example, ignores the possibility that individuals can seek out and evaluate information that supports their existing views and actively ignore refuting evidence (Lord, Ross & Lepper, 1979; Lord & Taylor, 2009).

1.2 Interactive model. In response to such criticisms of the deficit approach, the 'interactive model' of communication has been proposed as an alternative model of science communication from experts to non-experts. Also known as the contextual model, audience beliefs and values, and social context play a central role when engaging in (science) communications. In writing the editorial for the special issue of the journal *Public Understanding of Science*, Einsiedel (2007) encourages scientists to move beyond the deficit frame, to stop thinking of public as passive, homogenous and deficient in knowledge, and to view “publics as active, knowledgeable, playing multiple roles, receiving as well as shaping science” (Einsiedel, 2007, p.5).

An interactive communication model is seen as an on-going process of sending messages and negotiating their meaning (Logan, 2001; Wynne, 1991). Such interactive science communication approaches can also include an informal

conversation style, such as using inclusive and colloquial language (Logan, 2001; Einsiedel & Thorne, 1999). In examining the linguistic and discursive features of the IPCC Summary for Policy makers, Fløttum and Dahl (2011) found that the summary contained no explicit use of “we” (i.e., inclusive language) and was dominated by impersonal language. They suggest that dominance of impersonal language in the IPCC may be a technique to claiming neutrality of the science and managing points of non-agreements between the author(s).

Recent public opinion figures give some indication that audiences would like more two-way communications from scientists in general. A *Public Attitudes to Science* survey conducted by the Economic and Social Research Council (ESRC) in the UK ($n = 2259$) revealed that 58% of respondents felt that “scientists put too little effort into informing the public about their work”, and 69% felt that “scientists should listen more to what ordinary people think” (ESRC, 2014).

2. Climate change communication

Behavioural research has studied what barriers may inhibit favourable responses to climate change, and what interventions may help overcome these barriers (e.g., Gifford, 2011; for reviews see Steg & Vlek, 2009; Swim et al., 2009). While it is important to better understand *behavioural* barriers and motivators to pro-environmental actions, it is also vital to *engage* publics on the issue of climate change.

Better understanding of the forces behind engagement may help to foster public acceptance of environmental policies intended to help mitigate the effects of climate change and better understand the barriers to such acceptance (Ockwell, Whitmarsh, & O'Neill, 2009). Furthermore, overcoming barriers that originate in the communication

of the climate change science could facilitate personal behaviour change that might help to avert the threat of dangerous climate change (Roser-Renouf & Maibach, 2010).

2.1 Barriers to the communication of climate change. There are difficulties specific to the topic of climate change that pose their own challenges to the communications process. For example, Whitmarsh (2009) found that audience understandings of the topic varied depending on terminology used (such as climate change cf. global warming). As a result, different terminologies trigger different audience responses; for instance, ‘global warming’ evokes more concern than ‘climate change’. Whitmarsh argues this may be because conceiving the effects of “global warming” is simply easier for people. For instance, the term ‘global warming’ term suggests an increase in the global temperature; whereas “climate change” conveys ambiguous consequences. She urged researchers, because of the different connotations the terms “climate change” and “global warming” bring, to be aware that the wording contained within research questionnaires may inadvertently elicit different participant responses,

Another challenge presented in the communication of climate change is the temporal and spatial distance that is inherent in the topic (Lieberman & Trope, 2008; Milfont, 2010). As a result of this psychological distance people will not see climate change as an issue that has direct personal relevance and, as a result, makes the communication of its occurrence, causes and subsequent behaviour change challenging (Spence, Poortinga & Pidgeon, 2012; Spence, Poortinga, Butler, & Pidgeon, 2011; CRED, 2009; Weber, 2010; Trenberth, 2012; Bord, Fisher, & O’Connor, 1998; Moser & Dilling, 2004). Despite this lack of direct experience of climate change, however, a recent UK survey revealed 78% of respondents felt

informed about climate change and 75% felt that human activity does has a significant effect on the climate (ESRC, 2014).

In addition to the temporal and spatial challenges concerned with the topic of climate change, scientists are almost certain that climate change is occurring and is human-induced, yet at the same time there still remain a lot of uncertainties. Such an oxymoron, at face value, is confusing. However, there are reasons beyond the face value impressions why uncertainty is an obstacle in the (scientific) communications of global climate change information. Uncertainty within climate science takes a number of forms. For instance, uncertainty within climate projections can stem firstly from unknowns within the climate system and how these can be modelled; to the unknowable variables that might impact on future climate change (e.g., societal responses and human behaviour).

Thus, when scientists speak about future climate change, they tend to refer to a range of probable outcomes based on current understandings of the climate system and the factors that might affect it. The IPCC specifically define uncertainty as:

A complex and multifaceted property, sometimes originating in a lack of information, and at other times from quite fundamental disagreements about what is known or even knowable.

IPCC (2007, p.138)

Uncertainties around climate change have been linked to increased scepticism about the phenomenon (Patt, 2007). Increasing scepticism is a problem if it translates into inaction (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007), and research has indeed indicated scepticism reduces willingness to engage in action to mitigate

against the effects of climate change (e.g., Kortenkamp & Moore, 2006). However, risk-based impacts need to be communicated effectively because risk-based decisions are needed in the present in planning ahead for adaptation (Pidgeon & Fischhoff, 2011).

3 Uncertainty

It is necessary to briefly describe how uncertainty has been conceptualised in previous research and how it will be treated within this thesis.

3.1 Conceptualisations. Uncertainty has been studied in a variety of disciplines, including economics, statistics, physical sciences, and psychology. With this varied research attention comes varied conceptualisations of uncertainty. Even within psychology there are different forms of uncertainty people encounter. For example, personal uncertainty is uncertainty regarding oneself and social relationships (Berger & Calabrese, 1975; Hogg, 2000). Informational uncertainty is where features of information are lacking, therefore hindering judgement making (Van den Bos & Lind, 2010). Where informational uncertainty is concerned, further distinctions have been made between probabilistic uncertainty (i.e., risk) and immeasurable uncertainty (i.e., ambiguity over knowledge; Knight, 1921). Communication of probabilistic uncertainty (i.e., the topic and likelihoods around it) to stakeholders and affected parties is generally termed “risk communication” (Pidgeon & Butler, 2009).

This thesis will be focussing on the communication of informational uncertainty – in particular, probabilistic uncertainty: because this type of risk communication is typically the focus of science organisations that communicate climate change information (such as the IPCC and also the collaborative partner of this PhD, Met Office). Moreover, according to these organisations, risk-based decisions need to be made and implemented now to avoid and manage the dangerous impacts of climate

change so the effective communication of climate future impacts is vital in this context (Pidgeon & Fischhoff, 2011).

3.2 *Uncertainty and climate change.* The IPCC Fifth Assessment (2013) presents a technical summary accompanied with a document containing information on how uncertainty is to be treated within all of the reports (p.35). The IPCC advocate presenting levels of certainty using two metrics. Firstly, the *degree of confidence* is how confident the collective of IPCC scientists are in the validity of a particular finding – this expressed qualitatively using five qualifiers (very low, low, medium, high, and very high). The second metric is the *likelihood* of an event occurring - these are quantified and expressed probabilistically, and are also accompanied with calibrated language for describing quantified uncertainty. A guide of the likelihood outcomes and the terms assigned as used in the reporting within the IPCC are presented below in *Table 1.1*. Such projections are based on statistical analysis of observations or model results, or expert judgement.

Table 1.1

Likelihood Scale of the Intergovernmental Panel on Climate Change

Term	Likelihood of the outcome
Virtually certain	99–100% probability
Very likely	90–100% probability
Likely	66–100% probability
About as likely as not	33–66% probability
Unlikely	0–33% probability
Very unlikely	0–10% probability
Exceptionally unlikely	0–1% probability

The IPCC also provide supporting material for contributing scientists on uncertainty communications titled ‘Guidance Note for Lead Authors of the IPCC

Fifth Assessment Report on Consistent Treatment of Uncertainties'. Within this document is advice for how lead authors of the IPCC reports on how to treat (un)certainty, as described above with *confidence* and *likelihood* metrics. The IPCC also consider how audiences may respond to statements of uncertainty. Specifically, they say:

Be aware that the way in which a statement is framed will have an effect on how it is interpreted (e.g., a 10% chance of dying is interpreted more negatively than a 90% chance of surviving). Consider reciprocal statements to avoid value-laden interpretations (e.g., report chances both of dying and of surviving).

Mastrandrea *et al* (2010), IPCC 2010

(point number 4, p.2)

The extract above makes particular reference to Kahneman and Tversky's (1979) work on prospect theory, a model that attempts to explain how people manage risk and uncertainty. With the IPCC putting a lot of effort to make probabilities understandable (i.e., by including qualitative descriptions), it seems that they are also aware that audience interpretations of probabilistic uncertainties can vary if the same information is framed differently. Such interpretations of information are likely to have consequences on perceptions of risk and behavioural responses. Indeed, public scepticism towards climate change can be influenced by probabilities and model-based uncertainty (Patt, 2007). As such it is important to better see how individuals respond to broad situations of uncertainty and specific response to risk communications of probabilistic information.

3.3 Responses to uncertainty. People are typically averse to information containing uncertainty and ambiguity (Ellsberg, 1961; Camerer & Weber, 1992; Hogg, 2007). This raises a question about how bodies like the IPCC could present uncertainty to overcome such problems. The previous subsection (3.2) has illustrated how the IPCC currently conveys climate change uncertainty to laypeople. However, research has indicated that lay audiences do not necessarily interpret such probabilities in the way intended. Kahneman and Tversky's (1979) prospect theory suggests when individuals are presented with probabilistic alternatives of risk, decisions are made on quick reference judgements (heuristics) on the gains and losses of each option. Accordingly, attitudes towards equivalent risks, and the decisions based on these, can be quite different depending on whether these are framed as gains (e.g., surviving) or losses (e.g., dying). People tend to be loss-averse, and as such will be more conservative when these are fore-grounded (Tversky & Kahneman, 1981).

Similarly, audience perceptual differences have been noted in the context of climate change. Budescu, Broomell and Por (2009) presented participants with actual sentences from the 2007 IPCC report and asked them to assign numerical values to the probability statements. Some participants were given the accompanying verbal-numeric translation table whereas others were not. Interestingly, respondents' judgments of probability varied from the IPCC guidelines, even when the respondents had access to these. They found that interpretations of the qualitative terms, such as 'likely' and 'very likely', deviated somewhat from IPCC intended probabilities. Specifically people would underestimate the magnitude of effects. A consequence of this underestimation of events may lead people to perceive climate change as not an issue to be currently concerned about and does not need immediate action. Following their results, Budescu et al. (2009) recommend using both verbal and numeric

presentations of uncertainty, as this improved communication compared to one presentation of uncertainty.

Similarly, framing effects have also been found in comparing probability impacts of climate change communicated in a negative versus positive frame. Morton, Rabinovich, Marshall and Bretschneider (2011) compared probability statements regarding the impacts of climate change framed in a negative sense (i.e., likelihood of climate change losses *occurring*) versus positive framing (i.e., likelihood of losses *not occurring*). They found that positive framing (i.e., impacts not likely to occur) resulted in more pro-environmental behavioural intentions even under conditions of higher uncertainty. This suggests that while uncertainty might ordinarily be a barrier to communication, subtle shifts in the communication of probabilistic information may help overcome the negative effects of uncertainty.

3.4 Meanings of uncertainty to scientists and non-scientists. Typically uncertainty has been viewed in terms of a single dimension of probability, or degree of belief (Kahneman & Tversky, 1981). Though while in some respects probabilistic uncertainty is measureable and quantifiable (positivist in nature), it is simultaneously subject to individual interpretations and responses, as discussed in the previous subsection (3.3) (e.g., Tversky & Kahneman, 1981; Morton et al., 2011). As such, one could argue that uncertainty is a psychological (Windschitl & Wells, 1996) and social construct (Einsiedel & Thorne, 1999). For Einsiedel and Thorne (1999), uncertainty is a concept with a fluidity that spans social worlds, stating,

Uncertainty is a social construction, one that is negotiated among actors in a social system that includes various publics. Seen in this light,

uncertainty is manifested by individuals in a number of different ways, for different reasons, and with varying outcomes.

Einsiedel and Thorne (1999, p.44)

With this, scientists and publics do have different understandings of uncertainty (Zehr, 2000; Kempton, 1991). From a constructionist perspective, uncertainty is seen as a rhetorical tool that portrays science as objective in generating and presenting its ‘facts’ (Dunwoody, 1999). It is argued that such discourse is constructed in particular situations with specific (intended) effects (Gilbert & Mulkay, 1984; Shackley & Wynne, 1996), for instance to bolster legitimacy and validity in science (Gilbert & Mulkay, 1984; Potter, 1996; Edler, 1996; Zanna & Darley, 1987). The use of uncertainty during interactions can help maintain boundaries between scientists and policymakers (Shackley & Wynne, 1996) and publics (Zehr, 2000). For example, uncertainty positions scientists as the authoritative provider of knowledge reinforcing the constructed social hierarchy between scientists and publics. This is not restricted to uncertainty, research showing that scientists often engage with the public using scientific language (Cook, Pieri, & Robbins, 2004). However, using such scientific dialect to communicate with people not familiar with it can hinder understanding of the topic (Bourdieu, 2000).

Some researchers have suggested that communicating high levels of uncertainty may be harmful to audience perceptions of the communicator. For instance, to scientists uncertainty simply represents the quantifiable level margin of error associated with some prediction or finding. In contrast, publics sometimes perceive uncertainty to imply a lack of definitive evidence and as a consequence

increasing perceptions unreliability (Sharples, 2010). As Pollack (2003) states, “the uncertainties that scientists face are really not so different from the uncertainties we encounter in daily life ... Ironically, people who are not scientists often equate science with certainty, rather than uncertainty” (p.6). Indeed, laypersons generally expect experts to be confident and precise with their information (Shanteau, 1987). When a range of probabilities is communicated, audiences may infer that the source is unknowledgeable in their domain of expertise (Fischhoff, 1995; Shome & Marx, 2009). Conversely, however, disclosing uncertainty can signal honesty, rather than incompetence, at least for some people (Johnson & Slovic, 1995).

3.5 Summary. Uncertainty presents a major challenge in the communication of climate change information. In part this is because climate change science is a complex topic in itself, consequently making its communication tricky. In part also, people are generally averse to information that contains uncertainty. Research has identified some ways in which framing uncertainty can influence different responses people may have to uncertainty. Research also suggests that uncertainty has different meanings to scientists and publics.

Uncertainty and risk have often been strongly associated with trust (e.g., Renn & Levine, 1991; Kasperson, Golding & Tuler, 1992; Poortinga & Pidgeon, 2003; Slovic, 1993; Earle & Cvetkovich, 1995). Indeed, it is argued that (perceived) risk is integral to trust; with some researchers viewing risk as a precursor to trust i.e., the need for trust only occurs in a risk situation (e.g., Deutsch, 1958; Giffin, 1967; Schlenker, Helm, & Tedeschi, 1973; Johnson-George & Swap, 1982; Eiser, Miles, & Frewer, 2002). Conversely, some researchers argue that trust is prerequisite of perceptions of risk and effective risk communication (e.g., Kasperson, Golding, & Tuler, 1992; Poortinga & Pidgeon, 2003). Despite these differences of perceptions of

which is a precursor to which (discussed a little further in the section of Trust, 4.4 – *Trust and risk communication*), the intertwined relationship of trust and risk is evident. Because of the integral relationship between uncertainty and trust, we must also get a clearer picture of trust as a concept before exploring its role in communicating climate change information.

4 Trust

It has been said that trust is the fundamental ingredient in social interactions (Gambetta, 1988). Though the term ‘trust’ is often used every day, it is actually a complex relational feature to build, maintain, repair – and to research. Conceptualising trust has been attempted within a number of social science disciplines, notably economics, psychology and sociology. And, as with uncertainty, I will briefly discuss how trust has been conceived in previous research before defining how it will be treated in this thesis.

4.1 Conceptualisations. Trust has been defined as a “psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another” (Rousseau, Sitkin, Burt, & Camerer, 1998, p395). Said another way, trust involves two parties: a trusting party (trustor) and a party to be trusted (trustee) (Driscoll, 1978). Specifically, trust can take different forms depending on the situation. For example, *relational trust* is generally seen within (romantic) relationships (e.g., Lazelere & Huston, 1980), and is established through recurring interactions over time between actors (Rousseau, Sitkin, Burt, & Camerer, 1998). In contrast, *calculus-based* and *institutional trust* is established over short-term interactions and expectations made *in situ* (Rousseau et al., 1998).

Some thinkers have criticised researchers of trust for complicating the research concept (Metlay, 1999). For example, Metlay (1999) has argued that there are nuances in meaning and constructs within the concept of trust that may be discussing the same features. This view has been echoed by Siegrist, Gutscher, and Earle (2010) saying, “research has also spawned a confusing variety of measures, constructs and theories that has frustrated progress towards a more useful understanding of trust” (p.3). Despite this, I will attempt to discuss research on the topic of trust in the following subsections.

4.2. Early research. Originally social research into trust was guided by the ‘prisoner’s dilemma’ (Deutsch, 1958) framework, whereby trust was the extent to which someone would engage in co-operative behaviour (Deutsch 1960). Early social psychology research on the characteristics of trust studied it as part of a broader concept of ‘credibility’. Here ‘credibility’ was comprised and affected by two factors: expertise and trustworthiness (Hovland, Janis, & Kelley, 1953). As such, in measuring credibility, trust tended to be described, and manipulated for the purpose of experimentation, interchangeably with expertise (e.g., Hovland, Janis, & Kelley, 1953). Research over the decades continued to commonly include expertise as part of the make-up of trust (e.g., Griffin 1967; Deutsch, 1960; Kee & Knox, 1970).

Researchers have identified various attributes that lead to trust. These include: perceptions of fairness (e.g., Bromiley & Cummings, 1993); perceptions of competence (e.g., Gabarro, 1987; Sako, 1992); perceived competence and integrity (e.g., Lieberman, 1981); openness; (e.g., Pijawka & Mushkatel, 1991/2; Ouchi, 1981); predictability (e.g., Lewis & Weigert, 1985; Gambetta, 1988; Rotter, 1967). For Barber (1983) there are two dimensions of trust: namely, technical competence and expectations fulfilled. Kasperson, Golding and Tuler (1992), on the other hand,

identify four traits people look for when developing and maintaining trust: these are perceptions that the other person is committed, competent, caring and predictable.

Metlay (1999) took these various trait characteristics associated with trust (e.g., openness, reliability, integrity, credibility, fairness, caring, competence) and attempted to simplify the research concept of trust. Metlay proposed that trust towards an institution (the US Department of Energy in this specific study) was based on two distinct components: *affective elements* – these are trait perceptions based on affect, (e.g., caring, honesty); and the second aspect of trust is perceptions of *institutional competence* (i.e., how able the institution is).

Through the '80s and '90s research tended to take the view that trust (and trustworthiness) is inferred from perceptions of expertise and credibility (e.g., Cook & Wall, 1980; Kasperson, Golding, & Tuller, 1992; Metlay, 1999). Renn and Levine (1991) defined trust in risk communication contexts as, “Trust in communication refers to the generalized expectancy that a message received is true and reliable and that the communicator demonstrates competence and honesty by conveying accurate, objective, and complete information” (p.179).

Mayer, Davis and Schoorman (1995) provide a comprehensive summary of trust antecedents. They propose three characteristics of the communicator that repeatedly explained trustworthiness, these were: ability, benevolence, and integrity. These researchers suggested that each trait contributes a unique perspective to consider when evaluating others in terms of their trustworthiness. This suggests that while ability, or competence, might be one input into trust, trust is also a composite of further factors. Mayers and colleagues (1995) made comparisons to Aristotle's Rhetoric which suggests that a speaker's *ethos* (character) is based on the listener's

perception of three things: *phronesis* (intelligence); *eunoia* (goodwill intentions to audience); and *arete* (reliability, honesty).

4.3. *Recent research on person perception.* Since the late 1990s, social psychological research has moved towards a structured view of social judgment, also termed as stereotype content. As with Aristotle and thinkers since, trustworthiness and competence have remained central components on which judgements are made regarding person perception. Recent researchers have shown that trustworthiness is theoretically and empirically distinct to other components, such as competence.

Stereotype content models of person perception provide a framework of how impressions of others are formed, and with this provides a research tool to gauge how impressions of others may influence behaviours as a result (e.g., Leach, Ellemers, & Barreto, 2007; Fiske, Cuddy, & Glick, 2007; Wojciszke, Bazinska, & Jaworski 1998).

Although stereotypes can often appear quite idiosyncratic, social psychological research has shown that the plethora of trait perceptions which stereotypes embody can be grouped to represent their underlying dimensions. Most stereotypes contain information about the capacities of the stereotyped group (e.g., competence or agency) and their relational qualities (e.g., warmth and/ or morality). Perceived competency (e.g., perceiving groups and their members as capable, competent, and skilled) is a core dimension included in all theoretical perspectives of stereotype content. However, differences in theoretical opinion arise with regards to the distinctiveness of content dimensions of warmth (e.g., friendly, warm) and morality (e.g., trustworthy, moral). Such research is still in the spirit of Aristotle's thinking towards judgements of a person's character. Indeed, current research on person perception provides empirical support for three dimensions: competence,

warmth and morality (e.g., Leach, Ellemers, & Barreto, 2007; Fiske, Cuddy, & Glick, 2007; Wojciszke, Bazinska, & Jaworski, 1998).

Despite the nuances concerning warmth and morality, both the two and three-dimensional perspectives of impression formation are broadly similar to the earlier mentioned character assessments discussed by Aristotle in *Rhetoric*, where it is suggested that people are assessed in terms of whether (or not) they are wise, virtuous and good-willed.

Wojciszke and colleagues (e.g., Wojciszke 1994; Wojciszke, Bazinska, & Jaworski 1998; Wojciszke, 2005) and Fiske and colleagues (e.g., Fiske, Cuddy, & Glick, 2007) do not distinguish between warmth and morality. For these thinkers, the two components are contained within the same dimension. Hence these are two-dimensional stereotype content theories, comprising morality and competence (e.g., Wojciszke, Bazinska, & Jaworski 1998), and warmth and competence (e.g., Fiske, Cuddy, & Glick, 2007). Leach, Ellemers and Barreto (2007) have criticised this perspective for conflating morality with other constructs, such as warmth. They view warmth and morality as two distinct components – they believed “immoral competence is dangerous, and immoral sociability is disingenuous” (p.236). Accordingly they advocate a three-dimensional model of stereotype content, comprising of: competence, morality and sociability. Leach et al. empirically demonstrated three distinct dimensions that were comprised of unique traits. Furthermore, research has indicated that moral character is more important than warmth in impression formation (e.g., Brambilla, Rusconi, Sacchi, & Cherubini, 2011; Goodwin, Piazza, & Rozin, 2014).

4.4. Trust in risk communication. Trust has been applied aplenty in the field of environmental and technological risk management. Research has shown that trust in

institutions is closely related to the perception and acceptability of various risks (e.g., Kasperson, Golding and Tuler, 1992; Poortinga & Pidgeon, 2003; Slovic, 1993).

4.4.1 Cause or consequence. Despite the research consensus that the concepts of trust and risk are related, the direction of this relationship appears somewhat disputed. Mayer, Davis and Schoorman (1995) state, “It is unclear whether risk is an antecedent to trust, is trust, or is an outcome of trust” (p.711). Such confusion can hinder research when making claims about its antecedents and its consequences (Metlay, 1999, p.2).

Some theorists argue the need for trust only occurs in a risk situation (e.g., Deutsch, 1958; Giffin, 1967; Schlenker, Helm, & Tedeschi, 1973; Johnson-George & Swap, 1982). For instance, the acceptability of a risk is the determinant of trust. Eiser, Miles and Frewer (2002) term this the *associationist model of trust*. Conversely, some researchers argue that people only engage in risky situations if trust has already been established (e.g., Kasperson, Golding, & Tuler, 1992; Poortinga & Pidgeon, 2003). For instance, trust is a prerequisite of perceptions of risk; trust towards risk management institutions determines the level of perceived risk. Eiser, Miles and Frewer (2002) term this the *causal model of trust*.

Poortinga and Pidgeon (2005) investigated whether trust is the cause (causal chain account) or the consequence (associationist view) in the context of the acceptability of five risk communications issues (climate change, mobile phones, radioactive waste, GM food, genetic testing). Their results were more supportive of the associationist rather than causal model of trust.

4.4.2 Communicator characteristics and risk communication. As with early and broader research of trust and communication, judgements made in the context of risk communication and risk management were based upon trait dimensions of the

communicator as viewed by the recipient. For example, Pijawka and Mushkatel (1991/1992) found a strong negative relationship between perceptions of political trust and nuclear waste repository risk perceptions.

In risk situations, as in other communication exchanges, judgements are often based upon perceptions of communicator competence and honesty. With the communication of chemical hazard risks, for example, Jungermann, Pfister and Fischer (1996) found that trust in information sources was based upon honesty and competence. Peters, Covello and McCallum (1997) also explored public opinion towards hazardous chemical risks and showed that perceptions of trust and credibility as derived from three things: perceptions of expertise; perceptions of openness and honesty; and perceptions of concern and caring.

Poortinga and Pidgeon (2003) propose two dimensions of trust towards government policies in different risk contexts (such as climate change, mobile phones, radioactive waste, GM food, genetic testing). They firstly propose a *general trust* dimension, which encapsulates a range of trust-relevant traits, such as competence, fairness, care, openness. The second dimension they propose is *trust as a scepticism* component, which reflects a sceptical view of government policies.

4.5 Summary of trust. Despite some debate surrounding the precursory nature of trust and risk, the intertwined relationship of trust and risk is widely supported. The concepts around 'trust' have presented subtle differences of terminology and meaning. Trust has been said to have a composite of traits such as credibility, trustworthiness, morality, warmth, competence, honesty, reliability, benevolence, and integrity. Distinctions between components are important to make clear because without doing so the differences between trust and similar constructs (such as expertise) are blurred. Early research has often viewed credibility, trust and expertise

as intertwined. With some conceptualisations of trust involving competence, more recently these constructs have been studied as separate theoretical concepts – particularly competence as distinct from warmth/ morality. As such, trust is clearly an important component of communication, particularly in communications of risk and uncertainty.

Renn and Levine (1991) provide a useful definition of trust used in risk research, where information is viewed as “true and reliable and that the communicator demonstrates competence and honesty”. This is in line with previous research, where trust is a composite of traits (such as competent, reliable, fair, benevolence, integrity). An appropriate framework of trust in this present research thesis therefore views competence and morality as component parts of trust.

The next section will introduce two significant theories of communication in social psychology, and then I will move on to discuss the influence of source factors upon the audience in communication.

5. Social psychological perspectives of communication

Communication in social psychology is studied to explain how people receive and process messages. Communication as a process has been typically examined in the context of attitude change through persuasion. The processing of persuasive messages is seen to occur via one of two pathways.

5.1 Dual process models of information processing. Two prominent examples of this are the Heuristic-Systematic Model (Chaiken, 1980) and the Elaboration Likelihood Model (Petty & Cacioppo, 1986). These two models are very similar in essence. For instance, the Heuristic-Systematic Model (HSM) of information processing proposes that individuals process messages in one of two ways:

heuristically or systematically (Chaiken, 1980). The Elaboration Likelihood Model (ELM), similarly proposed a distinction between a peripheral route and a central route to persuasion (Petty & Cacioppo, 1986).

According to both of these theories, the first path to information processing is said to occur when the individual has little or no motivation to engage with the information being communicated. Under these conditions, the person is not influenced by the message content but rather the non-content cues outside of the message. In such situations, information is processed *heuristically* (Chaiken, 1980) or with *low elaboration* (Petty & Cacioppo, 1986) and is called the *heuristic processing* in the HSM (Chaiken, 1980) and the *peripheral route* in the ELM (Petty & Cacioppo, 1986). As such, the context rather than the informational content is what shapes message processing when motivation and/ or ability to engage in communication are low. Such contextual features can include the perception of expertise (Chaiken, 1980) or source attractiveness, likability and credibility (Petty & Cacioppo, 1986).

The second pathway to information processing is said to occur when an individual is motivated in a topic, for instance when it is a topic of high personal relevance. Under these conditions, the person deliberates carefully over the informational content and evaluates arguments contained within the message. In these situations, information is processed *systematically* (Chaiken, 1980) or with *high elaboration* according to the HSM (Petty & Cacioppo, 1986); and via the central route according to the ELM (Petty & Cacioppo, 1986).

According to both the HSM and ELM mental shortcuts (i.e., ‘rules of thumb’) are used to assist in making (speedy) judgements of events (e.g., Kahneman & Tversky, 1979; Chaiken, 1980). Such shortcuts are called heuristics, and these can include the stylistic features of the message peripheral to its content, such as speed of

presentation, use of imagery, length of message. Heuristic can also represent features of the message source and, as already mentioned, these can include source likeability, attractiveness, and credibility. As noted earlier in this chapter, a source perceived as credible can influence the persuasiveness of messages (Hovland, Janis, & Kelley, 1953).

Perceived personal relevance of information influences how people engage with and evaluate the message and/ or messenger (Chaiken, 1980; Petty & Cacioppo, 1986). For example, Petty, Cacioppo and Goldman (1981) showed that when people were being informed about something of high personal relevance, they were more influenced by the quality of the message content (strong versus weak arguments) compared to when informed about something of low personal relevance. In situations of low personal relevance, attitudes were influenced by the expertise of the source.

5.2 Summary. Relating these ideas and findings to the context of climate change communication, most people do not see this issue as one of direct personal relevance (e.g., Spence, Poortinga, & Pidgeon, 2012; Weber, 2010). Due to this, climate change communication is likely to be processed peripherally or heuristically (rather than centrally or systematically) by all but the most concerned members of the public. In addition to low personal relevance, climate change messages are typically complex and accompanied by a high degree of uncertainty. The combination of message complexity and high uncertainty is likely to undermine individual motivations to attend closely to the content of climate change messages. Therefore it would seem especially useful to consider in more depth the peripheral features of climate change messages that might enable communicators to be influential, even in situations of high uncertainty and reduced audience motivation. In the following

section, I reconsider how source factors and perceptions of these might work to facilitate or undermine communication, particularly in the face of uncertainty.

6. Communication and influence

Having earlier introduced the concept of trust and its associated components and how judgements of trustworthiness are inferred and when such judgements are likely to be relied upon, I will now discuss what effects these may have in terms of the communication and its influence.

6.1 Heuristics and influence. Early research. In earlier literature on persuasion, perceptions of the source of information were shown to guide audience responsiveness. For example, audiences who perceived the source as likeable are more likely to be persuaded by the message conveyed (e.g., Hovland, Janis, & Kelley, 1953; Chaiken, 1980; Petty & Cacioppo, 1986). Perceived expertise can also influence communication (Wilson & Scherell, 1993), and people are generally more persuaded by experts than non-experts (Kelman & Hovland, 1953). Source credibility plays a particularly influential role in attitude change when messages are ambiguous (Chaiken & Maheswaran, 1994). Here, Chaiken and Maheswaran (1994) manipulated source credibility by varying the source of product information, either a credible consumer magazine specialising in scientific testing or an information pamphlet prepared by a staff member of a discount retail store.

Other research has shown that though sources that were high in credibility were more persuasive, this effect was only temporary. Over time there is delayed impact of the low credibility source on attitude change, known as the ‘sleeper effect’ (Hovland, Lumsdaine, & Sheffield, 1949).

6.2 *Person perception and influence.* Later theorists have suggested the importance of stereotypical content judgements is that these provide cues to the individual about whom to *approach* and whom to *avoid* (e.g., Higgins, 1997; Oosterhof & Todorov, 2008). Therefore, the identification of potential threats is crucial in the information-gathering process (Wojciszke, Bazinska, & Jaworski, 1998). As such, social judgements assist in making (quick) inferences about whether a person will harm (someone to avoid) or help (someone to approach).

In the context of evaluating political candidates, early research has indicated that competence-related qualities are what people look for in a leader (Kinder, 1986; Markus, 1982). Conversely, however, it is suggested that this approach-avoid outcome is the reason perceptions of morality (rather than competence) are the central dimension when evaluating whether to (not) engage with others (Abele & Wojciszke, 2007; Leach, Ellemers, & Barreto, 2007). In other words the relational dimensions of stereotypes—that is, warmth and morality—are primary when people make decisions about whether and how to interact with a given target (e.g., Fiske, Cuddy & Glick, 2007). In particular, people are inclined to look for signals of morality when forming impressions of others (Brambilla, Rusconi, Sacchi, & Cherubini, 2011).

The reliance on stereotypic judgments may be especially pronounced when the motivation to engage in effortful message-based processing is low – as is likely the case with climate messages. Moreover, in the context of science communication the assumed level of competence of sources may be generally high, and therefore other traits (such as morality) may become more important as guides to engagement with those sources.

Similar findings were evidenced in recent research examining influence of perceived of trustworthiness in the context of electoral outcomes and candidate

support of political leaders. Chen, Jing and Lee (2014) ran a series of studies where participants evaluated the personality traits of political candidates based on inferences from their faces. They found that perceptions of trustworthiness increased the chances of winning actual elections, but only for those who were judged as competent.

6.3 Morality and uncertainty. In addition to guiding how people orient towards others, it is reasonable to take this further and consider whether perceptions of morality might have a particular role to play in situations of uncertainty. For instance, signals of relational features of morality convey feelings of security that is a means of coping with uncertainty (e.g., Dirks & Ferrin, 2001; Sorrentino, Holmes, Hanna, & Sharp, 1995).

van Prooijen and Jostmann (2013) experimentally examined the impact of perceived morality of authorities on conspiracy beliefs when in conditions of uncertainty. In two studies uncertainty was made salient subjectively (participants were asked to think about a time when they felt uncertain versus neutral, e.g., watching TV); and the perceived morality of authorities was manipulated (i.e., fake reports presenting an institution as moral or immoral). Their results showed that uncertainty salience shapes the effect of the perceived morality of institutions on belief in conspiracy theories, and they concluded that “uncertainty leads people to make inferences about the plausibility or implausibility of conspiracy theories by attending to morality information”, (p.109). They suggest that people perceive situations of uncertainty as threatening and therefore look for signals of morality to help or harm them (Van den Bos & Lind, 2002; van Prooijen & Jostmann, 2013). The process of looking for indicators of harm or help from others, and the role of morality in signalling that, reflects similar reasoning to that proposed by self-regulatory theory (Higgins, 1997; Oosterhof & Todorov, 2008).

6.4 Source influence in climate change. Within science communications, particularly controversial science issues, perceptions of source trustworthiness are considered to be as important as the informational content of any message they convey (Owens, 2000; Wynne, 1996; Sharples, 2010).

In a review of attitudes towards climate change and travel behaviour, Anable, Lane and Kelay (2006) considered how the public trust information sources of climate change. With respect to official institutions, they found that perceptions of trustworthiness differed according to the source of information: National governments, the EU and businesses were perceived as less trustworthy than non-governmental organisations or (government and industry independent) scientists. Research has indicated a relationship between perceptions of source trust and public support for climate change mitigation policies. For instance, increased policy support was associated with greater trust in environmental scientists and groups compared to government and industry (Dietz, Dan, & Shwom, 2007).

Research has shown that judgements of source credibility are made more difficult when experts disagree, potentially adding to the perceived uncertainty of the situation (e.g., Einhorn & Hogath, 1985). This is something often seen in courtrooms where expert testimony or competing lawyers are arguing contrasting interpretations, and jurors then need to weigh up the competing expert positions (Crammer & Webb, 1992; Cooper, Bennett, & Sukel, 1996).

Similar source credibility dynamics are played out with competing scientific positions of climate change (Callaghan & Augoustinos, 2013; Boykoff & Boykoff, 2004). Such conflicts among scientists played out in the public domain has contributed to the controversy over the existence, causes and impacts of climate change (Fischhoff, 1995). Consequences of expert disagreement are increased

scepticism (Patt, 2007) and reduced action (O'Neill & Boykoff, 2010).

Related to this, equal, rather than representative, coverage in the media of the scientific positions of climate change, gives the impression of a balance of expert opinion despite the imbalance of the amount of supporting evidence (Boykoff and Boykoff, 2004; Dunwoody 1999; Sharples, 2010). Such falsely balanced competing claims have been termed a 'conflict frame' (Boykoff and Boykoff, 2004).

Opinionated minorities often play on and amplify the scientific uncertainties to maintain the status quo and to justify inaction (Dunlap & McCright, 2010; Oreskes & Conway, 2010).

Such contrasting positions and the amplification of scientific uncertainty have the potential to fuel scepticism among the public. Research has indicated that higher levels of scepticism are associated with reduced inclination to take action to mitigate climate change (Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011). While uncertainty around climate change can lead to scepticism (Patt, 2007), uncertainty and scepticism are different constructs. While uncertainty is concerned around the science of climate change, scepticism is more the denial of anthropogenic climate change (Whitmarsh, 2011). Sources of scepticism and uncertainty include unreliable evidence, untrustworthy information sources (Whitmarsh, 2005).

Research has also shown that scepticism is shaped by worldviews individuals hold, such as environmental values and political preferences (Whitmarsh, 2011). Such worldviews can influence how people interpret climate change information or associate it with weather events for example, extreme cold weather (Capstick & Pidgeon, 2013). Corner, Whitmarsh and Xenias (2012) conducted experimental work to test the effects of 'biased assimilation' (Lord & Taylor 2009; Lord, Ross, & Lepper, 1979). Using conflicting arguments contained in mocked-up media articles,

the researchers demonstrated that prior differences in environmental attitudes lead respondents to process the same (ambiguous) information differently.

6. Summary

Climate change is an issue of great concern and with the capacity to affect vast numbers of individuals all over the world. As such, effective communication is needed to engage the public with this topic: clear and effective communication should increase public belief in the phenomenon of climate change and should encourage individuals to support pro-environmental policies and behaviours. However, a number of features central to the topic of climate change make its communication a challenge. Key among these barriers is the issue of uncertainty. Climate change is itself an uncertain phenomenon: it is happening, but cannot be seen; and will affect people mostly in distant times and places. Climate science is also uncertain – while scientists generally agree about the reality of the phenomenon, there is uncertainty in the predictions of its extent and likely impact. Because uncertainty is inherent to climate change and the science behind it, it cannot simply be ignored. Therefore, finding ways to effectively manage uncertainty is a key issue for the communicators of climate change.

Social psychology research has shown that perceptions of credibility are important for communication and persuasion (e.g., Hovland, Janis, & Kelley, 1953; Chaiken, 1980; Petty & Cacioppo, 1986) – particularly under situations of ambiguity (Chaiken & Maheswaran, 1994). Moreover, such qualities have been argued to be especially important with respect to understanding public responses to climate change (e.g., Pidgeon & Fischhoff, 2011; Whitmarsh, 2005; Poortinga & Pidgeon, 2003; Anable, Lane, & Kelay, 2006).

Research guided by modern theories of content characteristics moves beyond the one-dimensional composite of credibility made up expertise and trustworthiness. The untangling of expertise and trustworthiness from ‘credibility’ leads towards content models of person perception that term these as competence and morality (and/or warmth, depending on theoretical perspective) (e.g., Fiske, Cuddy & Glick, 2007; Brambilla, Rusconi, Sacchi, & Cherubini, 2011). The separate constructs of morality and competence have been found to have different effects on audience responses depending on situations (e.g., Chen, Jing & Lee, 2014; Leach, Ellemers, & Barreto, 2007; Abele & Wojciszke, 2007). Trust has also been shown to be important in situations of risk (e.g., Deutsch, 1958; Mayer, Davis, & Schoorman, 1995; Giffin, 1967) and risk communication (e.g., Kramer, 1999; Poortinga & Pidgeon, 2003). Finally, models of decision-making argue that when uncertainty is high, people will seek signals of source morality in order to make effective decisions (Van den Bos & Lind, 2002; van Prooijen & Jostmann, 2013). Given such findings, it is reasonable to expect that perceptions of source morality and competence serve as an important basis in the evaluation of communicators of climate change and the information contained within, and that the importance of morality might be amplified under conditions of uncertainty. The connections between these concepts – communication, uncertainty, and trust – are the focus of the research contained in this thesis.

7. Thesis aims

The broad aims of this PhD research were to investigate how source factors, message contents and audience perceptions interact to produce joint effects on message understanding, trust, and resulting attitude and behaviour change. As is cited in the social psychology literature, communication does not solely reside in the

informational content of the message. Communication is also shaped by how the source of a message is perceived by their audience. As such, communication is a dynamic *process*. Because of this, it is limiting to study each step of the communication chain (source, message, receiver) in isolation only. Thus, in the present research I aimed to explore the total communication sequence, including consideration of the interplay among the source, the informational content, and the recipient in the communications process.

I achieved this by (1) interviewing sources and communicators of climate science information to better understand their perspective; (2) exploring experimentally how the content of climate change messages, and the style within which these are delivered, affected audiences' responses, and; (3) exploring how potential audiences perceive scientific organisations, and the basis on which their judgements are formed. By triangulating the research to explore questions from different sides of the communication process I hoped to provide a more complete understanding that connects to the specific concerns of the actors involved in the challenging task of effectively communicating the science of climate change.

8. Epistemology and methodology

Before presenting the research that addressed the above aims, it is worth devoting some space to discuss the epistemological underpinnings and methods adopted in this research. Indeed, a researcher should be aware of their research positionality because this can influence the knowledge created through chosen methodology (Rose, 1997). Despite this, however, the training of psychology students has been criticised for tending to focus on the methods of research while neglecting the epistemologies and philosophical framework behind the choice of methods

(Darlaston-Jones, 2007). I will now discuss the epistemology and methodological approaches adopted in this programme of research.

8.1 Epistemology. In short, epistemology is the study of knowledge, the nature of this knowledge and how we know things to be true. The study of such is guided by knowledge paradigms. A *paradigm* is regarded to be an “accepted model or pattern” (Kuhn, 1970, p.23). There has often been a distinction in the nature and underlying assumptions between positivist and constructionist paradigms (Blaikie 1991; Flick 1992; Creswell & Plano Clark, 2007).

A *positivist (or postpositivist) paradigm* treats reality as tangible where objective facts are based on empirical observations (McEvoy & Richards, 2006; Ackroyd, 2004). Positivists aim to identify general laws that are based on empirical research. In contrast, a *constructivist (or interpretative) paradigm* postulates that reality is intangible and knowledge is constructed through social interactions (Gergen, 1999; McEvoy & Richards, 2006; Bryman, 2004). Traditionally these two positions have been viewed in opposition stemming from fundamentally conflicting foundations (e.g., Johnson & Onwuegbuzie, 2004; Burrell and Morgan, 1979; Creswell & Plano Clark, 2007; Thurmond, 2001; Creswell, 2009).

Some theorists, however, argue for a continuum of perspectives. For these thinkers it is not a dichotomy of assumptions, but more a spectrum of the perspectives that characterise positivist and constructivist approaches to social science (e.g., Morgan & Smircich, 1980; Johnson & Onwuegbuzie, 2004; Maxcy, 2003; Guba & Lincoln, 2005; Creswell, 2003). The *pragmatic paradigm* is an alternative framework that allows researchers to move beyond the constraints of a “forced choice dichotomy between postpositivism and constructivism” (Creswell & Plano Clark, 2007, p.27).

Pragmatism is concerned with producing socially useful knowledge, focussing “solving practical problems in the “real world”” (Feilzer, 2010, p.8). Here the research problem is paramount and applies all study approaches to understanding that problem (Creswell, 2003). Within the pragmatist paradigm different kinds of knowledge are valid and can co-exist. There can be both factual global objective knowledge and also localised subjective knowledge: and both are needed to understand or solve practical problems.

When considering features around the topic of climate change, arguably it is shrouded in similar positivist-constructivist paradigm tensions. In one sense climate change, particularly the science behind it, can be viewed as following a positivist paradigm: seeking to establish objective laws, driven by empirical evidence. In contrast, it has been argued that social, political and cultural contexts define the status of climate change knowledge (Irwin & Wynne, 1996), thus shaping knowledge within a constructivist framework.

Consider, for example, the issue of uncertainty. As discussed earlier in this chapter (*Section 3.4*), uncertainty is viewed in one sense as a quantifiable and logical construct used in science to express the likelihood of certain events (i.e., a positivist tradition). However, at the same time, uncertainty can hold different meanings to different groups, thus being a psychological and social construct (i.e., an interpretative tradition). Thus, with these two contrasting positions, the concept of uncertainty itself shifts from being a positivist construct in one social world (i.e., amongst scientists) to an interpretative concept in another (i.e., amongst non-science audiences). Thus, approaching the research from a pragmatist position is valuable in providing the flexibility of perceived realities as well as offering a diverse toolkit to explore these (contrasting) realities.

Similarly, the broader disciplines that make up ‘science communication’ – namely ‘science’ and ‘communication’ – can also be viewed as contrasting worlds. Science, as a discipline, is traditionally positivist, in that valid (scientific) knowledge is achieved through empirical data and scientific methods. This perspective can be contrasted with communication, which can be viewed as a construction of ‘reality’ through language.

Thus it seems reasonable, perhaps even necessary, to approach a topic that is arguably located in the context of a number of pragmatic issues by employing a research method that accepts and utilises mixed perspectives i.e., a pragmatist paradigm. The epistemological framework in which this thesis is situated is therefore best described as pragmatism. This is a thesis trying to seek how messages of science and scientists (with their (post) positivist traditions) reach the public (with a need to respect diversity and subjectivity, where a more interpretivist account is needed).

8.2 Mixed methods. In order to collect both relatively factual and tacit knowledge, encompassing both traditionally positivist and constructivist questions of research, this thesis has employed a mixed methodology. Some researchers view the mixing of qualitative and quantitative methodological approaches as incompatible because they perceive this to violate the contrasting epistemological assumptions. As discussed in the earlier (*Section 8.1*), the epistemological underpinnings of positivist (often used within quantitative research methods) and constructivist (often used within qualitative research methods) approaches are often viewed as so incompatible that to use these together is perceived as fundamentally incorrect (Thurmond, 2001; Creswell, 2009).

Often research studies that adopt a mixed methodology are underpinned by the pragmatist epistemology (Tashakkori & Teddlie, 2003; Feilzer 2010; Johnson &

Onwuegbuzie 2004). While some argue that the blending of epistemological paradigms and methodological methods are unfeasible, Creswell (2007) praises mixed methods for encouraging the researcher to draw upon multiple worldviews (i.e., a pragmatist paradigm).

Indeed, being aware of the differences between methodological approaches can be an advantage (Thurmond, 2001). Approaching the object of research through different methodological lenses enables the social scientist to gain a broader and deeper understanding, as well as a clearer picture of the issues of study. Arguably, a mixed-methods approach is one that avoids the constraints and weaknesses that often occur when attaching oneself to one particular method. In comparison, the use of multiple research strategies enhances construct validity, by

increasing confidence in research data, creating innovative ways of understanding a phenomenon, revealing unique findings, challenging or integrating theories, and providing a clearer understanding of the problem.

Thurmond (2001, p.254)

A mixed design approach can sometimes be more beneficial than a single approach design (Onwuegbuzie & Leech, 2005; Tashakkori & Teddlie, 2003). Indeed, attempts have been made to reconcile different methodological approaches, and to find ways that effectively blend qualitative and quantitative research. For example, Lee (1991) proposed an integrative framework of research, whereby both interpretative and positivist methods are seen as legitimate and can be used in collaborative ways to advance research inquiry. Snape and Spence (2003) concur, viewing methods as a research toolkit that consists of qualitative and quantitative

techniques, and each tool can be used as appropriate in different research contexts and to address different research questions.

Another strength of applying a mixed research design over a mono-method design is that the findings from one method can help develop or inform the other method(s) that may follow (Greene, Caracelli, & Graham, 1989; Yardley & Bishop, 2008). The research undertaken as part of this thesis adopted such an iterative approach, where one stage informed the next. As such, having the flexibility and diversity of mixed research methods, the foci of research evolved organically so when issues emerged as interesting and important, they were later explored by whatever means suited their further inquiry.

While a number of advantages come with applying a mixed method research design, Creswell (2003) cautions researchers to be clear on why quantitative and qualitative data need to be mixed before commencing the research.

It was important to present the research from a multi-stakeholder perspective including the views of the communicator, the message itself and the audiences, so it would have been potentially limiting to be constrained by a single methodology. Given the cross-disciplinary spread of the research within this thesis, and the dual theoretical and practical aims, a mixture of methodological approaches was deemed most suitable. The mixed methods design in this thesis thus allowed me to approach the communication of climate change information in different yet complementary ways. Climate scientist and communicator perspectives were achieved through semi-structured interviews: this gained depth and intricacies into the process of communicating climate change science through the articulation of the key actors directly. This was contrasted by the experimental methodology that allowed the examination of the cause and effects relationship. This was contrasted again with a

survey methodology, which provides greater ecological validity than an experimental method.

9. Thesis structure and chapter outlines

The thesis presents an iterative triangulation of research methods and perspectives on the dynamics of communicating climate change information. The starting point of this investigation was to speak with those who create and communicate climate science – that is, the scientists and professional science communicators. The aim of this first phase of the work was to get a better understanding of how these central actors in the communication chains understand the communicative activity they are engaged in. Chapter 2 reports the findings from a series of interviews with climate change scientists and professional communicators in which they discussed the challenges and opportunities of climate change communication and their own understandings of the process of communication. The key insight from these interviews was that scientists and communicators employed two different communication styles when engaging with publics. These are akin to the previously described informational deficit and interactive models of communications – something I refer to as informational versus relational communication styles respectively. Scientists also expressed some reservations about their role in the communication process – specifically the degree to which the provision of advice was appropriate and how this might affect audience perceptions of their credibility – and both scientists and communicators talked about the issue of uncertainty as it relates to science and communication.

Each of the themes identified in the qualitative work – communication styles, uncertainty, and advice provision – were picked up and developed in the following

quantitative work on audience responses. Specifically, Chapter 3 presents a series of experimental studies in which I explored how different communication styles such as variations in language (Pilot study), informational content such as uncertainty (Experiments 1 and 2) and advice provision (Experiment 3) in combination affected audience engagement with the message, belief in climate change, and willingness to act in pro-environmental ways. These studies collectively revealed how information and relational processes converge and shape responses to uncertainty.

The final piece of empirical work, contained in Chapter 4, used a survey to explore in more detail public perceptions of a real (rather than fictitious) scientific organisation to further unpick the origins and consequences of these perceptions. Specifically, the quantitative data generated by this survey allowed me to again test how organisational perceptions (e.g., of morality and competence) interacted with uncertainty to predict climate change responses. The qualitative data obtained in this survey provided some deeper insights into the origins of organisational perceptions beyond variations in communication style that was the focus of the prior experimental work. These data suggested that while perceptions of morality and competence are often inferred on the basis of similar criteria, the manner in which they are inferred might be different. Specifically, while competence is a concrete property inferred from specific measurable criteria, morality seems more diffuse and implicit, though no less important on the basis of the quantitative data.

In the final chapter, the findings of the empirical work are brought together and summarised. I present key conclusions around the dynamics of communication processes in shaping responses to uncertainty in climate change communication. The research strengths and limitations are identified and the theoretical and practical implications of the research findings are discussed (Chapter 5).

Chapter 2

How to communicate climate change information:

A qualitative investigation of the perceptions of climate scientists and professional communicators

The time to act is upon us. But all too often the issues surrounding climate change are shrouded in uncertainty and poor understanding. To a large extent, the challenge it's presented us with has been complicated by the language used to describe it

Climate Science and Weather Organisation, Chief Executive, Public Speech, 2009

Introduction

The above text is an extract from a public talk (Six Degrees — Our Future in a Warmer World, 2009) by the then Chief Executive of a climate science and weather organisation based in the UK. The speech starts by establishing the reality of climate change, describing it as a “geophysical phenomenon that has been meticulously observed and scientifically quantified for many years”. The speaker then goes on to talk of the urgency of responding to the changing climate. In this particular extract, the speaker proposes that a major challenge around the communication of climate change is complicated by the language used – particularly the uncertainties around climate change.

In the second chapter of this thesis, I will explore some of the key issues that were raised in this speech, particularly that touched upon in the quoted text – uncertainty, language, and communication. Accordingly, I wanted to better understand the process of climate change communications from the perspective of

those who communicated on this topic. And what challenges are perceived in particular, and how such challenges may be managed.

Aims

A modified grounded theory framework was employed as suitable in this situation. Such a framework is deemed appropriate when a researcher wishes to generate and develop knowledge and meaning from data that contain a wide variety of opinions and attitudes, without doing an injustice to their diversity and depth. Strauss and Corbin (1998) describe grounded theory as a theory “derived from the data, systematically gathered and analysed through the research process [where] method, data collection, analysis, and eventual theory stand in close relationship to one another” (p.12). Therefore in this situation, a literature review is not needed until after data collection.

A researcher therefore does not begin with a preconceived theory in mind, but rather s/he construct theory from the rich collection of knowledge, the aim of which is to explain the knowledge conceptually and contextually (Glaser, 2001). It is not a research method *per se*, but rather a framework within the larger family of qualitative methods. The intention when applying this approach is to establish hypotheses after knowledge gathering and analysis, not before data gathering and analysis. In approaching the research programme open to using mixed-methods, and in the absence of a pre-data collection literature review, grounded theory seemed appropriate in this instance. Furthermore, I would suggest this approach also brings benefits when initially addressing a project such as this about perceptions and experiences, since a positivist approach would focus on a small area of data, rather than creating a large knowledge base. The broad aim of starting with interviews was to get a better understanding of what communicators of climate science do and how

they see their role in the communication of climate change. In particular the aim was to conduct a series of face-to-face interviews with climate scientists and climate science communicators.

Procedure

Agreement with a major meteorological organisation based in the UK was secured. This facilitated access to potential participants from across its workforce and thus across a range of different job types and levels. It must be acknowledged that the focus on a single employer in a specific geographic location has a likelihood of rendering the findings somewhat context specific. Nevertheless, the aim of the research was to deepen understanding of communication practices. There were of course logistical advantages in conducting the research because of the specific context. It could also be argued that with research focused towards a common employer it was easier to gather, synthesise and interpret the qualitative data across the interviews.

Two approaches were used in recruiting participants for this piece of research. Firstly, because I initially wanted to ensure specific types of workers, ranging in age and seniority within the organisation, as well as a gender balance, I developed a screening questionnaire. I utilised a list of the contact details of 194 climate scientists within the organisation – 141 (73%) of these were male, 53 (27%) were female. Using this list I sent out an internal email containing an invitation letter (see Appendix 2.1) inviting people to take part in the interviews. The email was accompanied with an information sheet about the research and a short screening questionnaire that was used to ensure that participants varied in terms of their seniority, age, gender, and topic of work (Appendix 2.2). Only eight responses indicating willingness to participate were received via this method. The second approach consisted of word-of-mouth

recruitment within the same scientific organisation. Due to the communications team being much smaller ($n =$ approximately 20), the word-of-mouth approach was used from the outset. Within this department the gender balance leans more towards females, but I tried to get an equal male-female balance for the interviews.

In total, qualitative interviews were carried out with fourteen participants (7 were male and 7 female). Of the fourteen interviewees, nine were climate scientists (5 males, 4 females); and five were communicators (2 males, 3 females). The participants were of varying levels of seniority (including non-management and management levels) within their specialist area (either climate science or communications). The interviews were carried out at a mutually convenient time and location in Exeter, UK, and lasted between 35 minutes to 90 minutes.

Informed consent was obtained at the start of all interviews (Appendix 2.3) and each interviewee was provided with an information sheet about the research project at the end (Appendix 2.4). With the participants' consent, interviews were digitally recorded and subsequently transcribed to aid analysis.

A semi-structured interview schedule was prepared to assist myself when interviewing participants (Appendix 2.5). Interviews started with participants freely talking about their job, and what their role consisted of. Discussion then explored people's perceptions of audiences, and how they perceived to be seen by audiences. Discussion topics evolved to cover concepts such as, process of communications and what challenges/ barriers occur during such processes, uncertainty, trust, forms of communication, effective communication, and message understanding. Questions were developed based on the research project aims and interview objectives (these are summarised in the information sheet provided to interviewees, Appendix 2.4). Questions were asked in a broad manner, commensurate with a grounded theory and

the semi-structured approach to allow the participants to describe the characteristics and perceptions from their own viewpoints.

Analytic strategy and process

Data analysis ran alongside data collection to aid the iterative process of this research. Notes made during the interviews were combined with audio and transcriptions of the interviews. My analytic approach for the interview data was framed by three broad stages.

- a) Descriptive: The first stage of analysis was descriptive in its nature. Though this may seem basic, it is an essential starting point with any data analysis.
- b) Thematic: The second step of my analysis involved drawing out and clustering themes, interlinking these groups thematically.
- c) Interpretative: Finally, I scrutinised the data again, and interpreted themes to get meaning. Here, I move beyond descriptions by scientists and communicators, and aimed for a more in-depth perspective on the communication processes and how scientists and communicators construct their experiences.

Earlier in this chapter, I discussed how an inductive method of data collection and analysis was used, whereby the prominent themes come from the data itself, rather than imposing or searching for pre-defined themes. As advocated within grounded theory the process of such is “the generation of emergent conceptualised integrated patterns, which are denoted by categories and their properties” (Glaser 2001, p.9). This technique is similar to *thematic analysis* that, broadly speaking, involves identifying, analysing and reporting patterns in the data (Braun & Clarke, 2006). One benefit of following a thematic analysis framework is the flexibility this gives the analysis, due to its detachment from one of the two dominant

epistemological frameworks (i.e., positivism and constructivism) - this allows for pragmatist ideas to be applied to the data and interpretation. Braun and Clarke (2006) term this *thematic discourse analysis*. Despite this approach, I acknowledge that in the drafting of an interview topic guide may, at some level, influence the existence and prominence of themes.

Analysis involved reading and re-reading of the interview transcripts, becoming familiar with the verbatim statements and the context in which these sat. Re-readings were again carried out with line numbers and further annotation coding items in the text with line-by-line (Willig, 2008). I labelled these individual items, this process later allowing for patterns of themes to be sought. I then got to a point where new readings of the verbatim would fit determined concepts without creating new (sub)themes. Topics that emerged from the data were grouped together – providing the overarching broad themes. Subthemes, which made up the broader themes, were created bringing together strands of ideas and/ or experiences. Such components can be meaningless when viewed alone, but qualitative analysis, in essence, is the evaluation of how the ideas fit together in a meaningful way (Glaser 2001; Leininger, 1985). For each interview, a thematic map (using pen and paper) was devised showing the themes and subthemes, and their inter-linkages (Braun & Clarke, 2006). To assist further with analysis, the (sub)themes and key points were entered into an Excel spread-sheet with individual interviewees on the vertical; this *matrix mapping approach* assisted in assessing commonalities and differences between interviewees among the sample. The matrix mapping approach has previously been adopted in order to aid category sorting (e.g., Musselwhite, Avineri, & Susilo, 2014; Lyons & Haddad, 2009).

Analysis and discussion

Themes and subthemes were chosen on the basis of addressing the broad aim of the interviews: better understanding the roles and processes involved in communications. In line with matrix mapping, topics that did not directly align with the overarching aim, yet contributed to it, created sub-themes. Other points of interest that related to the literature but did not contribute to the overall aim were also collected and reported where appropriate.

The analysis that follows presents three general themes identified within the interview data: 1) Communication Process(es); 2) Communication Challenges; and 3) (Conflicting) Roles of Climate Scientists. Each of these themes consisted of a number of subthemes. Conceptually, the three themes evolved from being descriptive to interpretative over the course of the analysis, though they are not fully separate. Instead there is overlap and linkage both within and between the broader themes. In presenting the analysis, I tried to articulate these linkages as clearly as possible, giving examples of actual verbatim transcripts from the interviews; interpreting these and structuring them into some kind of narrative. The recurring themes across participants are presented below in *Table 2.1*.

Table 2.1. Summary of themes and sub-themes identified within interviews

Themes	Sub-themes
<i>One.</i> Communication process(es)	<ul style="list-style-type: none">– Perceived audiences– Message production– Effective communication
<i>Two.</i> Challenges	<ul style="list-style-type: none">– Subject matter (e.g., uncertainty)– People relations
<i>Three.</i> (Conflicting) Roles of climate scientists	<ul style="list-style-type: none">– To provide objective information– Professional roles vs. personal goals

To assure organisation anonymity, the organisation name has been excluded and replaced with *ORGANISATION*. “Comms” or “comms team” is a term commonly referred to within the organisation to mean *communications team*, and is often used within the verbatim extracts.

Some details accompanying transcript extracts within this chapter indicate the following. Italicised *Scientist* or *Communicator* indicates the group the interviewee belongs to; *P* followed by a number is the participant number they have been assigned⁵. Where extracts include exchanges of dialogue, the letter *I* represents *Interviewer*, with *P* representing *Participant*. The numbers in the left-hand margin alongside the verbatim extracts are the specific lines numbers within the interview transcription for that specific interview.

I will now go on and present the three broader themes I identified within this qualitative data, and describe each theme whilst elaborating on the sub-themes that constitute it.

1. Theme One. Communication process(es)

The first theme concerned how the key actors (climate scientists and communicators) engaged in the process of scientific communication. This theme starts fairly descriptive, providing insights of whom interviewees see as their audiences, how they perceive the process of communication and how this is performed in practice and what they see to be effective communication. Within certain subthemes I hope to show how perceptions move beyond the descriptive to a discursive nature of constructing their distinct worlds. For example, with the first

⁵ The participant number does not necessary represent the order the participants were interviewed in.

subtheme of *perceived audiences*, it can be seen how scientists construct and validate their perceptions of the non-science publics with whom they communicate.

1.1 Perceived audiences. This subtheme describes whom scientists and communicators see as the audience(s). This is important as it plays a role in determining how communications are presented and delivered. There was, of course, some individual variation in terms of the specific audiences that were focussed on by interviewees, but overall, a wide range of audiences were identified: policymakers, businesses, other scientists, utility companies, and publics. Broadly speaking, scientists saw publics as secondary to the other audiences with whom they communicate. For communicators, however, the general public was seen to be their primary audience. *Extracts 1* and *2*, below, reveal interviewee perceptions of who is seen as their main audience, and how this differs for communicators and scientists:

Extract 1

35 Oh, there are a whole range of people. So... which is one of the
36 tricky things about it because you've got anywhere from policy
37 makers, who kind of just want one pithy statement; through to
38 local government workers who have got a problem that they've
39 got to make a decision with people in their different sectors,
40 like water, infrastructure, transport. People like that. A lot
41 of these people are government or local government. But also
42 businesses can use it. Private companies can use it and it
43 would also then. The other extreme would be the impact
44 scientists, so the actual people who take climate change
45 information and feed it into their impacts model and also turn
46 the climate change information into something that's relevant
47 to people like crop yield or how much run-off you get, how much
48 river flow you get. Something like that. So it's a whole range
49 of people from academic scientists all the way up to... all the
50 way over. Not up. (laughs) Down to policymakers.

Scientist, P5

Extract 2

215

P3: Main audience. The general public.

Communicator, P3

The perspectives offered in the above extracts were broadly representative of comments given by the interviewees. Scientists tended to see their audience as specialist and narrow, comprising other scientists, governments and industry. Whereas communicators tended to see their audience as broader and more varied than scientists: businesses, government, and other science organisations – though the emphasis was communicating with publics.

I would also note that towards the end of *Extract 1* (49-50), this scientist gives an insight into how they may see their position in relation to one particular portion of their audience. In saying, “Not up [...] down to policymakers” (50) implies that this scientist is situating himself or herself as having higher social or intellectual status than policymakers. Such (perceived) status imbalance perceptions could have negative consequences when communicating to such persons. For example, holding such perceptions of their audience a scientist may inadvertently, through their language and actions, increase social distance between themselves and their audience. This can potentially result in audience disengagement with the speaker. Indeed, Shackley and Wynne (1996) suggest that within scientist-policymaker interactions, scientists use discursive tools (such as scientific uncertainty) as a ‘boundary-ordering device’. With this, the researchers suggest that the purpose of uncertainty (and its construction within particular discourse) is to maintain authority of science and the social order between scientists and policymakers. Specifically, scientists have particular ways to interpret uncertainty, as such policy makers may struggle to interpret uncertainty for themselves; therefore needing to work in collaboration with scientists (Shackley & Wynne, 1996). That said, while I do acknowledge that in some

ways uncertainty enhances scientific authority, it can also act to undermine such authority (Campbell, 1985; Zehr, 1999).

I have just established that scientists and communicators hold a perception of their audiences. The interview data also indicated that scientists also hold a view of how audiences perceive them as individual professionals. Such beliefs of how others may perceive us are known as meta-perceptions (Laing, Phillipson, & Lee, 1966). Given these are group-based judgments the term meta-stereotypes is more appropriate i.e., your own view of how outsiders perceive members of your group (Vorauer, Main, & O'Connell, 1998). *Extract 3*, below, illustrates how this particular scientist perceives their audience to view them as an organisation.

Extract 3

546 There's been quite a lot done on this because obviously
547 there've been a lot of studies that the ORGANISATION has
548 commissioned or been involved with. And it's, we're told, it's
549 [trust] very high and largely because of the science element,
550 because scientists are generally regarded quite highly and I
551 guess that's because they're regarded as knowing a lot of
552 information about that particular area because they've focused
553 on that area and I would guess that's the reason why they're
554 regarded more highly. Or we're [emphasis on word] regarded more
555 highly.

Scientist, P1

Notice when the above scientist was asked to give their opinion on how they thought the public perceived them as scientists and a science organisation, they start by saying “*there's been quite a lot done on this*” (546) and “*we're told*” (548). This implies that initially this person was not articulating their personal opinion but was drawing upon on a formal opinion (e.g., as established by research). This may be because external sources are the main source of this particular information. Looked at

differently this could also suggest that external sources of information carry more weight in terms of validity. This may have indeed been the speaker's personal opinion, but representing the information as externally sourced can give the impression of objective validation and 'fact'.

I would propose that this type of objective articulation is akin to Gilbert and Mulkay's (1984) *empiricist repertoire*. These two sociologists studied formal and informal discourses of their own and colleagues' scientific work among biochemists. Gilbert and Mulkay suggest that scientists employ two contrasting repertoires that are used interchangeably depending on the social function intended. The first and most explicit in science discourse is the *empiricist repertoire*. This discursive style is objective in its nature, signalling intelligence, legitimacy of opinion and status; the gathering and presenting of 'facts' is seen as sufficient in and of itself. In contrast, the *contingent repertoire* is more subjective, using less formal language, often used when things went wrong, and often used when talking about 'other' scientists. Gilbert and Mulkay suggest the use of both repertoires performs a function of defending own actions and beliefs (*empiricist*), while simultaneously discrediting others (*contingent*). Used interchangeably, the purpose of these repertoires, Gilbert and Mulkay suggest, is to maintain the idea and status of science.

In *Extract 3*, the respondent is verbalising in the style of the empiricist repertoire – using a distant grammatical style (such as third person), thus portraying their opinion as empirically based facts. So, in this extract, when asked to give an opinion about their perceptions of how the public views them, even if it is not necessarily the scientific topic of focus, this objectively presented opinion is used, maybe because it is their default style of opinion sharing.

Moreover, the speaker then switches between talking about (their perceptions of) audience perceptions of scientists/the organisation as an outside group, using words such as “*they’re*” (551, 553), “*they’ve*” (553), to then including themselves in the category (by using “*we’re*”). The interviewee was conscious of these inconsistencies to the extent they felt an explicit correction in their own statement at the end of the extract was deserved. One example for this clarification of group identification, the speaker is referring to (i.e., scientists) as being evaluated positively (e.g., “*regarded highly*”). One could speculate here that if the speaker was talking in a way where perceptions of scientists were negative (such as untrustworthy), then the inclusion of oneself in that category of scientist may not have occurred.

The quote (*Extract 3*) also captured the more general meta-stereotype scientists have about their audience. In this instance, the perception is specifically in relation to trust. While this presented trust as emerging from their concrete knowledge/ information, at other times the scientists portrayed trust as emerging from the caveats they placed on their knowledge/ information i.e., scientific uncertainties. Indeed, when the above interviewee continued (*Extract 4*, below), this alternative view of trust as a result of presenting the uncertainties was also evident i.e., trust deriving from the scientific uncertainties, which is actually part of the work of science.

Extract 4

692 I think that’s [including detailed caveats] why scientists are
693 regarded so highly, is the whole... I think people do understand
694 that science is about trying to get the truth and trying to
695 represent ... and trying to be as objective as possible and
696 that’s the training you get as a scientist. You’re really,
697 really uncomfortable if you’re not giving all of the detail and
698 all of the caveats. And I expect you probably realise this

692 talking with people. (laughs) If you talk with the comms team,
693 this is the really hard bit about trying to get a message from
694 science out to a paper or a media because it's got to be a very
695 simple message, short and scientists will always try to put as
696 many caveats and as many, "oh, but then there's this problem
697 and then there's this problem and then there are these
698 uncertainties". So scientists' training is all about taking
699 into account all of the uncertainties and trying to be as clear
700 about those as possible.

Scientist, P1

Such trust status may indeed be dependent on the context within it and those actors within it. For instance, uncertainty may be used as a boundary device (Shackley & Wynne, 1996), though the same concepts can also undermine science status.

The starting point for scientists, however, is that they are viewed as trustworthy by the public. Research has shown that scientists are considered independent and therefore trustworthy (e.g., Whitmarsh, Kean, Russell, Peacock, & Haste, 2005). I could relate this position of scientists holding inherent trust to the notion of values as truisms (e.g., McGuire, 1964; Maio & Olson, 1998), a concept that suggests that values are widely accepted beliefs and lack supportive evidence and cognitive effort. Thus, beyond the repertoires used in science, scientists hold an inherent honour of trustworthiness. This may originate from lay perceptions of organised scepticism (Merton, 1944/73), where the scientific method employed by scientists is trusted, and this translates itself as trust towards scientists.

The authority scientists hold may be reason enough for some people to trust them. Using this perspective draws on the argument from authority/ appeal to authority (Goodwin, 2011). This means if a person/ group is seen as an authority on a topic, any claims they then make about said topic are probably correct. Such expert claims are generally accepted because non-experts, by definition, are unable to assess

claims made by experts (Collins & Evans, 2002). Walton (2010) suggests that scientists (as experts of science) are a modern day authoritarianism, whereby expert scientific opinion is valued in society. However, this can lead to errors of logical fallacies (i.e., invalid reasoning) that come with assumed authority (Goodwin, 2011). Research from the field of studies in expertise and experience (SEE) suggests that purported experts are formally credentialed and dependent on social processes. In a sense, because these are attributed or socially constructed and is also real (e.g., Collins & Evans 2002; Goodwin & Evans, 2007).

An example of such can be seen in *Extract 4* (699), where providing information regarding “scientists’ training” appears to be appeal to authority strategy. Researchers have suggested that climate science experts involved with the IPCC assessment attempt to strengthen their appeal to authority by claiming that the IPCC report expressed a “consensus” view of all the relevant scientists (Goodwin 2009; Rehg, 2011). Such a strategy is termed by Shackley (1996) as a “consensus claim”.

Instead of stressing the consensus that backs their statements, it may provide a stronger reason for trust if they openly made themselves vulnerable to criticism for any mistakes they may make (Goodwin & Dahlstrom, 2011).

It should also be acknowledged that, although scientists are aware of the public and the communication the organisation has with the public, they rarely communicate with them directly; their messages are usually mediated through other actors in a chain of communication (such as professional communicators, media). This chain of communication is the focus of the next subtheme, *message production*.

1.2 Message production. The process of how the information becomes ‘a message’ can be complex and elongated. The process is initially determined by whom the communication is with. For instance, scientist-to-scientist interactions do not

involve communication professionals. However, organisation-to-organisation interactions, or organisation/individual interactions with the public are different. Here there is a (co)production in translating the information to a message between scientists and clients/communicators. Commonly discussed was the iterative nature of this specific process. From a scientist perspective, creating a message for their clientele is done mainly through the process of iteration and agreement. Such negotiations suggest that this process of message construction is producing an end product *with* the recipient rather than simply *for* them.

Extract 5

216 P: We'd normally, with standard projects, we would have 2 or 3
217 reviewers internally to make sure that... to go over the draft,
218 checking for problems or highlight any issues and make
219 corrections. We'd have another draft and again, any last final
220 points and then it would go to the customer for comment and so
221 they would be involved in that process. Not with the very first
222 draft, because we want to make sure the science and the
223 technical details are right but they would be involved in the
224 review process because it's finalised.

Scientist, P1

Extract 6, below, points to how scientists can also consider any *implicit audiences* that may be in receipt of their transmitted message (line 56). So, while providing information (e.g., a report) to their primary audience (e.g., local councils, utility companies) there is also an awareness of who these secondary audiences are (e.g., the public).

Extract 6

55 You may think it's for the government customer like the policy
56 maker but actually what they're interested in is the wider

55 audience and how that message is received by the general public
56 and other governments.

Scientist, P1

Research by Shackley and Wynne (1996) suggest that when scientists share their work with policymakers, they feel no longer in full control of how their information (particularly the scientific uncertainty) is presented to publics. Therefore, scientists are particularly attentive when constructing and negotiating messages with policymakers. Jasanoff (1987) suggests this is because scientists believe the knowledge they produced will be ‘deconstructed’ when applied in policymaking, and this can result in the (perceived) weakening of science authority in the public domain.

When producing a message primarily intended for publics (rather than clients), again there is an iterative process, though this is internal between scientists and communicators. The basic procedure for in-house message construction starts with an initial message (either formed by a communicator or scientist); moving to iterations, negotiations, compromise, agreement and finally the outgoing message.

This procedure is evidenced in *Extract 7*, below. This extract also demonstrates how this particular scientist sets out the purpose of the organisation (namely climate science), and what they see as the appropriate role for each actor within these parameters. This seems to be pointing towards a hierarchy within the organisation; and scientists and the science they bring with them are positioned at the top of this.

Extract 7

623 P: Sometimes it works in exactly the opposite direction than it
624 should do.

625 I: What do you mean?

626 P: Um, well have you heard the expression 'The tail wagging the
627 dog'? The dog wags his own tail, but when the tail starts
628 wagging the dog you have got a bit of a problem there. What I
629 mean by that is basically we are a Science organisation,
630 Science is our bread and butter so Climate Science, actually
631 first and foremost the weather forecasting is our bread and
632 butter, and it's what we are known for, and the ORGANISATION, and
633 now climate change has been, its status as far as ORGANISATION is
634 concerned is up there with weather forecasting as well, but
635 ultimately we are a Science organisation um, and what I think
636 Comms should be doing is tapping into the Science, they
637 shouldn't be leading the Science messages that go out. We do
638 the Science and they should be reporting that Science and
639 getting that Science out to the wider world, but often what
640 they do, it works the other way around where they decide what
641 Science messages should go out and then they get us to check
642 them but it is completely, 180 degrees out from what it should
643 be.

644 I: The content do you mean?

645 P: No, it's the process.

646 I: The process.

647 P: The process is 180 degrees out.

648 I: Why do you think that is? Why do you think that process is
649 as it is?

650 P: I don't know why it is the way it is. First and foremost it
651 is clearly a lack of internal communication about what the role
652 of communications should be in an organisation like *this one*.
653 They should, really a communication team should be serving the
654 interests of the Science and the Science not serving the
655 interests of Comms - because the organisation without Science
656 is nothing.

Scientist, P8

The scientist's view in *Extract 5* illustrate the iterative process of message construction between the client and the organisation. However, as it can be seen in *Extract 7*, this iterative process came become problematic when constructing a

message intended for publics. In this scenario, the scientists seem to be resistant to tailoring their message and think the process should be linear (driven by them and their science) rather than iterative. Alternatively, this could be interpreted in a different sense. That is, from the perspective of this scientist, it is initially the communicators who want to get a message out to the public and they go to the scientists asking for evidence to back the message (627, 638). However, this conflicts with the scientists' way of working, as they are trained to think the other way round, in that evidence is found first and foremost and then it is transmitted to the public (639).

When considering the process of a message for public consumption, the informational content and communications style is often done in tandem or iteratively internally between scientists and communicators.

Extract 8

370 Sometimes that process can take quite a lot of time, so you
371 will have lots of um, ah, toing and froing in terms of
372 trying to distil the message you are wanting to get, so you
373 will have a Scientific message and um it will be, it will be
374 um, distilled into a communications message, then as you
375 said that would go back upstairs and be checked by the
376 Scientist who go 'No, you have knocked out that nuance which
377 is important, you need to put that one back in' It will come
378 to us, we will try and again and it will go round in a, so
379 it is a kind of iterative process and we will get there
380 eventually, um, but sometimes the news media cannot wait for
381 that kind of iterative process because it is very here and
382 now. That kind of works on planned activities that you can
383 have that iterative process.

Communicator, P9

1.3 Effective communication. In addition to describing audiences and the process of communications, the effectiveness of communications was also discussed

by both communicators and scientists. Interviewees seemed to have different ideas about what constitutes effective communication, and it seems to vary depending on the specific circumstances under which communication was taking place. For example, when scientists interacted with policymakers or clients (e.g., businesses, utility companies), ‘effective’ communication was seen as reaching agreement about the content and language of the message. Though this is perhaps more of a negotiation of content, the success of communication was this agreement between the groups. The importance of such negotiations between scientists and policymakers has been seen in previous research (Shackley & Wynne, 1996; Jasanoff, 1996).

Beyond this scenario, scientists and professional communicators, perceived effective communication of climate science as the message being understood. The focus on (mutual) understanding was representative of the views on effective communication. This is illustrated *Extracts 9 and 10*, below:

Extract 9

87 I: What you would see as effective communication of climate
88 change information?

89 P: Effective communication of climate change information would
90 be to create an acceptable degree of understanding of the
91 science and what it means for a number of different audiences
92 and by acceptable... the point I’m trying to get across is what
93 you would reasonably expect someone in that particular audience
94 to understand. And that’s to know enough about the science, the
95 issues, to make a decision for themselves about what it means
96 to themselves.

Communicator, P6

Extract 10

106 I: So when you say... when you think about effective
107 communication, do you mean where the communication has
108 influenced behaviour or people have understood the message?

106 P: Both. Yes. Both. You could argue that getting somebody to
107 understand your messages is, in itself, influencing behaviour,
108 because there's an action involved. Yes. I think they're both
109 equally important.

Communicator, P3

Although 'understanding' the science was consistently reported as being an indicator of effective communication, there were no guidelines in place to gauge whether or not the audience had understood the message as they intended. Thus, on the one hand interviewees said it was important to arrive at mutual understanding transmitted information; however, for most interviewees, it was unclear how this would be assessed. This was evident when interviewees were explicitly asked how they determine whether some communication was effective. For example, as indicated within *Extract 11*:

Extract 11

108 P: I think that you have successfully communicated if someone
109 can erm, respond with a question or comment that makes sense
110 within the framework you've been using. So if I am talking to
111 the public and the public asks me how does carbon dioxide, why
112 is carbon dioxide such a big effect when it's a small part of
113 the atmosphere, and if I can come up with an answer which is
114 erm, a very, acknowledge they understand then I've achieved the
115 goal of communicating that subject. So I think it's imparting
116 understanding, it's the law of communicating.

Scientist, P10

Extract 11, articulates how a scientist makes a judgement on whether the message has been communicated as intended. Such discourse points the deficit model of communication being applied, e.g., "within the framework you're using" (110).

Such discourse also implies that this scientist seems to expect that a non-science audience will receive the information within the framework of science. Indeed, scientists do often engage with the public using their own language (Cook, Pieri, & Robbins, 2004). Bourdieu (2000) calls these ‘puffed-up words’ and argues that using scientific dialect in contexts where people are not familiar with such can hinder understanding of the topic. Further to this, when assessing public understanding of science, the focus is on whether publics understand science in the same way as scientists. Some thinkers question whether the public even should (or could) understand science in this way (Zehr, 2000). I would add here that the information exchange from a science to non-science audience does not simply reflect your own goals as a communicator, but also the relationship you are building with your intended audience.

Beyond this, while frames of reference for scientists and non-scientists overlap, their perceptions are distinct and can lead to mutual misunderstandings (Weber & Word, 2001). Moreover, scientists tend to assume that non-scientists make evaluations of science based on standards familiar to themselves as scientists (Weber & Word, 2001).

As shown in the quote below, *Extract 12*, communicators who are working with scientists see this tendency.

Extract 12

176 P: they don't actually understand that most people don't look
177 at something in the same intellectual way as they do, that they
178 will look at it in a completely different way. And therefore,
179 because we have to apply that intellect to actually come up
180 with the results doesn't mean the same intellect in the way
181 that you communicate them. And that's what I was trying to get
182 at when you talk about reasonable, because there will be

183 different tiers in society who will actually need the message
184 communicated in slightly different ways.

Communicator, P6

In the absence of formal processes to measure communication effectiveness, personal judgments tended to be used to gauge whether the communications were 'effective'. With this, a clear recognition, particularly from communicators, that some kind of measure of success regarding whether the message was *effectively communicated* was needed. See *Extract 13*, below.

Extract 13

86 I: Do you have some kind of measures of success to an effective
87 communication?
88 P: We don't, actually. And it's... it's quite interesting, isn't
89 it? Because in comms we think of output as being the product at
90 the end of the day, when actually we should be measuring
91 outcomes, and the two are quite different. We don't even
92 measure when we do do campaigns - and we've done several for
93 the effect of weather on health working through PCTs - primary
94 care trusts - to get information into GPs' surgeries. The end
95 point for us in comms has been the distribution of that
96 material. We haven't been back and said to GPs how effective
97 has it been? How much take-up has there been in the service?
98 What was your perception of it? So we tend to get as far as the
99 physical communication and we very rarely do any kind of
100 follow-up. And I think we probably ought to be better at doing
101 that.

Communicator, P3

Another interesting point that emerged from the interviews was the degree to which *effective communication* could or should extend to something beyond simply 'understanding'. *Extract 14*, below, suggests that communication effectiveness might

extend to acting in line with a given message i.e., behaviour change. However, this perspective was not the majority position. Indeed, to the contrary, most interviewees were of the opinion that behaviour was not a concern for this particular organisation, and therefore not a measure of communication effectiveness. For example, consider

Extract 14:

Extract 14

362 I: So what do you want them to do with the information?
363 P: I don't know. It's not... I don't think it's the public's
364 problem. It's the climate scientists' problem. I would like us
365 to present the message in a way that is more robust. So that...
366 so that when a cold winter does happen, when you know, as long
367 as it's not like 5 cold winters on the trot that happen, but
368 it's sort of managing expectations. Cold winters can still
369 happen. So what I don't want them [the public] to do is
370 overreact to a cold winter and say that means global warming is
371 not happening. Because what they're doing is responding to what
372 happens in the UK when, actually, even when we're having a
373 freezing cold winter here, you know, like on average the whole
374 globe is warming up.

Scientist, P5

What is interesting about *Extract 14*, above, is that when asked what they would like people to do with the information they are communicating, the respondent—either intentionally or unintentionally—does not actually answer the question. Instead, this scientist re-focuses the discourse on the struggles that scientists have in their science, with the wish to present “in a way that is more robust” (365). This can again be viewed as employing a discursive tool within the empiricist repertoire – ‘robust’ and empirical objectivity is seen as legitimate, with the alternative as irrelevant (Potter, 1996; Eder & Ritter, 1996).

Indeed, the broader tension this exchange alludes to, between understanding science and creating action (or not), is something I will return to later in this Chapter in *Theme Three*, the role of scientists.

Summary of theme one: Communications process. Interviewees identified a wide range of audiences, including policymakers, businesses, other scientists, utility companies, and publics. Scientists generally saw publics as secondary to other audiences (such as other scientists, academics, and policymakers). Communicators, on the other hand, viewed the general public as their main audience. Even though scientists did not immediately think of the public as their main audience, it is clear that they do think about this segment of audience and about how this audience perceives them. While there was a lot of discourse concerning *effective communication*, it seemed vague in its meaning and measure. For both scientists and communicators, effective communication was seen as the audience understanding information and not direct behaviour change (although it was mentioned, see *Theme Three*). There did not appear to be a ‘best practice’ guide on how to conduct internal or external communications. While clear ideas were expressed throughout the organisation about what constitutes effective communication, significantly there were no formal measures of communication success. Instead, the various actors tended to rely on their own intuitions and asking colleagues about when communication had ‘succeeded’ or ‘failed’.

2. Theme Two. Challenges

The second broad theme identified within this data relates to perceived challenges when communicating with others. Challenges came in many forms and were articulated in both similar and different ways by the two actors within this

context (i.e., scientists and communicators). To facilitate depiction of these challenges, I present two broad subthemes within this broader theme: the first being a challenge within the *subject* itself, namely complexities within climate science, including scientific uncertainties; the second strand of challenges concerns *people* involved in communications, both internally and externally to the organisation. While challenges of the subject and people are distinct the two do inevitably overlap.

2.1 Subject. Scientists and professional communicators acknowledged that there are certain features inherent to climate science that presents a challenge when communicating to various non-science audiences. These challenges include the complexities within the subject matter, the use of technical language, the amount and saturation of information around climate change, and the temporal and spatial distance of the topic. Principal among these was the challenge of *uncertainty*, of which there are a number of forms e.g., uncertainties within climate models; uncertainties within the climate system; uncertainties of impacts; and uncertainties in human behaviour and its influence within the climate system. Uncertainty frequently came up as a challenge amongst both scientists and science communicators, so I examined this particular challenge by looking at how it is perceived, portrayed and used.

2.1.1 Uncertainty. For both scientists and communicators, uncertainty repeatedly surfaced as one of the main challenges of communication of climate change science, particularly with respect to communicating with publics and other non-scientific audiences. While there were some divergences in how the challenge of uncertainty was viewed, there was also some agreement in how this challenge was understood for scientists and communicators. For instance, both groups talked about how uncertainty is contextually defined, meaning that uncertainty has a different

meaning for scientists and non-scientists. As such, both groups perceived negative effects of uncertainty on publics, particularly because uncertainty was likely to be interpreted by publics in terms of scientific (in)competence, with further implications for trust, belief in climate change and the science behind it.

Notwithstanding this, each group saw the precise challenge of uncertainty in slightly different ways. For scientists, it was the *ability* to communicate the scientific uncertainties to non-science audiences. For communicators, however, it was the *need* to communicate the uncertainties. These divergences of opinion are illustrated in the following two extracts below, *Extracts 15* and *16*:

Extract 15

226 P: It's very difficult to make a clear message from a very
227 technical aspect or subject or result...that's very difficult to
228 explain, because there are so many different aspects. So that's
229 where the communicating the uncertainty side has been quite
230 challenging, to do it in a very simple and clear way, but also
231 to make sure that we're not ignoring or missing out any
232 important details that need to be included in the message.

Scientist, P1

Extract 16

330 P: There is a 50% chance plus or minus 10% that our summers
331 could be wetter if you take into account x, y and z and you
332 only look at this small proportion of the country. However if
333 you look at this portion of the country there is a 25% chance
334 plus or minus seven and a half point three. That it could be
335 wetter in this part of the country but only in June because it
336 is dryer in July and August'" [...]..I am making it up for effect
337 because I'm like that. It is incomprehensible: scientifically
338 accurate, completely robust scientifically, but if you provided
339 that in the public domain it is perceived as complete and utter
340 gobbledygook and perceived as we don't know: and that's fine,
341 we might not know, but if we don't know let's say there is no
342 answer for that yet, we need further research.

Communicator, P9

2.1.2 *Overcoming uncertainty.* Uncertainty is considered a key barrier in the communication of climate change information, yet scientists and communicators fundamentally perceived it differently. With this, strategies employed to overcome the challenge of uncertainty are also different. For example, taking the following discourse, *Extract 17*, as typical of how a scientist may overcome the issue of uncertainty:

Extract 17

- 374 I: Uncertainties and communicating uncertainties. How do you
375 perceive that as part of the communications?
- 376 P: Well, it's extremely important to do this, and really, the
377 basic uncertainty for projecting climate change has not changed
378 since 1990. The early estimates were that most of the range
379 was, globally, this is globally first of all, was contained
380 within a range of 1.5° to 4.5° centigrade of global warming for
381 a doubling of CO₂, though of course it would be more than that
382 if it... if CO₂ more than doubles, and we're well on the way to
383 more than doubling. The other problem is regional. You can have
384 so much climate change globally, and you can show this
385 uncertainty. It's a very simple thing to do. It's just a graph
386 of rising temperature, and you can have two lines on either
387 side and you shade them in. And that shows the uncertainties.
388 It's a very simple thing to show.
- 389 I: And that's what you would show to the public.
- 390 P: Oh, I would show that to the public. Absolutely. Absolutely
391 show that to the public.
- 392 I: And do you think they... They'd get that?
- 393 P: Oh, they'd get that. They would get that.

Scientist, P14

The quote above (*Extract 17*) demonstrates how scientists may attempt to modify communication to non-science audiences. I note that the scientist here still

uses scientific language in accommodating a lay audience, working within the science frame of reference, and assuming that non-scientists will understand this. This is the deficit approach to communicating science: a one-way information model of communicating science which conceptualises the public as deficient in knowledge whilst also implying that scientific knowledge is somehow superior to untrained forms of knowledge (Davies, 1998).

As such, it has been suggested that scientific writing contains two important features called ‘passivation’ and ‘nominalization’, not usually seen outside of science and academia (Halliday, 2004; Halliday & Martin, 1993). That is, science writing uses more verbs in a passive voice, as well as more nouns. While there are advantages in using traditional science writing (e.g., avoidance of personal characteristics), such voices may be off-putting to those not trained in such writing style. Callaghan and Augoustinos (2013) suggest that scientists’ information deficit to communication may isolate certain sectors of the public, especially if there are alternative and more accessible discourses available in the public domain i.e., sceptical voices in contrast to the dominant (consensual) narrative.

For communicators, however, the challenge of communicating uncertainty is approached differently. *Extract 18*, below, describes how communicating uncertainties may not necessarily mean the message modification deals with the uncertainty itself.

Extract 18

22 P: How we sound in them [communications], so what’s the
23 tone of voice that we use, and we try and adopt quite a
24 friendly conversational tone of voice when we write,
25 because we are seen as being quite an authoritative
26 organisation and quite a kind of scientific kind of,
27 distant organisation and so we need to, if we are talking

28 about science we try and talk in a more conversational,
29 warmer way, so we would say 'we' and 'our'.

Communicator, P4

In relation to the language use mentioned in the above extract, 18, research has shown that the IPCC Summary for Policy makers of 2007 was dominated by impersonal language and contained no explicit use of “we” (Fløttum & Dahl, 2011). They suggest that impersonal language may be a means of claiming neutrality of and a way of managing any disagreements between the author(s). However, such a passive style of writing is also likely to be a rhetorical product of traditional science convention (Billig, 2011; Halliday, 2004; Halliday & Martin, 1993; Gilbert & Mulkay, 1984; Potter, 1996; Edler & Ritter, 1996; Zanna & Darley, 1987).

The communication approach from the extract above is akin to the perspective endorsed by communication theorists, whereby interactive science approaches can also include an informal conversation style, and this can be using inclusive and colloquial language (Logan, 2001; Einsiedel & Thorne, 1999). Unlike the one-way transmission of information (deficit model) which tends to assume public as deficient in knowledge (e.g., Sturgis & Allum, 2004; Wynne, 1991; Irwin & Wynne, 1996; Whitmarsh, 2009), the interactive-relational communication is seen as an on-going process of sending messages and negotiating their meaning (Logan, 2001; Wynne, 1991). This helps overcome misunderstandings between actors working within different frames of reference (Kellerman 1992; Craig 1999). Further, it has been argued that scientists and non-scientists would benefit by seeing science communications as a process as well as a product (Weber & Word, 2001) – indeed, this appears to be more the style adopted by communicators as indicated by how they talk about and communicate with their audiences.

2.1.3 *Purpose of uncertainty.* If uncertainty is seen to undermine the information being conveyed to non-science audiences, this raises an obvious question: why include it? For scientists, they feel they want to portray the information as accurately as possible. They commonly cite that uncertainty is inherent in scientific practice and presenting the uncertainties is rooted in them from their training as a scientist. Therefore, there is an apparent professional role of uncertainty in science.

From a constructionist perspective, however, uncertainty discourse is constructed in certain situations with specific (intended) effects (Gilbert & Mulkey, 1984; Shackley & Wynne, 1996). Furthermore, uncertainty can also serve as a way to legitimate more research and therefore generate further funding (Shackley & Wynne, 1996; Zehr, 2000). Further, thinking back to Theme One (subtheme perceived audiences), uncertainty is used as a ‘boundary ordering device’ between scientists and policy makers, to bring social order between these two actors (Shackley & Wynne, 1996). It has been suggested that for scientific topics of controversy science, competing positions may actually use uncertainty as a rhetorical tool (Dunwoody 1999).

Zehr (2000) has posited that uncertainty is often portrayed in the media through direct quotations from scientists or scientific reports. This relationship was managed in such a way (via the media) that science remained an authoritative provider of knowledge reinforcing the positions within a constructed social hierarchy between scientists and publics – and such rhetorical boundaries between scientists and the public reinforced identities of the scientist experts and the misinformed public (Zehr, 2000; Hilgartner, 1990).

As discussed earlier, the empiricist repertoire is a discourse amongst scientists to bolster the impression of ‘fact’. With this in mind, as discussed earlier under *Theme*

One, Perceived audiences (p.49), some researchers see uncertainty as a discursive tool within the empiricist repertoire (e.g., Gilbert & Mulkay, 1984; Potter, 1996; Edler, 1996; Zanna & Darley, 1987). Among publics this increases perceptions of scientists' authority rather than lessens it (Zehr, 2000). Particularly within scientific controversy, scientists may use uncertainty (and other devices) to attack and construct uncertainty about opponents' claims (Mazur, 1981; Zehr, 2000).

Though this style of communications is not appropriate for interactions with the public, it may be used in this arena because scientists think the communications will (indirectly) be viewed, and judged, to their peers. Scientists do indeed have the perceptions that public engagement will lead to their peers to judge them negatively (Royal Society, 2006; Mooney, 2010). In relation to this, the below extract (*Extract 19*) illustrates this from a communicator perspective:

Extract 19

570 I: Why is it so important to communicate the science with all
571 the uncertainties and probabilities?
572 P: Because that protects... it frankly protects your personal
573 integrity. Because that could, what you're doing, in doing it
574 that way you're actually communicating from your own shoes, not
575 from the other person's shoes. You're doing it... "I want to show
576 how good I am at this science. And I want to show you, you
577 know, I'm a really, really good scientist because I've done
578 this, this and this. And I also want you to, you know, trust me
579 because I'm not telling you this is certain; what I'm telling
580 you is because I've done all this really, really good work,
581 this is the most likely scenario that's an uncertain der, der,
582 der, der, der", and that is a basic mistake of communication.

Communicator, P6

While both scientists and communicators talked about uncertainty as a key barrier to effectively communicating climate change information, agreeing on the

negative implications in the communications - they talked about it and saw its role in different ways.

2.2. *People*. With challenges brought about by people, although these were vast, there was some agreement between scientists and communicators about who presented obstacles when communicating in this domain. This included politicians, scientist sceptics, media outlets and NGOs (non-governmental organisations). There were, however, some important differences between scientists and communicators in who was seen to be a particular challenge and the stated reasons for why they presented such a challenge.

The below extract (*Extract 20*) extends the scientist view that the public's knowledge of science is deficient. It also suggests they believe publics can be subject to bias and personal interests that are ideological/ emotional more than rational judgments based on the scientific information. This perspective among scientists has been noted in previous research. For example, in their paper 'The Scientists Think and The Public Feels', Cook, Pieri and Robbins (2004) propose that scientists, by way of discursive features, construct themselves in an active role and rational actors (i.e., they think). In contrast, scientists would talk about the public in passive terms, and when used agentive terms, the public were swayed by emotion and ideology (i.e., they 'feel'). The extract below, *Extract 20*, points to how this scientist perceives ideology, the politicisation and controversy associated with climate change:

Extract 20

65 I: How do you see effective communication?
66 P: Okay. I think it's very difficult. IPCC was very successful
67 until recently, and two things, of course, have conspired to
68 make life more difficult - the rise in America of very strong
69 right-wing ideology, which is totally against doing anything

70 about climate change, mainly because of the desire for
71 government to be small, and I've come across people in America
72 and had very interesting discussions, actually, with people
73 from the wild woods of Oregon who regard the American
74 government as their greatest enemy, and the Right wing of the
75 Conse... of the Republican Party isn't quite as extreme as that,
76 But it's on the way, and the Tea Party represent that. The
77 other problem of course we've had is climategate...

Scientist, P14

This scientist then goes on talking about “climategate”⁶ for a considerable amount of time. Even before the events surrounding climategate, climate change was a controversial topic. Climategate made it more so at the height of the affair. Burchell (2007) conducted interviews with eighteen crop genetic scientists who were working with GM crops, and at the time, working within conditions of controversy. Following discourse analysis of these scientists, Burchell suggested that scientists employed the *empiricist repertoire* when talking around a controversial science issue (i.e., GM crops), whereas non-controversial topics would draw upon a *contingent repertoire*. Burchell proposed this is an approach by scientists to reduce the negative effects of the ‘controversy’ by legitimating their own beliefs and, in the view of scientists, this is best done through employing an objective repertoire. This is less necessary when the topic is not controversial. Scientists tended to describe groups with opposing views to their own as contingent ‘others’. This is similar to the *contingent repertoire* proposed by Gilbert and Mulkay (1984), where a ‘lesser science’ is constructed, implying that the alternative side lacks knowledge, is subjective and personal, thus bolstering their own position. Despite this preference for empiricist over contingent

⁶ Climategate is the term that was attached to the email hacking controversy at the University of East Anglia in late 2009/early 2010, where over 1,000 private emails between climate change scientists were stolen and published online – the accusation of which included manipulating the data and misleading the public about the extent of climate change.

repertoire styles, Waterton, Wynne, Grove-White and Mansfield (2001) suggest that a more contingent repertoire approach with the public may result in less alienation and resistance by public. However, when communicating science with the public, particularly with areas of controversy, scientists are less likely to use contingent repertoire (Burchell, 2007).

What is also interesting with *Extract 19* is that when this scientist was initially asked about their perception of effective communication, and they very quickly went on to talk about sceptics, and how scepticism is related to political ideology. By framing scepticism as an ideological position it simultaneously placed the science outside of ideology by comparison, which casts scepticism as less scientific. That said, organised scepticism and challenging established theories is a normative tradition within the sciences (Storer, 1966).

For communicators, scientists' (lack of) understanding of public and the role of communicators was seen as problematic. Research has indicated that scientists do not seem to understand the public and do not think highly of them – often perceiving the public as incompetent, scientifically illiterate and emotional (Pew Research, 2009; Mooney, 2011). Scientists also viewed publics as lacking an understanding of risk (Cook, Pieri, & Robbins, 2004), and as viewing a binary definition of certainty and uncertainty. However, studies have shown that lay people are indeed scientifically literate, and do understand that nothing is risk free and are able to live with uncertainty and the lack of control that comes with it (e.g., Wynne, 2002). Furthermore, lay people have different understandings of certain knowledge, and are influenced by social, political and cultural contexts (Irwin & Wynne, 1996).

The challenge concerning 'people' extends further to those people who are located within the organisation and therefore able to directly influence the

communications process. While (competing) audiences may have been the most obvious ‘people’ barrier to the climate change message, other human entities were also identified. There was evidence in the interviews of internal divisions within the organisation, and these were seen to be a significant barrier to effective communication - in that it can elongate the message production process. More specifically, there was a strong tension between scientists and communicators of climate science. This tension was particularly salient to the professional communicators, who often brought it up without the need for specific prompting. This was initially brought up in the context of co-producing a complex message, containing uncertainty, and discussion of a wider conflict evolved. Scientists also recognised the tension if it came up in interview, but were less inclined to mention this spontaneously. Even when internal divisions were recognised, the two groups talked about this in different ways. In particular, communicators talked about this issue with more emotion, and were more inclined to construe it in “us and them” terms than scientists were. This may in part reflect an outward conflict in roles and stereotypes of each other, creating a deeper conflict between the two groups. Perhaps this is a consequence of the boundaries uncertainty discourse creates: a constructed social hierarchy between scientists and non-scientists (Zehr, 2000).

To illustrate this setting, let us consider the earlier mentioned process of iteration between scientists and communicators (*Theme 1.2*, message production). As previously noted, conflict tends to appear when communicators and scientists discuss and try to agree on a message. Bones of contention include the level of technical information and issues of uncertainty. While the conflict can manifest and erupt in a specific situation, it is not always the case; yet there remains a broader underlying tension. For example, consider the following extract, 21:

Extract 21

189 P: Comms say that they [scientists] consider themselves the
190 intelligencia of the *ORGANISATION* and they kind of throw their
191 weight around and not by nature perhaps, I can't believe I am
192 saying this, but um, perhaps a little bit introverted and not
193 necessarily so, um, adept at the people skills, um, that is a
194 big generalisation, um, and therefore I think there have been
195 clashes between Comms and Scientists because things just
196 haven't been handled particularly sensitively.

Communicator, P4

As also noted earlier, members of the communications team were more likely to discuss conflict openly and in these more general terms. Among communicators there is also a perception that conflict is unavoidable whenever communicators and scientists are working together because it stems from a broader relationship, *Extract 22*:

Extract 22

366 P: I think it boils down to a clash of culture between comms
367 and science. And never the two ends shall meet.

Communicator, P3

The conflict between the scientists and communicators might be partly exacerbated by the perception that one of these groups (science) is more central to the organisation than the other. Indicative of their centrality, when asked about how the public perceives the organisation, one scientist answered exclusively with respect to their own subgroup (scientist), rather than the organisation and their services as a whole. While this barrier may reflect a broader conflict between the organisational subgroups, it also, in some sense stems from the different perspectives each takes on

communication and what each group sees as the goal of this activity. This divergence of perspective affects both groups. Perhaps because of the presumed higher status of scientists (*Extract 21*) the divergence is more keenly experienced by communicators within the organisation because they may be left with a feeling that their expertise in communication is being overlooked or ignored for other reasons and in ways that compromise the job with which they have been tasked. As an indication of this, consider the following extracts:

Extract 23

165 I: Just going back to the relationship between Comms and
166 Scientists, do you think that has an impact on, obviously that
167 is an internal communication issue, do you think that also has
168 an impact on the effectiveness and the message that goes out?
169 P: Definitely yes, because I think it gets diluted. Um, I think
170 stuff goes out that is so full of caveats that it doesn't
171 really make sense to you anymore. You know, it is not a clear
172 piece of writing because it is so full of this might happen,
173 and there may be a chance that there will be a likelihood of
174 rain kind of thing and so you don't get clear and concise
175 writing when you are trying to express scientific things.

Communicator, P4

Extract 24

478 P: Difficult because you can get a bit worn down because you
479 think to yourself, okay.. There are two ways of looking at it.
480 Okay. I can have an easy life and I can just say, right, if
481 you're happy with that, I'll put it out. And then I'm thinking,
482 so yes, actually, I'm not really helping the people that these
483 messages were designed for; they were not designed to
484 communicate your science to other scientists.

Communicator, P6

Both scientists and communicators are, in the end, engaged with the same goal, and these groups broadly agree on *what* has to be communicated. Where they differ is in their understanding of *how* this goal should be attained—that is, about the best process for communication.

Perhaps this also points to a wider conflict, as suggested by one communicator in *Extracts 21* and *8*: a conflict between the disciplines and epistemologies and how each actor sees the world, and how to communicate within it. The scientist perceives the world from a positivist tradition. Whereas communicators may be viewing the world as interpretivist or socially constructed, and in viewing the world differently, they feel messages, as scientists would construct, would not be understood in a non-science domain. Such differences are reflected in their respective communicative styles. This is a fundamental issue that never gets resolved. In one sense, one could speculate if that communicators within this context (i.e., a science organisation) talked about theories they were applying to underpin their communications, then they may gain increased respect from scientists.

2.3 Summary of Theme Two: Challenges. A number of challenges to the communications of climate change information were apparent, both with the subject of climate change communications and with various social actors within climate change communications. Uncertainty was presented consistently as a challenge in this domain. Whilst there was some similarity across the two groups, uncertainty was also perceived differently. For scientists, it was the ability to communicate the scientific uncertainties to non-science audiences that was seen as the main challenge. For communicators, however, it was the need to communicate uncertainties and the use of scientific language that was seen as most problematic. In other words, the difficulties of communicating uncertainty in climate change differed for scientists and

communicators. Different perspectives of uncertainty led to different methods to overcome the issue of uncertainty. Scientists tended to continue using their own frame of understanding and science language. Communicators, however, would modify the language peripheral to the informational content of uncertainty, by changing their tone of voice.

I would interpret these different perspectives and approaches towards uncertainty to indicate two fundamentally different ways scientists and communicators approach communications with non-scientists. The scientists approach communication as a one-way information model of communicating science (deficit model), whereby transferring information is fundamental i.e., informational model of communications. Communicators, however, modify their message by the language peripheral to the informational content to engage publics i.e., relational approach to communications.

We also propose that the two groups constructed uncertainty differently: scientists constructing the professional role which demands it; communicators aware of the additional functions (e.g., status, boundaries, peers) that accompany uncertainty discourse. This had implications on relations between these two groups and the efficiency of message production.

I would like to mention here that temporal and spatial distance can be seen as a challenge that is associated with both the subject of the communication and the people involved. In one sense it is a challenge within the subject, because it concerns the nature of climate change. On the other hand, the time and space nature of climate change requires people in the here and now to establish perceptions of climate change that are temporally and spatially distant. These psychological distance features came up during the course of interviews, though in this study did not necessarily constitute

a broad or sub-theme. Rather than a theme in and of itself, the temporal and spatial distance was more seen as a challenge (barrier) when communicating, something that compromises the uncertainty being presented, because the projections are *so* removed in time and space.

3. Theme Three. (Conflicting) Roles of Climate Scientists

Both climate scientists and communicators explicitly articulated that the role of the science organisation and scientists is to provide robust climate science information. They felt the information communicated is based on the science, and includes all uncertainties. Scientists believe that such information helps audiences make (rational) decisions. The information exchange is seen to be policy-relevant and certainly not policy prescriptive. The information communicated must be viewed as objective, and providing behavioural advice was seen as damaging to (perceived) objectivity. As such, scientists (and organisational policy) are of the view they should provide no information on how people can change their behaviour to address climate change.

In line with this, when interviewees (scientist or communicator) were directly asked about providing information/advice on behaviour, the ‘provision of behavioural information’ was always interpreted as ‘policy advice’, and was viewed as the antithesis of providing objective information. However their response always indicates that ‘advice’ (at an individual behavioural level e.g., cycling more, using the car less) on behaviour means ‘policy’, and they try to maintain distance from policy/politics – and this is part of their frame of reference. Advice on behaviour modification is ‘telling people what to do’ — ‘we don’t do that, it’s up to policymakers to do that’. Is it that ‘policy talk’ (which includes information on

behaviour) is often accompanied/associated with ‘political rhetoric’ to *persuade* audiences to believe/do something? In contrast, scientists may perceive themselves as not needing rhetorical tools because their work is ‘empirical’ and thus ‘speaks for itself’. Let us consider some verbatim extracts with these ‘roles’ in mind.

Extract 25

273 I: Do you expect them [audiences] to consider your behaviour
274 when you’re talking about climate science? In terms of how they
275 can change their behaviour?

276 P: As far as I'm concerned, as a climate scientist, I study
277 work which is policy-relevant but not policy-prescriptive. It's
278 not up to me as a civil servant to tell the government what to
279 do. [...] That's not appropriate. It's not appropriate for the
280 IPCC either. I have to be policy-relevant and relatively
281 neutral when it comes to... obviously you can't be completely
282 neutral, but as neutral as possible when it comes to people's
283 behaviours, so it's up to them to react as they think fit.

Scientist, P14

The above Extract, 25, indicates that scientists saw the provision of advice as interfering with their perceived objectivity, and may lead the public to view them as persuaders rather than informers. However, Weber and Word (2001) ran a series of focus groups among non-scientists where participants discussed a factsheet on biodiversity. This factsheet was especially prepared for the study by a group of scientists, they perceived it to be objective and as intended to inform rather than persuade audiences. Focus group participants, in contrast, said that they did not know whether the content was intended to inform or persuade (Weber & Word, 2001). Once again this points to divergences in the frame of reference used by scientists and non-scientists; while scientists may write and perceive information to be neutral, they are

making these judgements based on their own reference frames, and assume that non-science audiences will be doing the same. Just as reference frames are important when employing empiricist and technical language, it is also the same principle when judging intent of information.

Within these interviews, I found scientists would explicitly situate themselves as objective and impartial actors within the climate change communications culture. Implicitly, however, their discourse can indicate they hold expectations of their audiences and have personal goals. In the below extract, *Extract 26*, the scientist is asked about uncertainty and its role in the communications process. They start off by talking about uncertainty but digress to talk about different actors' agendas within climate change communications.

Extract 26

271 In real life people often have to deal with uncertainty anyway,
272 even if very often they don't want to. So I think it can... it
273 can be a difficulty, and I think part of the problem is that
274 it's possibly unique to climate science is because it's so
275 political, there's perhaps a reluctance sometimes to really be
276 up-front about uncertainty because it's seen as they're
277 exposing yourself to being, you know, misinterpreted or your
278 research misused or something, and there are... there's a certain
279 branch of climate science communicators, if you like, who
280 deliberately want to downplay the uncertainty. They don't like
281 it. They think it's unhelpful. They just want things focused on
282 their key message. And I suppose that's fair enough if... It
283 depends on the purpose behind your communication. If you're a...
284 a campaigner with a particular agenda, then clearly if there's
285 a whole range of uncertain information, you want to pick the
286 bits that fit your agenda, and you're going to do that, whereas
287 from my perspective I come from the, you know, the science
288 side. I don't really have a political agenda. My agenda if I
289 had one would be to make sure the science is valued and
290 understood properly. I don't want to second-guess what people

291 are going to do with the information that I'm giving them. So
292 if I give them just one bit of it, then that may not be the bit
293 that they are, I suppose, useful to them. They... they need to
294 understand that there's a range of possibilities, so then they
295 can make an informed decision. But clearly that's... that can be
296 complicated because if there's... some people don't like having
297 too much information so it's a way... again, there can be
298 challenges in communicating the fact that there is uncertainty
299 without just giving them too much information or no information
300 at all. (laughs)

Scientist, P14

This scientist in *Extract 26* starts off by saying they (as a scientist) distance themselves from someone with an agenda (such as “campaigner with a particular agenda”, 169). They then go on to talk about not having a political agenda – and any agenda they may have is one of science (“to make sure the science is valued and understood properly”, 174). Yet, it could be argued that persuading people to value your work is an agenda in itself. This scientist then seems to acknowledge that people will want to do something with the information that scientists provide in decision-making (“they need to understand that there's a range of possibilities, so then they can make an informed decision”, 179). Thus, while the discourse explicitly discourages the use of information provision to inform decision-making, deeper consideration of the discourse indicates that scientists do expect the information they provide (though it may not be specifically concerning behavioural advice) will be evaluated and taken into account in the decision making process (with the consequence of potentially changing behaviour).

These inconsistencies with scientists' implicit/ explicit attitudes towards information provision are not uncommon. *Extract 27*, below, illustrates more explicitly that there is some hint towards people acting on the message, and the uncertainty in climate science is used to justify not taking any action.

Extract 27

449 I think if, um, people use the fact that we use the word
450 'uncertainty' as a reason for not acting, so they think that,
451 some people think it is not until you are 100% certain that you
452 should take any action, but you are never really going to be
453 100% certain with many aspects of Science anyway.

Scientist, P8

An alternative method to engage people with climate change proposed by communicators is relating the topic of climate change to everyday lives i.e., reducing the spatial and temporal distance. See *Extract 28*, for example.

Extract 28

262 P: I see that we have to present evidence and let people make up
263 their own minds and I see that it's very much an uphill struggle
264 in the developed world to get people to recognise that, A, the
265 climate is warming - I mean who would think it on a day like
266 today?, and B, that actually, it will... well, it could
267 potentially, let's say, impact their health and their social
268 wellbeing. Err... sorry. Their financial wellbeing. Because those
269 are the two biggies for people in the developed world. You know?
270 We may accept that people in the developing world will have
271 problems with finding food to eat and water to drink. But
272 they're a million miles away from our lives and lifestyles. I
273 think if you address the fact that climate change may impact
274 health and wealth in the western world and you address those
275 then people are going to be more inclined to act on a global
276 problem.

Communicator, P3

These inconsistencies and contradictions are common within interview discourse with scientists (e.g., Gilbert & Mulkay, 1984; Polanyi, 1986). Thinking more specifically about the contradiction of science information versus behaviour change, it may represent personal goals to achieve behaviour change, and these are in

conflict with the professional role of being a ‘climate scientist’. Alternatively, such expressions may not necessarily reflect personal views on behaviour change, but rather act as an indicator to scientists that the audience understands what has been communicated i.e., the information was communicated ‘effectively’ as shown by the actions following information provided. To some extent observing behaviour change following information could be a form of measuring ‘effective communication’. However, a wealth of research has shown a gap whereby attitudes towards and knowledge of environmental issues often do not lead to action (e.g., Kollmuss & Agyeman, 2002; Blake, 1999; Flynn, Bellaby, & Ricci, 2009; Poortinga, Steg, & Vlek, 2004; Lane & Potter, 2007). Therefore, behavioural responses are a weak gauge of effective communication. Though for scientists, audiences acting upon their science information could be a sort of positive affirmation of their professional role as a ‘scientist’ – despite this being potentially too personal to be science. Polanyi (1958), however, argues that the interplay between the impersonal and personal forces makes science what it is.

Such contrasting messages seem to permeate through the organisation. The extract opening this chapter by the Chief Executive of a meteorological organisation points to two things of interest with the present research in mind. Firstly, the CEO suggests that uncertainty and poor understanding of climate change is amplified by the language use in this context. This is in line with what I had similarly set out in *Theme Two, Challenges*. Secondly, he is also explicit in saying that action is required. He uses the word ‘us’, though does not specify whom he specifically had in mind. I would speculate here that he is broadly alluding to humanity. This call for action is implied throughout the speech – and seems to be inconsistent with (scientist) perceptions of their (presented) role in the domain of climate change communications.

It may reflect conflicting sets of norms at an institutional level - norms around the impersonal character of science versus its counter norm of the personal character of science. In other words, impersonal and personal personas as characterised through empiricist versus contingent repertoires (Gilbert & Mulkay, 1984).

Goodwin and Dahlstrom (2011) suggest that scientists can strengthen their appeals by increasing the risks they are undertaking in offering their views. Relatedly, Goodwin and Dahlstrom (2011) and Wynne (1992) that climate scientists may be more trusted if they present themselves as less certain.

3.1 Summary of Theme Three. While explicit expressions describing the role of the scientist and science organisation are of objectivity and of a non-advisor in terms of decision-making; implicitly there are some suggestions that scientists do expect the information they are communicating to be absorbed and taken into account when making decisions. Similarly, some (a minority) of the scientists show contrasting discourses between their professional role as a scientist and their personal goals pro-environmental behaviours. While the personal side of science is explicitly frowned upon, it appears to play an implicit role in how scientists construct themselves.

Chapter Summary and Discussion

This qualitative research and its process gave me the advantage of exploring different perspectives regarding the communication of climate change information. At one level the descriptions of content are useful in establishing face-value ‘facts’. Moving beyond this, interpretation of the content and discourse reveal implicit perceptions, social realities, inconsistencies and conflicts.

I first presented descriptions of what it is scientists and professional communicators do. There are substantial commonalities between the two groups e.g., perceptions of effective communication, uncertainty as a barrier to communications, and the iterative process of message production. There were also some significant differences between scientists and communicators, e.g., perceptions of primary audiences, perceptions of how uncertainty is a barrier, and its role in science communications.

Fundamentally, it appears that climate scientists and professional communicators work on different models of communication. For scientists, the priority is transferring as much scientific information as possible, highlighting the uncertainties, and maintaining technical language. Scientists focus on an ‘informational’ model of communication. This is akin to the deficit frame of science communication, assuming that the public are empty vessels waiting to be filled with knowledge. Historically this has been the dominant model of communicating science (Einsiedel & Thorne, 1999). For communicators, however, understanding their audience is primary in their communication – they prefer to understate the uncertainties, simplify language, speak directly with rather than at the public, bringing them along with the message being delivered (and the wider notion of all being in it together) and have a warm and friendly style of communication – which they call

‘tone of voice’ – indicating that communicators focus on a more ‘relational’ model of communication. This style is more similar to the interactive (rather than deficit) model of science communication. The interactional communications approach highlights the importance of context, audience beliefs and values (e.g., Sturgis & Allum, 2004; Wynne, 1991; Davies, 1998; Logan, 2001).

These different approaches to communication appear to have caused some conflict between the two groups. This appeared implicit for scientists, for example in Extract 7, in addition to indications of a superior attitude (e.g., “tail wagging the dog” expression, line 626), this could also point towards some tension from the perspective of scientists towards communicators. Communicators were explicit about this intergroup conflict, using language such as ‘us and them’ to depict the relationship between scientists and communicators. This was unprompted, discussed in-depth and with emotion for communicators. This was a less salient issue among scientists, who rarely discussed it unprompted. Communicators believe the conflict does impact upon the final message e.g., taking overly long to produce a short message; or a short and concise message becoming meaningless to a member of the public due to its caveats, uncertainty and scientific language.

At face value, these different approaches to communication may be because of these actors’ different areas of expertise, disciplines and training. For instance, scientists are trained to write in the third person, in a stylistic nature and from a positivist tradition. In fact, when discussing job roles, this was explicitly expressed by many of the participants. However, a further look at the discourse can also indicate more subtle perceptions of scientists, their audience and how they see themselves in social order. Extract 1 shows a scientist describing their audience, towards the end saying “down to policymakers”; and clarifying ahead of this by stating “not up”. This

suggests that this particular scientist sees himself as of higher social or intellectual status as one of his main audience. Or maybe just the message is higher as it is shrouded in objective science and therefore has a higher privilege than more relational messages. Some caution should be noted here, as one could argue ‘down’ in this context may indicate from the source (i.e., in terms of flow), rather than down i.e., from “on high”. However, *Extract 7* could also be indicative of a superior attitude, with scientists as the “dog” and communicators as the “tail” is indicative of a superior attitude (line 626). Regardless of causation, this could have the effect of increasing social distance between the scientist and their audience – which can be disengaging in the context of communicating climate change information, and more broadly, how this particular scientist perceives his function in society.

I would suggest the language and use of uncertainty performs a number of functions. Among scientists uncertainty is a function of their professional role, with all scientists advocating that this is the way of science, and there will always be uncertainties and these uncertainties needs to be communicated. Uncertainty also seems to perform a psychological role, often explicitly expressed by communicators, with some implicit indicators by scientists themselves. Non-scientists have suggested that the language of uncertainty (alongside other science specific language-use) has a role in allowing scientists to show their ‘scientific prowess’, scientists how good they are, giving protection for the scientists and science (amongst their peers), and showing audiences how competent they are (to gain trust). Further, uncertainty and technical language use can serve ‘a number of legitimate functions in scientific communication’ (e.g., Gilbert & Mulkay, 1984; Potter, 1996; Edler & Ritter, 1996; Zanna & Darley, 1987).

These perceptual differences among scientists and communicators also are manifest in divergences in approach to message adaptation to increase audience engagement (and understanding). As I demonstrated, scientists preferred following an established rhetorical convention, i.e., including the uncertainties and certain technical language is important. When efforts are made to modify their communications to non-science audiences, methods of message modification still tend to be within the science framework. With scientists' model of communication, it could also point to underlying professional, social pressure or (self or other) expectations that accompany being a 'scientist'. Therefore the deficit model approach of communication; 'educating' publics on the science – whilst maintaining science community specific language/uncertainty - also maintains the role/image/status of scientists.

In contrast, communicators modify their message by the language peripheral to the informational content. For example, the 'tone of voice' is an important aspect of effective communication of climate change information: such as adopting a warm, friendly style of writing/communication. Furthermore, communicators have a preference to make the message more meaningful in everyday life. For example, making the informational content more social, economic and empathetic is favoured by communicators. Scientists attempt to make information relevant to people, but still rely on the scientific approach for doing so (such as localised impacts of flood risks, reference to shorter term climate modelling rather than longer period – perhaps in an attempt to reduce the temporal and spatial distance). Communicators do explicitly talk about behaviour more than scientists, but still stop at giving advice on behaviour change, with the qualification of it not being part of 'our' (the organisation's) role to do so.

This is akin to recent work on communicative differences in science discourse and construction of scientist (public) identity. Callaghan and Augoustinos (2013) have suggested that consensus and sceptical scientists debate the topic differently, and therefore engage audiences differently. They argue that the consensus scientists (advocating the occurrence of anthropogenic climate change) apply the information-deficit model of communication. In contrast, sceptical scientists utilise an interactive model of communication, believe that science communication can and should always make the most of the interactive communicative style. By recognising the two different approaches of *reified* and *consensual*, contextualised in economic interest and using inclusive and colloquial language, they increase the feeling that (sceptical) climate science is common sense knowledge. This undermines consensual climate science – combined with the authoritative approach to communications this makes the alternate rhetoric (sceptical) more attractive.

Indeed, interviewees rarely talked about what happens after the message has been ‘effectively communicated’. Once understanding of the science of climate change is increased, then what? Would it lead to people increasing their pro-environmental behaviour? This is perhaps unlikely because the organisation likes to position themselves as politically neutral, holding the perception that any advice giving is not for them to do. For instance, the explicit attitude during interviews was that the work conducted by the organisation is policy-relevant but not policy-prescriptive (e.g., *Extract 24, 277*). Yet implicitly, scientists do seem to expect that the information they are communicating is absorbed and taken into account when making decisions. Similarly, some (a minority) of the scientists show some kind of conflict between their professional role as a scientist and their personal pro-environmental goals and behaviours.

In summary, the communication of climate change information is a complex one – even at the level of internal communications within a scientific climate change research organisation. ‘Uncertainty’ is the main challenge in such communications – due to its scientific and social complexities, which make it a particularly difficult challenge to overcome. Relational processes within this science organisation seem important when constructing a public communications message from scientific information. Scientists tended to advocate a deficit model of science communication, where *what* to communicate superseded consideration of how information is communicated (i.e., an informational communication style). In comparison, communicators were more concerned with *how* to communicate the information (i.e., a relational communication style).

Chapter 3

The roles of ‘tone of voice’ and uncertainty when communicating climate change information

A series of experimental studies

Introduction

The previous chapter presents an in-depth qualitative study, in which I investigated the process of climate change communication from the perspectives of scientists and professional communicators. On the basis of this analysis, I proposed three broad themes: 1) Communication Process(es); 2) Communication Challenges; and 3) (Conflicting) Goals/Roles of the Climate Scientist. Theme One, in particular, was concerned with the different ways in which scientists and professional communicators understand the basic process of communication and the goals they pursue in relation to this when dealing with the public. Climate scientists were advocates of the “information-deficit” model of science communication, whereby technical language and uncertainties are of central importance and fully educating the public about climate science is the primary goal of communication. Communicators, however, adopted a more relational approach to science communication. They preferred to build a relationship with their audience(s) and achieved this through using simplified language. Specifically, they adopted a warm and friendly style of communication, which they termed ‘tone of voice’.

Building on these insights from this qualitative work, especially the ideas that emerged under Theme One, in the next phase of this research I wanted to experimentally explore the consequences of these two different models of communication and their possible impact when communicating climate change

uncertainty to public audiences. Based on the qualitative work one of the main challenges was communicating (uncertainty) to non-scientific public audiences. Public communications was seen as important at the organisational level and was predominantly done by a team of communications experts. Though not viewed as a priority by scientists, communications with lay audiences was something they undertook. While internal (e.g., between scientists and communications team members) and other external (e.g., with policy-makers and industry) were also seen to present challenges, there appeared to be project and client-focussed iterative processes in place to assist these exchanges (see page 58). Bearing these issues in mind, in considering the target audiences for this set of experiments, the focus was with non-specialised public audiences.

My starting point for this investigation was a Pilot study in which I varied the language peripheral to the information. In one condition, the communicator employed an exclusive style of language, being cold and creating communicator-audience distance rather than closeness. In the alternative condition, the communicator used a warm ‘tone of voice’, via using inclusive and warm language peripheral to information. The latter maps onto the style advocated by communicators from my qualitative research. Varying the style peripheral to the content of the communication allowed me to explore what, if anything, might be conveyed to audiences by communicators who adopt different approaches to communication.

Expanding on the Pilot study, my subsequent experiments included factors that represented the other themes to emerge from the qualitative research. Experiments 1 and 2 focus on how communication style interacts with the informational content of climate change messages – specifically content that communicates scientific uncertainty, one of the key challenges for climate change

communication identified under Theme Two of the qualitative analysis. Both these studies crossed the communication style manipulation with a manipulation of uncertainty (lower versus higher) and examined the combined consequences of these factors for audience engagement and action. Experiment 3 introduced a further factor to this design that drew upon the third theme from the qualitative research: the (conflicting) roles of scientists. In my interviews, scientists expressed concerns about the provision of advice on how publics might change their behaviour in response to the scientific information they provide. Specifically, scientists worried that providing advice and guidance might undermine perceptions of their role as neutral providers of impartial information. With this in mind, I varied the provision versus absence of clear advice in the message and explored how this, in combination with communication style and uncertainty, shaped responses to the climate change message.

Before presenting an empirical study of this, I briefly recap the relevant literature on (risk) communication, trust and the role of person perception within these processes – and set the backdrop of these experiments in the research context.

Research recap and experimental context. The aim of the experiments was to examine how uncertainty might be managed in communication to avoid its likely negative effects. However, unlike prior research on uncertainty communication, I wanted to consider how factors peripheral to the message itself might modify how people respond to the informational content, particularly any uncertainty contained within it. Specifically, I consider the audience perceptions of communicators and how these guide their responses to messages that contain uncertainty.

To assess these possible consequences, I focus on perceptions of the communicator in terms of the stereotypic dimensions of morality, warmth and

competence. As highlighted in Chapter 1, person perception research suggests that these stereotypic perceptions capture most of the important variance in how one thinks of other people, and that perceptions of warmth/ morality are primary when people decide whether and how to engage with others (e.g., Brambilla, Rusconi, Sacchi, & Cherubini, 2011). That said, morality seems to dominate ‘other’ person perception, whereas competence dominates self-perception (Wojciszke, 2005).

Chen, Jing and Lee (2014) showed that perceptions of trustworthiness increased the chances of winning actual elections, but only for those who were judged as competent. It may also be noteworthy that Chen, Jing and Lee (2014) were using the term trustworthiness instead of morality – also the two terms were not used interchangeably. For the purposes of this thesis I will be using the term ‘morality’, predominately to remain consistent with terminology used in impression formation theories. However, I am also aware that the term morality can have slightly differently connotations outside of social psychological theory, for example with connections to religion (i.e., a relationship between religious views and morality). I would like to stress that in this context ‘morality’ does not necessarily equate to religious morals, but is a term used in previous research to capture traits such moral, trustworthy, honourable, honest.

Information can be processed via different routes, and the level of influence of message and messenger will depend on situational factors. Within the elaboration likelihood model of persuasion (Petty & Cacioppo, 1986), for example, information is processed through one of two routes: the *central route* whereby the individual thinks carefully about a communication’s content and is influenced by the strength of the arguments it contains; and the *peripheral route*, used to process information when the individual has little or no motivation to engage with the information being

communicated. *Heuristics* are used to process information via the peripheral route, include the stylistic features of the message other than its content (e.g., speed of presentation, use of imagery, length of message), and features of the source from which the message originated, such as source likeability, attractiveness or credibility (e.g., Tversky & Kahneman, 1973; Chaiken, 1987; Petty & Cacioppo, 1986). In the context of climate change, individuals are unlikely to feel motivated to seek out and fully process information about this issue because it is distant from their immediate concerns, both in time, space, and hypothetically (Liberian & Trope, 2008; Trope & Liberman, 2010). This lack of motivation is likely to be further amplified by the probabilistic nature of climate science information. Research has shown that uncertainty and risk are barriers to effective communication. People avoid messages that contain uncertainty (Camerer & Weber, 1992) and uncertainty can hinder action (Kuhn, 1997). Such findings are clearly a concern for those involved in the communication of climate change to publics—the very nature of the message may undermine public engagement with communication around this issue.

Given my assumption that much communication about climate change is likely to be processed peripherally by all but the most concerned and engaged of publics, it is useful to consider more deeply the peripheral features that might enable climate change communicators to be influential in the face of uncertainty. In relation to this, I focus on how the communicator is perceived—specifically the stereotypes that audience have about the sources of climate change messages—and the factors that might influence such perceptions.

Moreover, communicating information about climate change is a form of risk communication. Research has shown that in relation to risks where public knowledge is low (e.g., biological security), public trust in the organisations communicating the

information is important (Blendon, Benson, Desroches, & Weldon, 2003; Siegrist & Cvetkovich, 2000).

Therefore, in the context of climate change communications, perceptions of the messenger and their morality may be particularly important in fostering social trust between the actors, potentially increasing willingness to engage with climate change messages, despite them containing high levels of uncertainty. Arguably communication plays a role in developing trust, and language-use within that is potentially a key feature of that. With these in mind, I wanted to experimentally examine how the general chains of communication, messenger-message-recipient, interact in the context of communicating climate change information.

Pilot Study

The aim of the pilot study was to explore what, if anything, using a warm and friendly ‘tone of voice’ as learnt from the qualitative work, might contribute to the likely effectiveness of uncertain climate change communication, since this was considered a primary tool for effective communication by the professional communicators interviewed. To explore the consequences of this, I contrasted a warm ‘tone of voice’ (open language) to a more corporate and distant ‘tone of voice’ (closed language) – the details of which will be described in the procedure below. Although both these conditions contained the same core information, I anticipated that the different communication styles might cultivate different impressions of the communicator by the recipient. To assess this, I measured perceptions of communicator warmth, morality and competence.

Method

Participants, design and procedure

Eighty-five participants took part in this online pilot study, recruited from within university networks and friends of friends by email invitation. Of the sample 31 were male, 49 female and 5 respondents did not disclose their gender. The mean age of this sample was 32 ($SD = 12.78$).

After following a link to the study, and being provided with some basic information about it, participants were presented with a screenshot from a webpage of a (fictitious) climate research organisation (the Hanley Centre). This webpage provided a description of the organisation and summarised some general climate change information based on their research. To manipulate language, I varied the wording on this webpage screenshot. In the open language condition ($n = 40$), the information was contextualised using inclusive words such as “we”, “our” and “us” (e.g., “We are a world-leading group with expertise researching changes in the earth’s climate”). In the closed language condition ($n = 45$), the same information was expressed using more exclusive and distant words, such as the name of the organisation (e.g., “the Hanley Centre is a world-leading group with expertise researching changes in the earth’s climate”).

After they had read the description of the organisation, participants were asked to give their impression of the organisation by rating how well each of forty-five adjectives described the Hanley Centre (1 = *not at all* to 7 = *extremely*). The list of adjectives included a mixture of traits associated with the three common dimensions of stereotype content (warmth, morality and competence) as well as some additional descriptors considered relevant to the specific organisation and their communication (e.g., capable of emotions, united, biased).

Factor Analysis of the descriptive adjectives revealed an unclear and incoherent pattern of loadings. Accordingly, I restricted the items to those that mapped onto the stereotype content dimensions and re-conducted the Factor Analysis. This revealed three components that together explained 74.05% of the variance. Again, however, the factor loadings were somewhat ambiguous – for example, some competence and morality items loaded together (efficient, trustworthy, knowledgeable, competent, honest, intelligent, moral); and all but one of the reversed-scored items loaded together (dishonest, inept, incompetent, immoral, untrustworthy, amateurish). The warmth-related items, however, did seem to cluster together.

Given the indistinctness of this data reduction, perhaps due to the limited sample size, I decided to be guided by theoretical rather than empirical considerations and guided by previous research (e.g., Wojciszke et al., 1998; Fiske et al, 2002; Leach et al, 2007). Thus I formed three scales, one for each of the stereotype content dimensions: *Competence* (competent, intelligent, knowledgeable, efficient, and reversed scores of incompetent, inept and amateurish, $\alpha = .91$); *morality* (moral, honest, trustworthy, and reverse scores of immoral, dishonest and untrustworthy, $\alpha = .91$); and *warmth/ sociability* (warm, good-natured, friendly and reversed scoring of cold, $\alpha = .87$). The Pilot study can be found in Appendix 3.1.

Results and Discussion

Preliminary analyses revealed that gender was associated with organisational perceptions independent of language condition. Females ($M = 5.65$, $SD = 1.10$) were more likely than males ($M = 5.05$, $SD = 1.19$) to perceive the organisation as moral, $t(77)=-2.30$, $p = .04$, and were more likely than males to see the organisation as warm (Females $M = 4.81$, $SD = 1.22$; Males $M = 4.29$, $SD = 1.14$), $t(77)=-1.94$, $p = .07$. There was no gender difference on perceptions of competence, $t(77)=1.51$, $p = .14$,

(Females: $M = 5.38$, $SD = 1.16$; Males: $M = 4.99$, $SD = 1.05$). Accordingly, I controlled for gender in subsequent analyses.

The main analysis compared the experimental conditions on the stereotypic dimensions of morality, warmth and competence while controlling for gender differences in these. With respect to perceptions of organisational morality, there was a significant effect of language on perceptions of morality, $F(1, 79) = 4.54$, $p = .04$. Open language created a perception of the organisation as more moral ($M = 5.69$, $SD = .84$) than the closed language ($M = 5.18$, $SD = 1.35$). There was also a marginal effect of the manipulation on perceptions of competence, $F(1, 79) = 3.45$, $p = .07$. An open language style also signalled slightly higher competence ($M = 5.47$, $SD = .90$) than the closed language style ($M = 5.02$, $SD = 1.27$). There was no effect of the language manipulation on perceptions of communicator warmth, $F(1, 79) = .66$, $p = .42$.

On the basis of these results I concluded that language peripheral to information can influence audience perceptions of the communicator. Open language tends to convey morality compared to closed language. Open language also, but to a lesser degree, enhances perceptions of communicator competence, comparative to closed language. Neither open nor closed gave impressions to the audience regarding communicator warmth.

Experiment 1

The pilot study established that there are consequences of different forms of communication in generating perceptions of the communicator. The goal of Experiment 1 was to build upon this and examine whether these consequences extended to affect the audience's willingness to engage with and follow the communicator, for example by being influenced in positive ways around the message of climate change. I was also interested in how these variations in language style might interact with other features of the message and the information it contained. Building on Theme Two from the interviews, I was specifically interested in the barrier of uncertainty in climate change information and how this might affect audience responses. Thus, this study was designed to examine the combined effects of communication style and informational uncertainty on audience responses to a climate change message.

Expectations for this study are summarised below:

1. Using an open language style (as expressed by using a warm tone of voice) would cultivate perceptions of communicator morality in comparison to closed language;
2. Higher levels of uncertainty would undermine the effectiveness of climate change communications;
3. An open language style (as expressed by using a warm tone of voice) would buffer audiences against the negative effects of uncertainty by facilitating their engagement with the source and its message.

Method

Participants and design

One hundred and fifty-two psychology undergraduates were recruited during an in-class practical session. This sample consisted of 30 males and 122 females, and the mean age was 20.10 ($SD = 3.92$). Participants were presented with a pen and paper questionnaire to be completed during the class time. This questionnaire contained the experimental manipulations, to which participants were randomly assigned in a 2 (language: open, closed) x 2 (uncertainty: high, low) between-subjects design.

Procedure and measures

Participants were told that the questionnaire was part of a market research exercise for a local scientific organisation seeking feedback about their web-design. As such, the questionnaire contained screen-shots from the organisation's website and questions relating to respondents' impressions of this. Within these screen-shots were the experimental manipulations and the associated questionnaire assessed the key dependent variables. The questionnaire as used in this experimental study can be found in Appendix 3.2.

On the first page of their questionnaire, participants were presented with a screen-shot from the homepage of a (fictitious) climate research organisation (the Linford Centre), which described the organisation and its goals. To manipulate language, the wording on this homepage was varied. Consistent with the Pilot study, the 'open language' condition contextualised information using inclusive words, such as "we", "our" and "us" (e.g., "We are a world-leading group with expertise researching changes in the earth's climate"). The 'closed language' condition instead presented the same information using more exclusive and distant language, such as

the name of the organisation “the Linford Centre”, or “corporate” and “executive” (e.g., “The Linford Centre is a world-leading group with expertise researching changes in the earth’s climate”).

Following this, I asked participants for their impressions of the Linford Centre based on their web-profile. Specifically, participants were presented with a list of twenty-four adjectives and asked to rate how much each adjective was reflected in their impression of the Linford Centre (1 = *not at all* to 7 = *extremely*). This list of adjectives was reduced from the Pilot study, and only included a mixture of traits associated with the stereotypic contents of competence, morality and warmth/ sociability (Wojciszke et al, 1998; Fiske et al, 2002; Leach et al, 2007). Consistent with theoretical expectations, the factor analysis represented this list via three underlying factors that together explained 57.28% of the variance. These factors represented perceived *competence* (powerful, prestigious, influential, confident, corporate, credible, efficient, professional, competent, capable, helpful, serious, proud, incompetence reversed); perceived *warmth/ sociability* (relaxed, casual, friendly, warm), perceived *morality* (moral, honest, sincere, trustworthy, and reversed distant and cold). Composite measures reflecting each of these dimensions were calculated by averaging the respective traits ($\alpha s > .72$). See *Table 3.1* for the list of correlations and alphas.

Following this, participants were presented with a second screenshot from the Linford Centre webpage. This webpage summarised the key findings from their research on climate change and presented a series of future impacts of climate change. This is where the level of uncertainty was manipulated. The intention of separating the language and uncertainty manipulations served to strengthen the effects of each manipulation.

I used a manipulation of uncertainty that had been successfully used in previous research (see Morton, Rabinovich, Marshall, & Bretschneider, 2011). I varied how these impact likelihoods were presented. In the *low uncertainty* condition, each impact statement was accompanied by a single probability rating (e.g., “Based on current rates of CO₂ emissions [there is an] 80% chance that climate change will make a quarter of all species extinct”). In the *high uncertainty* condition, the same information was presented, but a range of probabilities was instead given (e.g., “Based on current rates of CO₂ emissions [there is a] 70-90% chance that climate change will make a quarter of all species extinct”). Importantly, the probabilities presented in the low uncertainty condition were always the mean of the ranges in the high uncertainty condition counterpart. The language manipulation was reinforced within this screenshot by presenting the climate change information using either open and inclusive (“we”), or closed and exclusive language (“the Linford Centre”), consistent with the language condition of that particular survey.

While the scientists in the interview study presented in Chapter 2 broadly speaking did not communicate with the public, there was a sense (at the organisational and individual level) that this is something they wanted to do more of in the future. They were keen to know ways that may facilitate communication of this type of information with non-specialised, public audiences. The type of uncertainty (i.e., probabilistic uncertainty of future impacts) used in the experiments is specific and subtle (rather than ambiguous uncertainty), however this form of uncertainty was referred to during the interviews (Chapter 2) and is often used in climate change projections, e.g., IPCC. The comparisons of low/ high uncertainty is indeed subtle, but climate change information is not void of uncertainty; thus the alternative condition still needs to be uncertain.

Following this second screenshot of the Linford Centre webpage, participants were presented with a series of opinion statements and asked to rate their agreement with each of these statements (1 = *strongly disagree* to 7 = *strongly agree*).

This questionnaire in this instance was interested in the key dependent measures: understanding of, and engagement with, the message; trust in the Linford Centre; belief in climate change; and pro-environmental behavioural intentions. The composite scales and reliability scores are described below.

Engagement with the message. This was assessed with two items: “I found the summary engaging”, and “I tuned out while reading about this organisation’s research (reversed)” ($r = .54, p < .001$).

Perceived understanding of the message. This was measured via two items: “I understand the meaning of the Linford Centre’s research” and “I do not understand what this research is supposed to mean”. After reverse scoring the latter, these two items were averaged to form a single index ($r = .51, p < .001$).

Climate change beliefs and global risk perceptions. Beliefs about the reality of anthropogenic catastrophic global climate change were assessed via three items measuring general climate change beliefs: “In my opinion climate change is happening”; “Climate change is something that I personally believe in”; and “I remain somewhat sceptical about climate change and if it is real” (reversed). A further three items assessed the more specific belief that climate change as an anthropogenic, rather than natural, phenomenon: “In my opinion climate change is man-made”; “Human beings are responsible for climate change” and “Climate change is a natural process rather than something caused by human activity” (reversed). Global risk perceptions were thus: “I believe there is a global risk of the consequences of climate change”; “I

think there will be bad consequences of climate change for the planet”; and “I believe that the global consequences of climate change will be severe” (Cronbach’s $\alpha = .89$).

Personal risk perceptions. Next a series of items assessed participants’ beliefs about the personal risks of climate change: “I feel personally at risk from the consequences of climate change”; “I personally worry about climate change and how it will affect me”; “I do not think that climate change affects my own personal life in any way” (reversed); and “For me, climate change is nothing that I am personally concerned about” (reversed). After appropriate reverse scoring, a measure of perceived personal risk of climate change was created ($\alpha = .87$).

Individual intentions. Finally, a set of questions assessed how willing participants would be to engage in a variety of actions in response to climate change (1 = *not at all willing* to 7 = *very willing*). Specifically, I assessed intentions to engage in a range of pro-environmental household actions: “Reduce my household energy use”; “Recycle (more)”; “Use less water”; and “Reduce, reuse, recycle” ($\alpha = .88$). I also assessed intentions to engage in a various travel-related behaviours: “Walk (more) instead of using the car”; “Cycle (more) instead of using the car”; “Use a car less”; Use public transport (more) instead of the car”; and “Limit unnecessary air travel” ($\alpha = .72$).

I acknowledge the potential for variations in responses to specific climate communications, such as engagement and understanding, perceptions of risks, scepticism, behavioural intentions, acceptance of policy. The focus of outcome variables of interest in this study were in relations to perceptions of the communicator (competence, warmth, morality); the message (engagement, perceived understanding); and individual response (behavioural intentions). These were all variables that seemed of mutual interest to ourselves as researchers as well as the non-

academic CASE partner. In hindsight, measuring other behavioural responses (such as political voting intentions) may have proven to be interesting.

Demographics. Finally, I gathered demographic information, such as gender and age, and provided a space at the end for further comments and a detachable information sheet was provided offering resources for further information about climate change and environmental behaviour. After participants had completed the questionnaire and returned their responses, they were fully debriefed about the experimental manipulations and the purpose of the research.

Table 3.1. Means, SDs, Correlations and Cronbach's for variables in Experiment 1

Variable	Mean	SD	1	2	3	4	5	6	7	8	9
1. Competence	5.09	.87	(.88)								
2. Warmth	3.93	.97	-.10	(.72)							
3. Morality	5.21	.89	.67**	0.10	(.82)						
4. Engagement	4.34	1.29	.38**	.08	.40**	(.86)					
5. Perceived understanding	5.51	1.08	.21*	-.03	.20*	.25**	(.66)				
6. Global belief	5.40	.96	.21*	-.01	.27**	.38**	.09	(.89)			
7. Personal risks	4.05	1.42	.10	.03	.13	.38**	.05	.54**	(.87)		
8. Household intentions	4.83	1.19	.01	-.04	.00	.20*	.13	.24**	.26**	(.73)	
9. Travel intentions	4.17	1.38	-.09	-.05	-.15	.06	.05	.15	.19*	.43**	(.72)

Note: $N = 152$ **. Correlation is significant at the 0.01 level, *. Correlation is significant at the 0.05 level.

Reliabilities (Cronbach's α) are on the diagonal.

Results

Preliminary Checks

The descriptive statistics, correlations and Cronbach's alpha for all variables can be found in *Table 3.1*.

Despite efforts to randomise allocation to conditions, there were significant associations between gender and allocation to the uncertainty, $\chi^2(1) = 5.58, p = .018$, and language conditions, $\chi^2(1) = 3.23, p = .07$. This was particularly the case in the open language and high uncertainty conditions, although there were more females relative to males overall. In addition, preliminary checks on the data suggested associations between gender and age and some of the dependent measures. For example, older participants, $r = -.19, p = .02$, and men, $r = .15, p = .07$, perceived the organisation to be less competent; older participants were more willing to consider changes to their travel behaviour in response to climate change, $r = .17, p = .03$, and females were more likely than males to consider changes to their household behaviour, $r = .16, p = .05$. Given these slight differences in how people oriented to the target organisation and to the issue of climate change based on demographics, and given the non-random distribution based on gender, age and gender were included as covariates in all analyses.

Main analyses

Organisation impressions. First I was interested in the effects of the language manipulation on the impressions participants formed of the organisation as a whole. To explore this, the open and closed language conditions were compared on the three stereotype content dimensions (dependent variables) while controlling for gender and age (covariates).

This revealed a significant effect of language on perceptions of communicator morality, $F(1, 150) = 2.62, p = .044$. When language was open, the source was perceived as significantly more moral ($M = 5.30, SD = .86$) compared to when language was closed ($M = 5.05, SD = .69$). The language manipulation had no effects on perceived competence (which was always high, $M = 5.06$) or perceived warmth (which was neutral, $M = 3.93$, on a 7-point scale), $F(1, 148) = .19, p = .67$ and $F(1, 148) = .56, p = .46$, respectively.

This finding, in combination with the results of the Pilot Study, confirms that open language signals the morality of the communicator to the audience. To explore how these language-based organisational impressions shaped responses to communication, and the role of uncertainty in this, I conducted a series of 2 (language: open, closed) x 2 (uncertainty: low, high) analyses of variance on the remaining dependent variables.

Engagement with the message. The analysis on engagement with the message presented revealed no main effects of language or uncertainty, $F_s < 2.17, p_s > .13$. There was, however, a marginally significant Language x Uncertainty interaction, $F(1, 146) = 2.90, p = .09$, however. A pairwise analysis revealed a significant effect of language in the high uncertainty condition, $F(1, 146) = 5.61, p = .02$. Under conditions of high uncertainty, respondents felt more engaged with the message when communicated using open language ($M = 4.79, SD = 1.36$) than when communicated using closed language ($M = 4.12, SD = 1.03$). Language did not influence message engagement under conditions of low uncertainty, $F(1, 146) = .00, p = .95$. This Language x Uncertainty interaction on message engagement is shown in *Figure 3.1*.

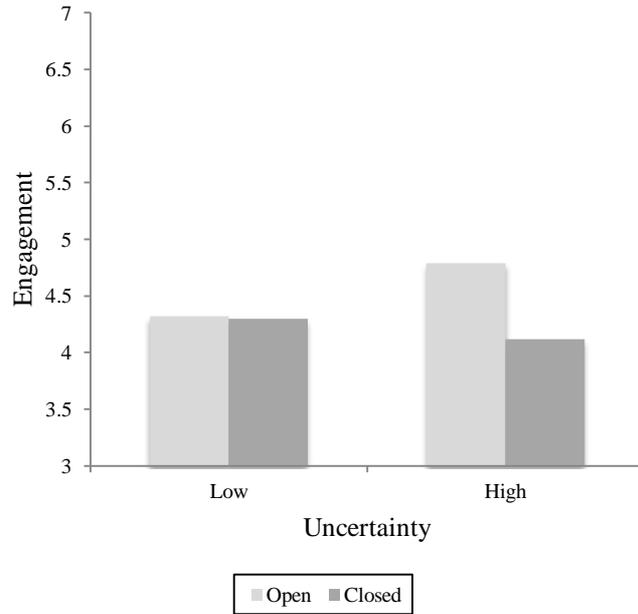


Figure 3.1. Two-way interaction of language and uncertainty on level of engagement with presented climate change science

Understanding of the message. The analysis of self-reported understanding showed no main effect of language, $F(1, 146) = 0.1, p = .92$, or uncertainty, $F(1, 146) = 1.20, p = .27$, and no interaction between these variables, $F(1, 146) = .85, p = .36$.

Global climate change belief. Next I explored the effects of the manipulations on participants' beliefs about global climate change. The analysis revealed a marginal main effect of the uncertainty manipulation, $F(1, 146) = 3.56, p = .061$. Participants were less inclined to believe that global climate change was happening when uncertainty was high ($M = 5.27, SD = 1.01$) compared to when uncertainty was low ($M = 5.64, SD = .88$). There was no main effect of language, $F(1, 146) = .290, p = .591$, or interactive effects, $F(1, 146) = 1.95, p = .165$, on this variable.

Personal risk perceptions. With respect to perceptions of personal risk, there was a marginal main effect of language, $F(1, 146) = 3.05, p = .083$. Participants exposed to open language perceived more personal risk ($M = 4.28, SD = 1.50$) than those exposed to closed language ($M = 3.83, SD = 1.32$). There was no effect of

uncertainty, $F(1, 146) = 1.95, p = .165$, and no interaction effects, $F(1, 146) = 2.67, p = .134$.

Behavioural intentions. Finally, I explored the effects of the manipulations on individual intentions to engage in pro-environmental behaviours. In the analysis of pro-environmental household behaviour, after controlling for gender, $F(1, 146) = 5.02, p = .027$, and age, $F(1, 146) = 2.25, p = .136$, revealed no main effects of language, $F(1, 146) = .23, p = .629$, or uncertainty, $F(1, 146) = .04, p = .840$. There was, however, a significant interaction between language and uncertainty, $F(1, 146) = 4.47, p = .021$. This interaction is displayed in *Figure 3.2*, below.

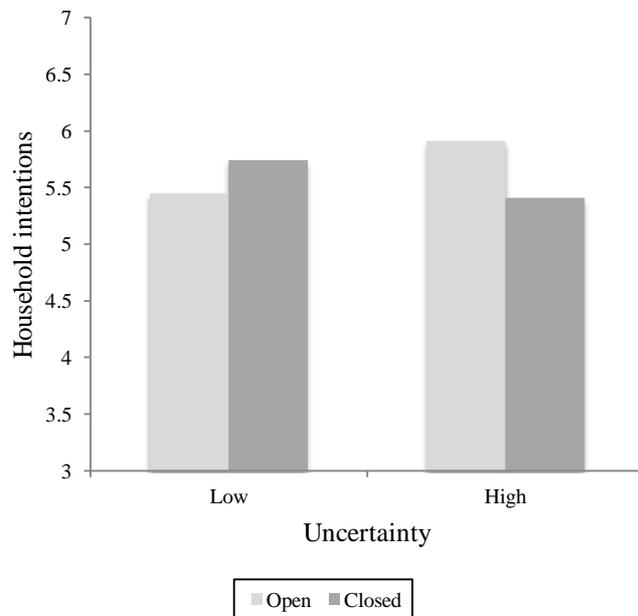


Figure 3.2. Two-way interaction of language and uncertainty on pro-environmental household intentions

Pairwise comparisons revealed that there was a significant effect of language under conditions of high uncertainty, $F(1, 148) = 4.47, p = .036$. When uncertainty was high, pro-environmental household intentions were greater for people exposed to open language ($M = 5.91, SD = 1.14$) compared to those exposed to the closed

language ($M = 5.41$, $SD = .94$). Under conditions of low uncertainty, language did not influence environmental household intentions, $F(1, 148) = 1.00$, $p = .319$.

Looked at differently, there was also a marginal effect of uncertainty in the open language condition, $F(1, 148) = 2.96$, $p = .087$. When exposed to open language, participants' intentions to engage in pro-environmental household behaviours were stronger under situations of high uncertainty ($M = 5.91$, $SD = 1.14$) compared to low uncertainty ($M = 5.46$, $SD = 1.10$). There was no effect of uncertainty in the closed language condition, $F(1, 148) = 1.85$, $p = .18$.

In the analysis of pro-environmental travel intentions, after controlling for gender, $F(1, 146) = .32$, $p = .570$, and age, $F(1, 146) = 3.84$, $p = .052$, there were no significant main effects of language, $F(1, 146) = .04$, $p = .846$, or uncertainty, $F(1, 146) = .28$, $p = .601$, and no interaction between these, $F(1, 146) = .22$, $p = .641$.

Discussion

The results of this study show that uncertainty is a barrier to communicating climate science information: higher levels of uncertainty resulted in lower levels of belief in climate change. However, my results also show that the negative effects of uncertainty are not inevitable and that it is possible to maintain audience engagement even under higher levels of uncertainty. To do this, however, it is important to attend to the style of communication and what this signals about the communicator themselves. Indeed, previous work has shown that polite and formal language creates perceptions of distance (Brown & Levinson, 1987), thus adversely affecting levels of trust in the source of the communication. These two experiments show that adopting open language (e.g., by using words such as 'we' rather than more distant closed language) can foster perceptions of communicator morality (Pilot and Experiment 1), perceptions that seem to have positive consequences for the communication process,

especially when there are other factors that might interfere with effective communication – namely, the presence of uncertainty.

In Experiment 1, when uncertainty was high, adopting open (versus closed) language resulted in stronger engagement with the message and stronger household intentions to act in line with it. When uncertainty was low, language used to communicate the information was less important for audience engagement and (intended) action. This suggests that relational processes between the communicator and recipients can shape how audiences respond to informational content of climate change messages, especially under conditions of high uncertainty. More specifically, it appears that relational aspects of communication (such as language style) can buffer people against the negative effects of (high) uncertainty in the information being presented i.e., respondents were more willing to follow communicator lead especially when uncertainty is high when open language is used.

To explain this “buffering effect” of open communication in high uncertainty, it may be useful to consider what exactly an open communication style conveys to the audience. In both the Pilot Study and this experiment, an open communication style was consistently associated with enhanced perceptions of communicator morality.

This signalling of communicator morality may increase trust from the audience and a willingness to follow the communicators lead, even when understanding may be low, for example under conditions of high uncertainty. Indeed, other research within the persuasion literature would suggest that particularly when motivation or ability to process messages is low, people rely on cues peripheral to the information when deciding how to respond, such as “experts are trusted” (Petty & Cacioppo, 1986; Chaiken, 1980). Language and associated perceptions of morality may be such a cue.

Although there are many other cues that may accompany a message and aid communication in challenging situations (e.g., when motivation is low), communicator morality may be especially important. When there is risk involved in communications, and climate science is a form of risk communication, perceived communicator morality is likely to be important (Blendon, Benson, Desroches, & Weldon, 2003; Siegrist & Cvetkovich 2000). Signals of morality through language-use, are therefore important in cultivating a communications relationship involving trust. Once trust is established, individuals are more likely to follow instructions given by someone they trust (Shore, 2003).

Practical implications. The findings from this experiment, and its associated Pilot Study could have important practical implications. For example, the IPCC (Intergovernmental Panel on Climate Change) is a scientific body under the auspices of the United Nations with the mission to provide “a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts” (IPCC, 2013). They report their consensus findings to the scientific communities as well as producing a document aimed at non-scientist audiences (namely policymakers), the aims of which are to present the key findings and uncertainties within climate change research to date. Research carried out by Fløttum and Dahl (2011) examined the linguistic and discursive features of the IPCC Summary for Policy makers. Interestingly, their research found that the report was dominated by impersonal language and contained no explicit use of “we”. Fløttum and Dahl suggest that such impersonal language may be a means to claiming neutrality of and areas of differing views between the author(s). The use of the passive voice is also likely to be a rhetorical product of traditional science convention (Billig, 2011; Halliday, 2004; Halliday & Martin, 1993).

The present findings would suggest, however, that such impersonal language may have unintended effects on other dimensions by which an organisation is perceived, and that this may have consequences for the effectiveness of their communications with the public. Specifically, using language that creates a feeling of distance may become a barrier in itself and hinder audience engagement. Thus, when communicating to an audience outside the scientific field of interest, it is important to recognise that the default science communication (“deficit model”) may not be effective in a non-science setting. Moreover, the information exchange between a science to non-science audience does not simply reflect the communicator’s own goals, but also to the relationship they are building with their intended audience. Interestingly, this tension parallels some of the differences between professional communicators and scientists interviewed in the previous chapter. On this basis, the role of communication processes in such important scientific material is undoubtedly an important focus for future research.

Limitations. As with all empirical studies, although the results are interesting and inline with expectations, they are not without their limitations. Clearly, it would be important to replicate these results to demonstrate robustness to the findings and methods devised; particularly given this is a sample consisting of first year undergraduate psychology students. This led to Experiment 2 below. The issue of sample selection aside, it seems that understanding communication processes, and how these shape audience motivations, is key to managing uncertainty when delivering messages about climate change. One way to overcome the barrier of uncertainty when communicating with non-scientists is to consider the language peripheral to the message content, and what this signals to audiences about the communicator.

Experiment 2

The primary aim of Experiment 2 was to replicate the previous design to give robustness to Experiment 1's findings. In so doing, I also considered why the effect of language is particularly relevant under conditions of high uncertainty. I suggested that in situations where uncertainty is high, individuals are particularly likely to evaluate communicators and rely on their perceptions of the trustworthiness of the message source. When uncertainty is low, the message is clearer and perceptions of the source may be less important. This reasoning suggests that perceptions of communicator morality might mediate positive effects, especially under conditions of high uncertainty. However, I was unable to test this in my previous study since morality perceptions were assessed before the uncertainty manipulation and might have been affected by it. Accordingly, in Experiment 2, I presented the manipulations together and measured organisational impressions after both manipulations have been administered.

Method

Participants and design

One hundred and sixty-two students were recruited around the campus of the University of Exeter, located in the South West of England. The sample consisted of 73 males and 85 females (four participants did not specify their gender) aged between eighteen and fifty years (mean age = 21.76; $SD = 4.34$). All questionnaires were administered by pen and paper, with all participants completing their survey on the spot, taking them about 15 minutes. As with Experiment 1, respondents were randomly assigned to one of the four conditions of a 2 (language: open, closed) x 2 (uncertainty: low, high) between-subjects design.

Procedure and measures

Participants were presented with a questionnaire that contained a screenshot from a fictitious science organisation's (the Linford Centre) website and questions relating to respondents' impressions of this – the same way as in Experiment 1. Within these screenshots the experimental manipulations of language and uncertainty were administered. The main difference between Experiments 1 and 2 was that the language and uncertainty manipulations were presented on the same page in this study, and participants' impressions of the organisation were measured after the presentation of both manipulations together. The questionnaire as used in this experimental study can be found in Appendix 3.3. After completing the questionnaire participants were thanked and debriefed.

As in the previous study, these organisational impressions included items that tapped into each of the stereotype content dimensions of morality, competence and warmth. As previously I created composite measures of each dimension: *competence* (competent, professional, efficient, capable, incompetence reversed); perceived *warmth/ sociability* (warm, friendly, cold reversed), perceived *morality* (moral, sincere, honest, trustworthy, immoral reversed) (all Cronbach's α s > .72).

Consistent with the previous study, I also measured engagement with the message, beliefs about climate change and the perception of associated risks, and the individual's intentions to engage in a range of climate relevant behaviours as the primary dependent measures. Likert scales were used to record their agreement with each of the statements (1 = *strongly disagree* to 7 = *strongly agree*).

Engagement with the message was measured with two items: "I found the summary engaging"; and "I tuned out while reading about this organisation's research" reversed, ($r = .29, p < .001$). These inter-correlation items are lower than

seen in Experiment 1 suggesting that the relationship between the correlation items are weaker among this sample. This could perhaps be due to different environmental conditions in which the information was read. Experiment 1 was conducted in-class where conditions were quiet with minimal distractions. Experiment 2 was conducted away from the class around campus where conditions were noisy and potentially more distracting for participants. This may have had an effect on engagement levels whilst completing the survey.

Perceived understanding. This was measured with two items. “I understand the meaning of the Linford Centre's research” and “I do not understand what this research is supposed to mean” reversed, ($r = .57, p < .001$).

Linford Centre trust. Trust of the organisation was measured with two items. “Based on what I have read, I would find it hard to trust the Linford Centre as a source of information about climate change (reversed)” and “Based on their research, the Linford Centre seems to be a trustworthy source of information about climate change” ($r = .67, p < .001$).

Global climate change belief and personal risk perception. As with Experiment 1, I assessed belief that climate change is happening⁷, that it is caused by human actions⁸, that it represents a significant global risk⁹ and the degree to which the individual personally felt a sense of risk associated with this¹⁰. Again, I considered whether these various items represented distinct domains of belief versus a single underlying dimension. A Factor Analysis revealed two main underlying components

⁷ Items: “In my opinion climate change is happening”, “Climate change is something that I personally believe in” and “I remain somewhat sceptical about climate change and if it is real” reversed.

⁸ Items: “In my opinion climate change is man-made”, “Human beings are responsible for climate change” and “Climate change is a natural process rather than something caused by human activity” reversed.

⁹ Items: “I believe there is global risk of the consequences of climate change”, “I think there will be bad consequences of climate change for the planet” and “I believe that the global consequences of climate change will be severe”.

¹⁰ Items: “I feel personally at risk from the consequences of climate change”, “I personally worry about climate change and how it will affect me”, and “For me, climate change is nothing that I am personally concerned about” reversed.

which emerged from the complete set of items. Global climate change belief items account for 53.72% of the variance; this composite measure achieved reliability score of Cronbach's $\alpha = .92$. Personal risk perception items accounted for 9.43%, with the composite measure achieving a Cronbach's reliability of $\alpha = .74$.

Behavioural intentions. A set of questions assessed how willing participants would be to engage in a variety of actions in response to climate change (1 = *not at all willing* to 7 = *very willing*). Specifically, as before, I created two behavioural intentions measures, household behaviour¹¹ ($\alpha = .88$) and travel behaviour¹² ($\alpha = .81$).

Demographics. Finally, I gathered demographic information such as gender and age, and provided a space at the end for further comments.

¹¹ Items: "Reduce my household energy use", "Recycle (more)", "Use less water", and "Reduce, reuse, recycle"

¹² Items: "Walk (more) instead of using the car", "Cycle (more) instead of using the car", "Use a car less", Use public transport (more) instead of the car", and "Limit unnecessary air travel".

Table 3.2. Means, SDs, Correlations and Cronbach's alpha for variables in Experiment 2

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Competence	5.11	.88	(.81)									
2. Warmth	3.99	.84	.16*	(.69)								
3. Morality	5.04	.86	.70**	.29**	(.79)							
4. Engagement	4.17	1.20	.32**	.27**	.29**	(.45)						
5. Perceived understanding	5.14	1.28	.32**	.19*	.28**	.26**	(.72)					
6. Trust	4.60	1.24	.70**	.24**	.63**	.36**	.33**	(.80)				
7. Global belief	5.22	1.10	.25**	.00	.34**	.22**	.24**	.31**	(.89)			
8. Personal risks	3.79	1.21	.06	-.04	.10	.20*	.02	.22**	.60**	(.74)		
9. Household intentions	4.90	1.29	.07	.06	.18*	.16*	.06	.07	.45**	.36**	(.83)	
10. Travel intentions	4.46	1.47	.02	.07	.12	.07	-.01	.00	.42**	.37**	.72**	(.81)

Note: $N = 162$ **. Correlation is significant at the 0.01 level, *. Correlation is significant at the 0.05 level. Reliabilities (Cronbach's α) are on the diagonal.

Results

The descriptive statistics, correlations and Cronbach's alpha for the variables in Experiment 2 can be found in *Table 3.2*.

Preliminary analysis

As in the previous experiment, there were some demographic effects on the dependent variables. For example, when looking at the stereotypic traits, males ($M = 4.93$, $SD = .98$) perceived the organisation as less competent than females ($M = 5.23$, $SD = .86$), $t(156) = -2.06$, $p = .041$. Males ($M = 4.90$, $SD = .98$) were also slightly less likely to see the organisation as trustworthy than females ($M = 5.14$, $SD = .83$), $t(156) = -1.70$, $p = .091$. There were no gender differences in perceptions of the organisation's warmth between males ($M = 3.98$, $SD = .816$) and females ($M = 3.98$, $SD = .88$), $t(156) = .04$, $p = .966$. Females ($M = 5.26$, $SD = 1.15$) were more likely than males ($M = 4.46$, $SD = 1.30$) to consider changes in their household behaviours, $t(155) = -4.12$, $p < .001$. Similarly, older people were more willing to change their household ($r = .21$, $p = .007$) and travel behaviour ($r = .18$, $p = .021$) in response to climate change.

Given these demographic differences, age and gender were included as covariates in all analyses. Further to this, I carried out checks for outliers on key variables (such as morality) in key conditions (open language). One particular respondent was an extreme outlier on the variables, in responding value 1 on most variables (even on reversed scored items), giving the impression that little thought went into their answer. They were therefore excluded from the analysis.

Organisation impressions. First, I checked whether the language manipulation successfully influenced audience impressions of the organisation's morality, as found in the Experiment 1 and the Pilot Study. However, a 2 (language: open, closed) x 2

(uncertainty: low, high) analysis of variance controlling for age and gender revealed that perceptions of morality were not higher in the open communication language ($M = 4.89$, $SD = 1.02$) than the closed language condition ($M = 5.16$, $SD = .76$), $F(1, 151) = 2.32$, $p = .130$. Given the language and uncertainty manipulations were presented together, and then followed by the trait ratings, I also checked for effects involving uncertainty. However there was also no significant main effect of uncertainty or interactions between language x uncertainty, $F_s < 2.87$, $p_s > .093$. The language manipulation also had no effect on perceived competence (which was always high, $M = 5.09$, on a 7-point scale), $F(1, 151) = .15$, $p = .697$, and there was no main effect of uncertainty or any interaction, $F_s < 1.24$, $p_s > .267$. Perceptions of warmth also revealed no main or interactive effects of the variables, $F_s < .56$, $p_s > .457$.

Thus, contrary to the previous Pilot Study and Experiment 1, the language manipulation did not elicit an impression of the organisation in the present study. This somewhat complicates the interpretation of this experiment, an issue I return to later in the supplementary analyses reported below.

Outcome variables. Although the above results for organisational perceptions suggest that the manipulation of language failed, I nonetheless examined the effects of the manipulations on the dependent measures. A 2 (language: open, closed) x 2 (uncertainty: low, high) analysis of variance on message engagement after controlling for gender, $F(1, 152) = .12$, $p = .730$, and age, $F(1, 152) = .99$, $p = .322$, revealed that no main effects of language, $F(1, 152) = 0.56$, $p = .457$, or uncertainty, $F(1, 152) = .28$, $p = .596$, and no interaction between these variables on message engagement, $F(1, 152) = .60$, $p = .441$. The same analyses performed on the remaining outcome variables – understanding, trust, global belief, personal risks, and household and

travel behaviour intentions – also revealed no main or interactive effects of the manipulations on any of these variables, $F_s < 1.96$, $p_s > .165$.

Supplementary analysis

As noted above, and contrary to expectations, the language manipulation did not prompt a more moral impression of the organisation in the present study. Although I do not know why the manipulation failed to produce the expected results in this study, the absence of effects on perceived morality may explain the absence of further effects across the dependent measures. To explore whether the null findings were indeed due to the manipulations or whether the underlying hypothesis was, in fact, incorrect, I repeated the above analyses substituting the measured organisational perceptions (moral and competent) for the language manipulations and exploring the effects of these independently and in interaction with the manipulation of uncertainty. Both stereotype dimensions were retained in this analysis given their overlap – because of this overlap, it was considered important to examine the effects of morality independent of competence and vice versa. The following analyses contains a series of three-step regressions; using all dependent variables available, the three steps in which the independent variables were entered into the model as follows: Step 1, Gender and age; Step 2, centred perceived competence, centred perceived morality and manipulated uncertainty (dummy coded); Step 3, the morality x uncertainty and competence x uncertainty interactions were added. This analysis allowed control for each dimension variable, morality and competence (Step 2); and also their unique interactions with uncertainty (Step 3).

Engagement with the message. The overall model was significant ($F = 2.94$ (1,

149), $p = .007$). This was driven by a marginally significant effect of perceptions of communicator competence ($\beta = .21, p = .063$). As shown in *Table 3.3*, there is no significant contribution of perceived morality ($\beta = .17, p = .138$) and manipulated uncertainty ($\beta = -.00, p = .980$) to this model; nor is there a significant interaction between perceived morality and manipulated uncertainty ($\beta = -.03, p = .772$) or the interaction between perceived competence and manipulated uncertainty ($\beta = .03, p = .781$). Engagement with the message is, to some extent, shaped by audience perceptions of communicator competence.

Table 3.3. Regression analysis predicting message engagement

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	4.52	.57		7.90	.000
Gender	.06	.19	.02	.30	.768
Age	-.02	.02	-.07	-.91	.366
2. (Constant)	4.67	.55		8.55	.000
Gender	-.06	.19	-.02	-.32	.753
Age	-.02	.02	-.07	-.91	.365
Perceived Competence	.28	.15	.20	1.88	.062
Perceived Morality	.24	.16	.17	1.52	.130
Manipulated Uncertainty	-.01	.19	-.00	-.03	.975
3. (Constant)	4.68	.55		8.50	.000
Gender	-.06	.19	-.02	-.30	.767
Age	-.02	.02	-.07	-.93	.356
Perceived Competence	.28	.15	.21	1.88	.063
Perceived Morality	.24	.16	.17	1.49	.138
Manipulated Uncertainty	-.01	.19	-.00	-.03	.980
Morality x Uncertainty Interaction	-.09	.32	-.03	-.29	.772
Competence x Uncertainty Interaction	.08	.30	.03	.28	.781

Note:

¹ $R = .08, \text{adj } R^2 = .01; F(2, 154) = .45, p = .637.$

² $R = .35, \text{adj } R^2 = .10; F(5, 151) = 4.15, p = .001.$

³ $R = .35, \text{adj } R^2 = .08; F(7, 149) = 2.94, p = .007.$

Perceived understanding of the message. The overall model was significant ($F = 2.71 (1, 149), p = .011$). This was driven by a significant main effect of perceived

competence ($\beta = .28, p = .014$). There are no further main or interactive effects of any further variables, $\beta s < .07, ps > .508$. Suggesting that, as with message engagement, perceived understanding of the message was largely influenced by how competent the communicator was viewed by the audience. The results are shown in *Table 3.4*, below.

Table 3.4. Regression analysis predicting perceived message understanding

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	4.80	.61		7.87	.000
Gender	.12	.21	.05	.60	.550
Age	.01	.02	.02	.28	.782
2. (Constant)	2.47	.85		2.91	.000
Gender	.00	.20	.00	-.01	.996
Age	.01	.02	.04	.45	.651
Perceived Competence	.39	.16	.27	2.45	.015
Perceived Morality	.13	.17	.09	.78	.437
Manipulated Uncertainty	-.13	.20	-.05	-.64	.526
3. (Constant)	2.50	.86		2.92	.000
Gender	-.02	.21	-.01	-.12	.908
Age	.01	.02	.04	.52	.606
Perceived Competence	.40	.16	.28	2.48	.014
Perceived Morality	.11	.17	.07	.66	.508
Manipulated Uncertainty	-.13	.20	-.05	-.62	.536
Morality x Uncertainty Interaction	.06	.34	.02	.19	.853
Competence x Uncertainty Interaction	.09	.32	.03	.28	.778

Note:

¹ $R = .53, \text{adj } R^2 = .01; F(2, 154) = .22, p = .803.$

² $R = .33, \text{adj } R^2 = .08; F(5, 151) = 3.76, p = .003.$

³ $R = .34, \text{adj } R^2 = .07; F(7, 149) = 2.71, p = .011.$

Linford Centre trust. The overall model was significant, $F = 25.36 (1, 149), p < .001$, something that was driven by the variables entered at Step 2 which has the greatest, $F = 35.60 (1, 149), p < .001$. The results are shown in *Table 3.5*. At Step 2, trust was predicted by perceived competence ($\beta = .49, p < .001$) and perceived morality ($\beta = .30, p < .001$). There was no significant main effect of manipulated

uncertainty ($\beta = -.09, p = .126$). At Step 3 of the model, there were no significant interactions of perceived morality x manipulated uncertainty ($\beta = .03, p = .694$) or perceived competence x manipulated uncertainty ($\beta = .03, p = .744$).

Table 3.5. Regression analysis predicting Linford Centre trust

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	4.41	0.59		7.52	.000
Gender	.34	0.20	.14	1.70	.092
Age	-.02	0.02	-.05	-.68	.499
2. (Constant)	-.74	.59		-1.25	.215
Gender	.08	.14	.03	.55	.587
Age	-.01	.02	-.04	-.63	.528
Perceived Competence	.69	.11	.49	6.20	.000
Perceived Morality	.45	.12	.30	3.86	.000
Manipulated Uncertainty	-.21	.14	-.09	-1.54	.126
3. (Constant)	-.71	.60		-1.18	.238
Gender	.05	.14	.02	.36	.720
Age	-.01	.02	-.03	-.50	.620
Perceived Competence	.70	.11	.50	6.21	.000
Perceived Morality	.43	.12	.29	3.64	.000
Manipulated Uncertainty	-.21	.14	-.09	-1.51	.133
Morality x Uncertainty Interaction	.09	.24	.03	.40	.694
Competence x Uncertainty Interaction	.07	.22	.03	.33	.744

Note:

¹ $R = .15, \text{adj } R^2 = .01; F(2, 154) = 1.66, p = .194.$

² $R = .74, \text{adj } R^2 = .53 F(5, 151) = 35.60, p < .001.$

³ $R = .74, \text{adj } R^2 = .52; F(7, 149) = 25.36, p < .001.$

Global belief. The overall model was significant, $F = 3.84 (7, 149), p = .001.$

This was driven by a significant main effect of perceived morality ($\beta = .34, p = .003$) and gender ($\beta = .17, p < .033$). There are no further main or interactive effects of any further variables, $\beta s < -1.20, p s > .233$. The results are shown in *Table 3.6*.

Table 3.6. Regression analysis predicting global belief

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	4.40	.51		8.60	.000
Gender	.44	.17	.20	2.53	.012
Age	.01	.02	.03	.31	.756
2. (Constant)	2.62	.71		3.70	.000
Gender	.35	.17	.16	2.12	.035
Age	.01	.02	.03	.34	.733
Perceived Competence	.01	.13	.01	.09	.928
Perceived Morality	.42	.14	.33	3.05	.003
Manipulated Uncertainty	-.20	.17	-.09	-1.20	.231
3. (Constant)	2.62	.72		3.67	.000
Gender	.37	.17	.17	2.15	.033
Age	.01	.02	.03	.33	.743
Perceived Competence	.00	.14	.00	-.01	.989
Perceived Morality	.43	.14	.34	3.07	.003
Manipulated Uncertainty	-.20	.17	-.09	-1.20	.233
Morality x Uncertainty Interaction	.08	.29	.03	.27	.785
Competence x Uncertainty Interaction	-.17	.27	-.07	-.63	.528

Note:

¹R = .20, adj R² = .03; F(2, 154) = 3.25, p = .041.

²R = .39, adj R² = .12; F(5, 151) = 5.34, p = .000.

³R = .39, adj R² = .11; F(7, 149) = 3.84, p = .001.

Personal risk. The overall model was not significant, $F = 1.67 (7, 149), p = .121$. Though there was a significant main effect of gender ($\beta = .20, p = .014$). There are no further main or interactive effects of any further variables, $\beta_s < .94, p_s > .350$.

The results are shown in Table 3.7.

Table 3.7. Regression analysis predicting personal risk

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	2.79	.56		4.97	.000
Gender	.55	.19	.23	2.90	.004
Age	.01	.02	.03	.34	.736
2. (Constant)	2.47	.82		3.01	.003
Gender	.54	.19	.22	2.79	.006
Age	.01	.02	.03	.31	.758
Perceived Competence	-.09	.15	-.07	-.59	.553
Perceived Morality	.19	.16	.13	1.17	.243
Manipulated Uncertainty	-.09	.19	-.04	-.48	.636
3. (Constant)	2.53	.82		3.07	.003
Gender	.49	.20	.20	2.49	.014
Age	.01	.02	.04	.46	.648
Perceived Competence	-.07	.16	-.05	-.43	.671
Perceived Morality	.15	.16	.11	.94	.350
Manipulated Uncertainty	-.09	.19	-.04	-.45	.654
Morality x Uncertainty Interaction	.13	.33	.04	.39	.700
Competence x Uncertainty Interaction	.19	.31	.07	.62	.536

Note:

¹ $R = .23$, adj $R^2 = .04$; $F(2, 154) = 4.26$, $p = .016$.

² $R = .25$, adj $R^2 = .03$; $F(5, 151) = 2.01$, $p = .081$.

³ $R = .27$, adj $R^2 = .03$; $F(7, 149) = 1.67$, $p = .121$.

Behavioural intentions. The model predicting household behavioural intentions was significant, $F = 5.34 (7, 148)$, $p = .001$, accounting for 17% of the variance in intentions, see Table 3.8. In the final model, the only significant predictor, aside from the covariates, was perceived morality, $\beta = .23$, $p = .031$. The demographic variables of gender ($\beta = .32$, $p < .001$) and age ($\beta = .24$, $p = .002$) Participants who perceived the organisation to be more moral were more inclined to report willingness to engage in pro-environmental household intentions. No other effects were significant, β s $< .15$, $ps > .150$.

Table 3.8. Regression analysis predicting household behavioural intentions

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	2.02	.58		3.46	.001
Gender	.85	.19	.33	4.50	.000
Age	.07	.02	.23	3.14	.002
2. (Constant)	2.10	.58		3.61	.000
Gender	.83	.19	.33	4.39	.000
Age	.07	.02	.22	3.03	.003
Perceived Competence	-.19	.15	-.13	-1.25	.212
Perceived Morality	.35	.16	.23	2.21	.028
Manipulated Uncertainty	-.00	.19	.00	-.01	.996
3. (Constant)	2.05	.58		3.53	.001
Gender	.82	.19	.32	4.27	.000
Age	.07	.02	.24	3.15	.002
Perceived Competence	-.21	.15	-.15	-1.39	.167
Perceived Morality	.35	.16	.23	2.18	.031
Manipulated Uncertainty	-.01	.19	-.00	-.03	.977
Morality x Uncertainty Interaction	.47	.32	.15	1.45	.150
Competence x Uncertainty Interaction	-.42	.30	-.15	-1.39	.166

Note:

¹ $R = .40$, adj $R^2 = .15$. $F(2, 153) = 14.87$, $p < .001$.

² $R = .44$, adj $R^2 = .16$. $F(5, 150) = 7.06$, $p < .001$.

³ $R = .45$, adj $R^2 = .17$. $F(7, 148) = 5.40$, $p < .001$.

The same analysis performed on travel intentions (summarised in Table 3.9, below), was also significant, $F = 2.66$ (7, 148), $p = .013$). Although there were no main effects of perceived morality ($\beta = .19$, $p = .096$) and manipulated uncertainty ($\beta = .03$, $p = .752$), at the final Step of the model, there was a significant interaction between Perceived Morality x Manipulated Uncertainty ($\beta = .29$, $p = .011$). There was also a significant interaction between Perceived Competence x Manipulated Uncertainty ($\beta = -.24$, $p = .031$).

Table 3.9. Regression analysis predicting travel intentions

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	2.43	.71		3.41	.001
Gender	.35	.23	.12	1.53	.129
Age	.07	.03	.19	2.453	.015
2. (Constant)	2.47	.72		3.46	.001
Gender	.34	.23	.12	1.48	.142
Age	.07	.03	.19	2.38	.019
Perceived Competence	-.22	.19	-.13	-1.18	.238
Perceived Morality	.34	.19	.20	1.75	.082
Manipulated Uncertainty	.08	.23	.03	.36	.718
3. (Constant)	2.38	.70		3.37	.001
Gender	.31	.23	.11	1.31	.191
Age	.08	.03	.21	2.69	.008
Perceived Competence	-.26	.18	-.16	-1.39	.166
Perceived Morality	.32	.19	.19	1.68	.096
Manipulated Uncertainty	.07	.23	.03	.32	.752
Morality x Uncertainty Interaction	-1.00	.39	-.29	-2.57	.011
Competence x Uncertainty Interaction	-.79	.37	-.24	-2.17	.031

Note:

¹R = .23, adj R² = .04. F(2,153) = 4.12, p = .018)

²R = .27, adj R² = .04. F(2, 150) = 2.27, p = .050)

³R = .34, adj R² = .07. F(7, 148) = 2.66, p = .013)

The significant interactions were decomposed by simple slope analysis (Aiken & West, 1991). The Perceived Morality x Manipulated Uncertainty interaction was driven by a significant effect of perceived morality under conditions of high uncertainty, $t = 2.26$, $p = .025$, but not low uncertainty, $t = .33$, $p = .740$. As graphed in Figure 3.3, travel intentions increase with increased perceptions of morality, this effect being amplified under high uncertainty. This pattern is consistent with what was observed experimentally in the previous study: under conditions of uncertainty, perceptions of morality guide audience responses.

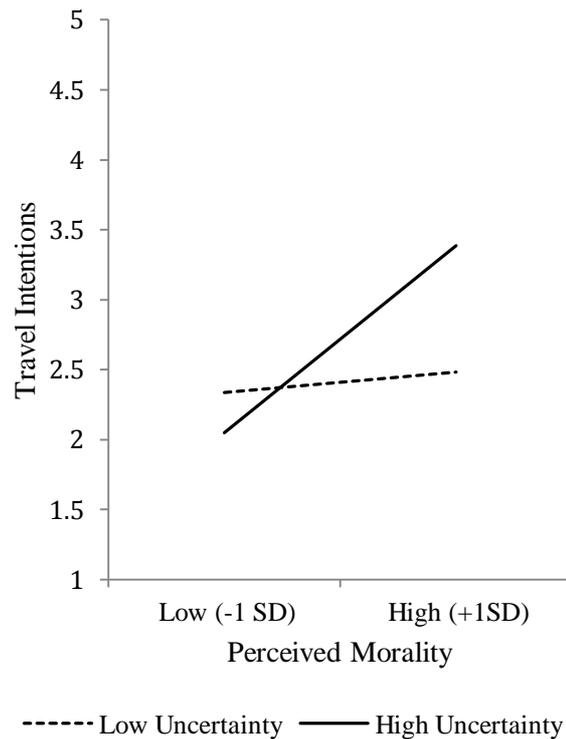


Figure 3.3. Regression interaction for travel intentions between perceived morality and manipulated uncertainty, as indicated by manipulated high and low uncertainty subgroups

The interactive effect involving competence and uncertainty was also driven by a marginal effect of perceived competence under conditions of high uncertainty, $t = 1.81, p = .072$, but not low uncertainty, $t = -.75, p = .453$. However, as the plotted graph below, Figure 3.4, shows, pro-environmental travel intentions decreased with higher levels of perceived communicator competence. This negative effect on travel behaviour intentions is slightly stronger under conditions of high uncertainty compared to lower uncertainty.

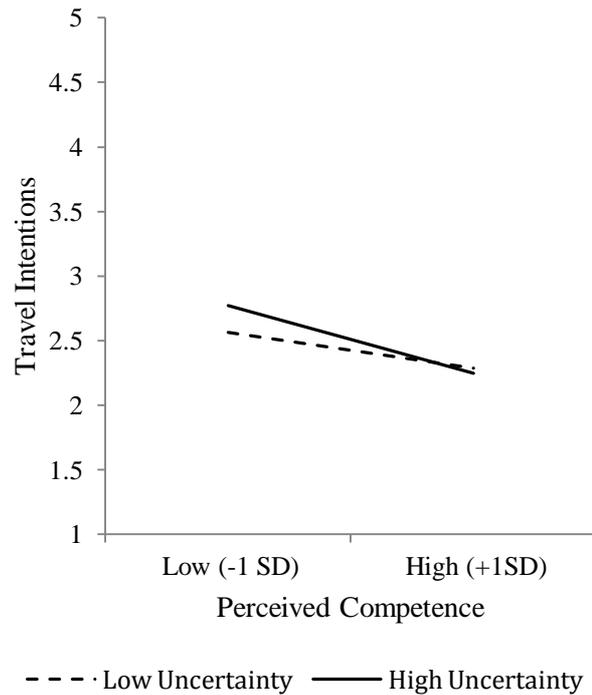


Figure 3.4. Regression interaction for travel intentions between perceptions of communicator competence and uncertainty, as indicated by manipulated high and low uncertainty subgroups

Summary of supplementary analysis. When concerning perceptions of organisational trust, I found that perceived morality and perceived competence influenced trust in the organisation. Perceived morality also predicted household intentions. Engagement with and perceived understanding of the message was largely influenced by how competent the communicator is viewed by the audience. When I considered travel intentions, perceived morality interacted with the level of uncertainty: when perceived morality was low, whether uncertainty was low or high, perceived morality does not differ the predictive power of on travel intentions. When perceived morality was high, however, the predictive power was stronger under manipulated high uncertainty comparative to manipulated low uncertainty. The results also showed an interaction between perceived competence and manipulated uncertainty on travel intentions: with perceptions of high competence resulting in

similar predictive powers regardless of uncertainty condition. When perceived competence was low and manipulated uncertainty was high, however, the predictive power on travel intentions increased.

Discussion

Although the aim of this study was to replicate and extend the previous findings, the key manipulation of communication style appears to have failed. In contrast to both the Pilot Study and Experiment 1, there was no effect of an open communication style in enhancing perceptions of communicator morality. Since the reasoning is based on this effect, it is difficult to interpret any results of this experiment, especially those that involve the language manipulation. As the results showed, however, there were no effects of this manipulation on the dependent measures, either alone or in interaction with uncertainty. Despite this, supplementary analyses in which measured organisational perceptions were substituted for the language manipulation did reveal interesting patterns that were mostly consistent with Experiment 1 and expectations. Namely, in these supplementary analyses morality predicted trust in the organisation (alongside perceptions of competence) and there was an interaction between perceived morality and uncertainty on travel intentions: under conditions of high uncertainty, morality (more than competence) seemed to matter when individuals were making decisions about how to behave in response to the message.

However, it should be noted that there was no similar effect of perceived morality and manipulated high uncertainty leading to higher engagement as per Experiment 1. This study, instead, found that perceived competence played an important role in shaping individuals' engagement with the climate change information presented. One can speculate why the interaction between morality and

uncertainty was not also significant on engagement with the climate change message in this study. Perhaps, in adjusting the study and presenting both manipulations simultaneously, the influence of language manipulation was lost. There were also some interactions between perceived competence and uncertainty on travel behaviour. Here, unexpectedly, higher perceptions of communicator competence resulted in reduced behavioural intentions, a stronger relationship when under conditions of high uncertainty comparative to low uncertainty. In line with the finding from Experiment 1, this is particularly the case under conditions of high uncertainty.

Furthermore, circumstances surrounding survey administration itself may also have an impact on receptiveness to the questionnaire and responses contained within. The time of year and setting when completing the survey was different in experiments one and two; the first being an in-class experiment, the second being on campus during exam time in May. Or it could be that establishing trust (e.g., by language use) is a prerequisite before communicating information containing uncertainty.

Though I have not been able to replicate the findings on all manipulations as per the earlier studies, the results of this present study partially support the previous work in this PhD research, and I have managed to replicate the earlier findings conceptually. Specifically, as seen in Experiment 1, high uncertainty and high morality conditions leads to increased pro-environmental behavioural intentions – though travel in this case, rather than household as seen in Experiment 1. There was also a negative role of perceived competence on travel intentions, something not shown earlier.

Experiment 3

The experimental work that has so far been reported in this chapter was inspired by the first two themes that emerged from the initial qualitative work undertaken with scientists and professional science communicators. This qualitative work revealed three important overarching themes that were differentially associated with the two groups of participants. The first theme concerned the importance of communication as a process – that is a process within which communicators reach out, connect to, and engage with audiences through building relationships with them. Central to this process was the strategic use of language – often termed ‘tone of voice’ – to cultivate a warm, approachable and inclusive atmosphere around the communication of scientific information. Understandably, attending to the processes of communication was a key concern for the professional communicators interviewed. The second theme centred on the uncertainties inherent in climate science, including what is and is not known about climate change and the various scenarios that might reasonably be expected on that basis. Here the focus was on fully and accurately communicating uncertainties when presenting climate change information to audiences. Understandably, the importance of accurate information and the communication of uncertainties was a key concern for the climate scientists interviewed.

In transitioning to the experimental work, each of these themes became the basis of the two key manipulations that have been employed. The theme of communication processes and how these might aid audience engagement was represented in the manipulation of language – that is, whether information was presented using an open and inclusive language (relying on words like “we” and “us”) versus a distant and closed language (relying on corporate language and referring to

the organisation as an entity). The theme of information and uncertainties was represented in the uncertainty manipulation – that is the degree to which climate projections were accompanied by lower versus higher levels of uncertainty. In the previous studies, I explored how these two factors combine to influence audience responses. The general picture to emerge is that both elements are important: although increasing uncertainty can erode audience engagement, the use of open language seems able to maintain, or even elevate engagement under high uncertainty.

So with these qualitative insights adapted for experimental manipulations, I have indeed some interesting findings, yet some further ambiguity – particularly with the Experiment 2, in its lack of manipulation and lack of interaction between (perceived) morality and high uncertainty. Such ambiguity may originate from the slight change in methodology (i.e., presentation of manipulations together, environmental conditions), or the mixed results may point to alternative explanations within the conceptual framework than previously seen.

For the next, and final, experimental study presented in this chapter, I wanted to extend the work by incorporating the third significant theme that emerged from the qualitative investigation. This theme revolved around the (conflicting) roles of scientists as informers versus advisors of the public. More specifically, during the interviews scientists expressed concerns about the provision of guidance and advice on how publics might change their behaviour in response to the scientific information they provide. The provision of behavioural advice was something that scientists saw as being ‘not our role’. Instead, they felt more comfortable focussing on climate projections and leaving it up to publics and policy makers to themselves make judgements about how best to respond to this information. One reason cited for this was that the provision of advice might erode public trust by undermining the

perception of climate scientists as independent and neutral actors. However, embedded within this theme was also evidence of a conflict between the personal and professional goals of scientists (i.e., to be neutral and independent) and expectation that publics nonetheless *should* respond behaviourally to the information they present, even if they do not provide them with specific guidance over what the best response might be. In light of these concerns, I became interested in the further role that providing behavioural advice (versus not providing this) might play in shaping public responses alongside the interactive effects of language and uncertainty observed in the previous studies.

Past research in health psychology has established that the notion of behavioural advice is important for message acceptance (Taylor, 2011). For instance, behavioural recommendations, as suggested in line with the Protection Motivation Theory, helps people avoid negative behaviours by increasing preventative behaviour: as well as perceived severity of and likelihood of harm; self- efficacy (i.e., personal goal attainment) and response efficacy (effectiveness of promoted behaviour) are suggested factors from the PMT which enable us to protect ourselves (Bandura, 1977, Rogers 1983). More specifically, response efficacy can potentially be achieved with provision of information that aims to increase beliefs about the effectiveness of the recommended behaviour. This is particularly prominent when in the context of creating fear (i.e., fear appeals), and the advised action will avert threat (Bandura, 1977). High-fear appeals and high-efficacy messages have been shown to produce the greatest behaviour change (Witte & Allen, 2000).

In the context of climate change, however, fear appeals may lead to denial, as a mechanism to manage the negative feelings of fear rather than attend to the potential threat (Moser, 2007; Swim et al, 2009; CRED, 2009; Feinberg & Willer, 2011).

Audiences may also reject fear-invoking appeals, viewing them as manipulative or underhand (Moser 2007; O'Neill & Nicholson-Cole, 2009), and as a result are likely to undermine public engagement with climate change (e.g., Whitmarsh, 2011; O'Neill & Nicholson-Cole, 2009). For example, fear appeals may lead audiences to become desensitized to the message, or the other extreme of denial in order to cope with the risks posed by such a changing climate (O'Neill & Nicholson-Cole, 2009).

In addition to this, reflecting upon the views of scientists during the interviews (Chapter 2), there was the perception that provision of advice is not part of their role as a scientist. The provision of advice was seen to have potential negative effects of perceptions of competence and trustworthiness as a scientist.

Despite the potential negative consequences of the provision of behavioural advice, it is plausible to argue there could be a potential (positive/neutral) role in climate change communication. Previous literature highlights the importance of trust and relationship building in risk communication (e.g., Kasperson, Golding, & Tuler, 1992; Poortinga & Pidgeon, 2003). Providing behavioural advice is, however, a different sort of information – which may help facilitate audience responses (such as efficacy).

In taking the approach that communication is a relational process, arguably presenting information about climate change (i.e., risks and impacts) without informing what to do as a response could be viewed as a harmful to the communication process. Thus, one could postulate that accompanying impacts information with behavioural advice may be beneficial to the communication process. Goodwin and Dahlstrom (2011) talk about the importance of commitment towards an on-going relationship. So from this perspective, the provision of information with advice could be seen as part of the relationship building. This may be more beneficial

than presenting advice for the sake of it, as well as providing information without advice. This could be related to aspects of trust previously documented. For example, viewing someone as trustworthy has been linked to viewing them as reliable and consistent in actions. McGregor (1967) proposes, “inconsistencies between words and actions decrease trust” (p.164). Not completing the communication relationship may be seen as inconsistent, and therefore be detrimental to the communication process

Thus, with this in mind, it may indeed be that advice provision may be beneficial to message transmission and not necessarily have negative consequences on perceptions of communicator competence. Furthering this position, providing advice on a topic can increase its relevance to the audience especially in the case of climate change which is already perceived as irrelevant by many. de Vries, Terwel and Ellemers (2014) explored the relative persuasiveness of communications that only contain highly relevant information or combine highly relevant with irrelevant or moderately relevant information. Arguably, the science of climate change is irrelevant for many people but the actions required here and now are highly relevant. In the context of support for carbon dioxide capture and storage technology, highly relevant information for the argument that the implementation of carbon capture and storage would have important climate benefits. de Vries et al (2014) showed that adding irrelevant information dilutes the impact of highly relevant information resulting in weakening people’s beliefs about the issue.

Beyond this, the simple premise of advice provision is that the information, which it contains, reduces cognitive effort for recipients, especially when decisions are made under conditions of high uncertainty. Consequently, though the invoking of fear can prompt people into taking account behavioural recommendations, it is not necessarily a prerequisite to increasing response efficacy through information. Given

this, the advice presented in this experiment is emotionally neutral, avoiding the invoking of fear.

The behavioural advice presented to respondents in this experiment aimed to be clear and simple actions that can help mitigate the effects of climate change. The advice was intended to be relevant in everyday life. The efficacy measures that followed this manipulation do not specifically refer to the advice provided; but was a broader efficacy measure in response to the present/ absent of neutral information. Whilst I acknowledge self and response efficacy have specific meanings (i.e., self versus action expectancies) I wanted to look at the bigger picture of the effects of advice provision versus information lacking advice.

From a medical practice perspective, clear and concise recommendations increase the likelihood of information being understood and remembered (Ley, 1983; Ley 1998), and more precise behaviours are likely to be carried out (Michie & Johnston, 2004). This approach has been advocated in the context of climate change recommendations. Gardener and Stern (2008) state, “The public needs more direct and coherent advice concerning household and individual actions” (p.15).

In the previous studies included in this programme of research, probabilistic information concerning the consequences of climate change has been presented without any advice on what individuals could personally do to respond to these climate projections. Despite the lack of specific advice, results have indicated that people are willing to respond behaviourally, especially under conditions of high uncertainty, at least given certain conditions – namely, under a high trust relationship associated with the use of open and inclusive language. Having observed this apparent willingness to engage, a remaining question is how this willingness is affected by the actual provision of advice. Drawing on the above-mentioned perspectives, it seems

that the provision of advice should strengthen beliefs about how their own behaviour would help mitigate climate change, and increase engagement with the climate change messages, even those that are associated with high uncertainty.

However, in light of the concerns expressed by scientists, I was also interested in how the provision of advice might shape public trust in scientists and whether there was a potential for this to be undermined if scientists were seen to “have an agenda”. To explore these issues, I added an advice manipulation to the previously established paradigm, resulting in a 2 (language: open, closed) x 2 (uncertainty: low, high) x 2 (advice: present, absent) experimental design. As in the previous studies, measures of message engagement and behavioural intentions were key dependent measures. To test whether behavioural advice facilitated increased feelings of efficacy, I included some additional measures (e.g., “I believe I can do something about climate change”). I also wanted to explore whether the provision (or not) of behavioural advice influences perceptions of communicator competence and morality, so I included person perception measures both before and after the behavioural advice manipulation.

Expectations for this study are summarised below:

1. Providing pro-environmental behavioural advice will have no negative effect on perceptions of communicator competence and/or morality i.e., the provision of advice will not reduce perceptions of competence/morality compared to when advice is absent;
2. There will be a main effect of provision of behavioural advice; its presence will increase efficacy and behavioural intentions compared to its absence;

3. Irrespective of advice, people will respond more positively to messages contained in high uncertainty when open rather than closed language.

Method

Participants and descriptives

Participants were recruited using a company that specialises in online surveys. They use an online loyalty scheme points, enabling respondents to collect points that can later be exchanged for products. This survey took approximately 20 minutes to complete. The questionnaire as used in this experimental study can be found in Appendix 3.4. Four hundred and twenty-one participants took part in this online study, 221 of which were male, 191 female and 9 respondents did not disclose their gender. The mean age this sample was 45.50 years old ($SD = 17.94$).

All participants were provided with a weblink, which randomly directed respondents to one of the eight possible versions of the survey that represented 2 (language: open, closed) x 2 (uncertainty: high, low) x 2 (advice: present, absent) between-subjects experimental design. The table below (*Table 3.10*) summarises the distribution of participants across these conditions.

Table 3.10. Descriptive summary of participants within each condition

Language	Advice				Total
	Present		Absent		
	Low	High	Low	High	
Open	52	43	64	68	227
Closed	41	47	55	51	194
Total	93	90	119	119	421

Procedure and measures

Consistent with the earlier experimental studies within this PhD programme of research, participants were told that the questionnaire presented to them was part of a research exercise for a (fictitious) scientific organisation, the Linford Centre. As before, this questionnaire contained screen-shots from the Linford Centre's website followed by a series of questions designed to elicit the respondent's impressions of this organisation and their views on climate change more generally. The three manipulations contained within each screenshot and measures following each manipulation are described below.

Language manipulation and subsequent measures

The questionnaire started with general information about the study and obtained the respondent's consent to participate in the study. Following this, the survey started with a screen-shot from the homepage of a (fictitious) climate research organisation (the Linford Centre), which described the organisation and what they do. As in previous studies, language was manipulated by varying the wording on this homepage—specifically whether the organisation referred to itself using words like “us”, “we” and “our” (an open style) versus referring to itself in a corporate and impersonal way (e.g., “the Linford Centre”; a closed style).

To ensure that people actively reflected on the organisation and the information around it, the survey asked participants whether they had heard of the Linford Centre (Yes/No/Maybe) and to write a small description of what the group does. Following this, participants were asked to rate the degree to which they perceived the organisation as possessing each of seven traits that included the dimensions of competence and morality. Items assessing competence were competent,

professional, capable ($\alpha = .91$), and the items assessing morality were moral, truthful, dishonest (reversed), sincere ($\alpha = .83$). Ratings were given on a 7-point scale ranging from 1 = *not at all* to 7 = *extremely*. Although previous studies had also included traits that reflected the dimension of warmth, this was dropped from the present study given the lack of previous effects involving these measures.

Uncertainty manipulations and following measures

Following the webpage introducing the organisation, and the associated trait ratings, participants were presented with a second screenshot summarising the key findings of future impacts of climate change based on the organisation's research. As in the earlier two experiments this is where the level of uncertainty was manipulated. Briefly, the page summarised climate projections based on the Linford Centre's research, projections that were either accompanied by precise probabilities (e.g., "based on current rates of CO₂ emissions [there is an] 80% chance that climate change will make a quarter of all species extinct"; the low uncertainty condition) versus a range of possibilities (e.g., "based on current rates of CO₂ emissions [there is a] 70-90% chance that climate change will make a quarter of all species extinct"; the high uncertainty condition). The language manipulation introduced in the previous page was continued when presenting this information also.

Following exposure to this second webpage, participants were presented with a series of opinion statements and asked to rate their agreement with each of these statements on a single 7-point scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*. These opinion statements explored the key dependent measures of understanding of and engagement with the message and trust in the source. The scale items and reliability scores are as follows:

Engagement with the message was measured with two items: “I found the summary engaging”; “I tuned out while reading about this organisation’s research (reversed)” ($r = .41, p < .001$).

Perceived understanding of the message was measured with two items: “I understand the meaning of the Linford Centre’s research” and “I do not understand what this research is supposed to mean”. After reverse scoring the latter, these two items were averaged to create a single variable ($r = .50, p < .001$).

Trust in the Linford Centre was measured by two items: “Based on their research, the Linford Centre seems to be a trustworthy source of information about climate change” and “Based on what I have read, I would find it hard to trust the Linford Centre as a source of information about climate change” ($r = .50, p < .001$).

Advice manipulations and following measures

Following the language and advice manipulations, which correspond to previous studies, a final screenshot was presented that contained the advice manipulation. In the advice present condition, the Linford Centre conveyed the message that they see it as part of their role to provide behavioural advice on responses to climate change (i.e., “We are committed to providing information on how to act as a response to climate change”) and then listed simple behaviours to mitigate against climate change was presented (e.g., “Cycle more”, “Reduce, reuse and recycle”). The advice absent condition conveyed the message that it was not part of their role to provide advice on responses to climate change and indicated where such information could be found (i.e., “We do not believe we should provide advice on how to respond to climate change. Below is a list of organisations and web links you can go to for information on how you can help avoid dangerous climate change”).

Again, the language peripheral to the content remained consistent with the language condition.

Following exposure to this webpage, I again measured perceptions of the communicator competence and morality to see if the provision versus absence of advice altered initial perceptions. I also measured general attitudes towards climate change; beliefs about the (human) causes of climate change, perceived consequences of climate change, perceptions of climate change risk, efficacy and behavioural intentions. The scale items and reliability scores for each of these measures are as follows:

Global climate change belief and personal risk perception. As in Experiments 1 and 2, a factor analysis suggested one factor explaining 59.19% of the variance with the various belief items.¹³ The remaining items that did not load on this factor were the personal risk items, which loaded on a separate factor explaining 10.92% of the variance. Given this, the belief items were collapsed into a single index of global climate change belief (Cronbach's $\alpha = .91$) and the personal risk items were collapsed into a separate index ("I feel personally at risk from the consequences of climate change"; "I personally worry about climate change and how it will affect me"; and "For me, climate change is nothing that I am personally concerned about" [reversed]; $\alpha = .77$).

Efficacy. This was measured with four items; "I feel there is something I can personally do to act against climate change", "I feel it is in my power to tackle climate

¹³ "In my opinion climate change is happening", "In my opinion climate change is man-made", "Human beings are responsible for climate change", "Climate change is a natural process rather than something caused by human activity (reversed)", "Climate change is something that I personally believe in", "I remain somewhat sceptical about climate change and if it is real" (reversed), "I believe there is global risk of the consequences of climate change", "I think there will be bad consequences of climate change for the planet", "I believe that the global consequences of climate change will be severe".

change”, “I believe my actions have an influence on climate change”, and “I feel there is nothing I can do about climate change” (reversed; $\alpha = .88$).

Individual intentions. A set of questions, identical to those used in the earlier experiments, assessed how willing participants would be to engage in a variety of actions in response to climate change (1 = *not at all willing* to 7 = *very willing*), including household behaviours¹⁴ ($\alpha = .85$) and travel intentions¹⁵ ($\alpha = .82$).

Organisation impressions. Participants were again presented with a list of traits and asked to rate how they perceived the organisations with respect to those traits (1 = *not at all*, 7 = *extremely*). The list contained a mixture of competence- and morality- related words. The competence-related words used in this second measurement were able, skilled, incompetent (reversed; $\alpha = .77$) and perceptions of morality were assessed with the words honest, trustworthy and immoral (reversed; $\alpha = .73$). Organisational perceptions were measured differently here than earlier in the questionnaire to avoid repetition in the survey and repetition effects.

Demographics. Finally, I gathered demographic information such as gender, age, science training, and provided a space at the end for further comments. Here respondents were provided with a web link to receive their company reward points. Following this, participants were provided with information explaining the purpose of the research; the effects of the language and uncertainty manipulations from the earlier experiments; and they were informed of the additional experimental condition (advice provision) in the current survey. Participants were also provided with contact details for further information. This gave the participant the option to find out more information regarding the study deception and other aspects of the study if they wished.

¹⁴ Items: “Reduce my household energy use”, “Recycle (more)”, “Use less water”, and “Reduce, reuse, recycle”.

¹⁵ Items: “Walk (more) instead of using the car”, “Cycle (more) instead of using the car”, “Use a car less”, Use public transport (more) instead of the car”, and “Limit unnecessary air travel”.

Table 3.11. Means, SDs, Correlations and Cronbach's alpha for variables in Experiment 3

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Competent Time1	5.28	4.78	(.91)											
2. Competent Time2	5.14	1.26	.21**	(.77)										
3. Morality Time1	5.12	1.23	.87**	.74**	(.83)									
4. Morality Time2	5.17	1.22	.19**	.86**	.76**	(.73)								
5. Engagement	4.48	1.38	.22**	.63**	.62**	.58**	(.58)							
6. Understanding	4.96	1.30	.08	.43**	.40**	.45**	.46**	(.65)						
7. Trust	4.60	1.42	.22**	.67**	.66**	.66**	.64**	.44**	(.67)					
8. Global belief	4.72	1.30	.17**	.45**	.49**	.43**	.53**	.40**	.48**	(.91)				
9. Personal risks	4.05	1.38	.10*	.38**	.40**	.36**	.44**	.22**	.39**	.72**	(.77)			
10. Efficacy	4.44	1.45	.14**	.50**	.50**	.50**	.49**	.29**	.41**	.57**	.62**	(.88)		
11. Household Int.	5.16	1.28	.07	.41**	.44**	.43**	.36**	.29**	.28**	.45**	.45**	.55**	(.85)	
12. Travel intentions	4.68	1.43	-.01	.31**	.33**	.33**	.32**	.20**	.22**	.44**	.45**	.48**	.66**	(.82)

Note: $N = 421$ **. Correlation is significant at the 0.01 level, *. Correlation is significant at the 0.05 level.

Reliabilities (Cronbach's α) are on the diagonal.

Results

Demographic checks

The descriptive statistics, correlations and Cronbach's alpha for all variables can be found in *Table 3.8*. Consistent with the previous work in this PhD, women ($M = 5.37$, $SD = 1.00$) perceived the organisation as more moral than men ($M = 4.93$, $SD = 1.24$), $t(410) = -3.93$, $p < .001$. Similarly, women perceived the organisation as more competent ($M = 5.48$, $SD = 2.00$) than men ($M = 4.87$, $SD = 1.31$), $t(410) = -3.70$, $p < .001$; were more engaged with the message than men were ($M_s = 4.62$ & 4.33 , $SD_s = 1.32$ & 1.43 , $t(410) = -2.08$, $p = .038$); trusted the Linford centre more than men ($M_s = 4.94$ & 4.28 , $SD_s = 1.25$ & 1.53 , $t(410) = -4.80$, $p < .001$); and were more inclined than men to believe in anthropogenic climate change ($M_s = 4.58$ & 4.21 , $SD_s = 1.36$ & 1.60 , $t(410) = -2.56$, $p = .01$). There were also positive associations between age and reported understanding of the message communicated, $r = .11$, $p = .022$, and between age and household intentions, $r = .11$, $p = .025$, however age was negatively correlated with belief in the anthropogenic causes of climate change, $r = -.10$, $p = .048$. Due to these associations with key processes or dependent variables, age and gender were included as covariates in all analyses.

Education, income and occupation had no such effects. For example, there were no effects of education on perceptions of communicator competence or morality $F_s < 1.55$, $ps > .174$. Similarly, education had no effects on engagement, understanding or trust, $F_s < 1.45$, $ps > .205$; or global beliefs, response efficacy, belief or household and travel behaviour, $F_s < 1.40$, $ps > .225$. There were similarly no effect of occupation on communicator perceptions, $F_s < 1.33$, $ps > .217$,

engagement and understanding, $F_s < 1.03$, $p_s > .418$, or behaviour, $F_s < .25$, $p_s > .987$. The patterns were similar with respect to income, $F_s < 1.46$, $p_s > .190$.

Primary analysis

As with the earlier experiments, to address the hypotheses I tested the main and interactive effects of the three manipulated variables on the outcome measures via a series of 2 (language: open, closed) x 2 (uncertainty: low, high) x 2 (advice: present, absent) analyses of variance. Although certain dependent variables were measured before all independent variables had been manipulated, I nonetheless analysed all data in this way in order to check for any spurious effects.

Organisation impressions. Organisational impressions were assessed both immediately after the first language manipulation and then again after the advice manipulation. To test how language shaped organisational impressions across time (i.e., before and after the advice manipulation), and to explore whether uncertainty and the provision of pro-environmental behavioural advice changes these impressions, I conducted mixed between-within ANOVA.

The 2 (language: open, closed) x 2 (uncertainty: low, high) x 2 (advice: present, absent) x 2 (time: 1, 2) mixed ANOVA (controlling for age and gender) on competence revealed no main effect of time, $F(1, 400) = .089$, $p = .766$, and no significant main or interactive effects of the manipulations, $F_s < 1.80$, $p_s > .181$. Thus perceptions of competence were not shaped by the manipulations and were relatively stable across time. The same analysis on morality revealed no main effect of time, $F(1, 400) = .380$, $p = .538$, and no main or interactive effects of the variables, $F_s < 2.90$, $p_s > .089$.

Engagement with and perceived understanding of the message. The analysis on engagement with the message (which was measured before the advice manipulation) confirmed the absence of any spurious main or interactive effects of advice, all $F_s < 3.06$, $p_s > .08$. Contrary to expectations, however, there were also no main effects of language, $F(1, 411) = 2.52$, $p = .113$, or uncertainty, $F(1, 411) = .00$, $p = .999$, and no interaction between these variables, $F(1, 411) = 1.08$, $p = .299$. The analysis of perceived message understanding similarly showed no main or interactive effects of advice, $F_s < 1$, but also no main effects of language, $F(1, 411) = .051$, $p = .822$, or uncertainty, $F(1, 411) = .296$, $p = .587$, and no interaction between these variables, $F(1, 411) = .917$, $p = .339$.

Linford Centre trust. Levels of trust in the organisation were also measured after the language and uncertainty manipulations but before the advice manipulation. The 2 (language: open, closed) x 2 (uncertainty: low, high) x 2 (advice: present, absent) analysis of variance on trust confirmed the absence of any main or interactive effects of advice, $F_s < 1$, but also revealed no main effects of language, $F(1, 410) = 2.44$, $p = .119$, uncertainty, $F(1, 410) = .237$, $p = .627$, and no interaction between these variables, $F(1, 410) = 1.24$, $p = .266$.

All remaining variables were measured after the advice manipulation and could, therefore, potentially be influenced by this. However, across all these variables there was little evidence for any effects of these manipulations, as detailed below:

Global climate change belief. The analysis on belief in global climate change revealed no main effects of language, uncertainty, or advice, all $F_s < 1.07$, $p_s > .302$, and no interactions involving these variables, $F_s < 2.05$, $p_s > .15$.

Personal risk perception. The analysis on personal risk perceptions showed no main effects of language, uncertainty, or advice, all $F_s < .214$, $ps > .644$, and no significant interactions involving these variables, $F_s < 2.74$, $ps > .10$.

Efficacy. The analysis of response efficacy show no main effects of language, uncertainty, or advice, all $F_s < 1.82$, $ps > .177$, and no significant interactions involving these variables, $F_s < 3.29$, $ps > .073$.

Behaviour. The analysis of general intentions revealed no main effects of language, uncertainty, or advice, all $F_s < .407$, $ps > .524$ and no significant interactions involving these variables, $F_s < 1.91$, $ps > .168$. Identical patterns were observed when travel intentions (all $ps > .28$) and household intentions (all $ps > .148$) were considered separately.

Secondary analyses

The primary analyses reported above revealed no main or interactive effects of any of the variables, and as such provide no straightforward support for the hypotheses. Although the overall picture did not conform to expectations, it was possible that the predicted effects might be shaped further by features of the respondents – for example, their demographic characteristics. Indeed, the previous studies were conducted mostly on young, higher educated, and female participants. It is therefore plausible that the evidence obtained from these studies is, in fact, limited to populations defined by those features. The large and diverse sample recruited for this study allowed me to test that possibility by including demographic factors as moderators of the predicted effects, rather than simply controlling for the effects of these, as was done in the primary analyses, for example. To begin this exploration, I initially focussed on gender as a possible moderator of the experimental effects.

Given the correlation between gender and science training, I controlled for science training in all gender analyses. I also separately tested the possible role of science training as a moderator of the experimental effects, given the intuitive relevance of this for science training. Again, in these analyses I controlled for any effects of gender.

Gender effects

Organisation perceptions. The previous mixed analyses of variance on organisational perceptions were repeated with gender as an additional variable. In the analysis of perceived competence, there were no significant main effects or interactions of time with the manipulations, $F_s < 2.78$, $p_s > .096$.

When examining perceptions of communicator morality, there was a significant time x gender x language x uncertainty x advice interaction, $F(1, 380) = 3.87$, $p = .050$. However, as this interaction as driven by effects at Time 1, $F(1, 380) = 6.25$, $p = .013$, rather than at Time 2, $F(1, 380) = 3.81$, $p = .052$, and that advice was only manipulated prior to the Time 2 assessment, it is difficult to interpret this interaction and these effects are likely to be spurious. There were no significant main effects or interactions of time with the manipulations, $F_s < 2.17$, $p_s > .148$.

Engagement with the message and understanding of the message. Including gender in the analysis of engagement revealed a main effect of this variable, $F(1, 410) = 4.53$, $p = .034$, as well as a significant Gender x Uncertainty interaction, $F(1, 400) = 3.87$, $p = .050$, which was further qualified by a significant Gender x Language x Uncertainty, $F(1, 411) = 3.80$, $p = .052$. Probing of this three-way interaction revealed that it was driven by a significant Gender x Language interaction under conditions of

high uncertainty, $F(1, 204) = 4.79, p = .030$, but not low uncertainty, $F(1, 208) = .07, p = .800$.

Under high uncertainty, men reported more engagement in response to closed ($M = 4.57, SD = 1.40$) rather than open language ($M = 3.89, SD = 1.43$), $F(1, 200) = 7.03, p = .009$. Under high uncertainty, however, women reported no difference in engagement levels in response to open ($M = 4.84, SD = 1.26$) and closed language ($M = 3.71, SD = 1.19$), $F(1, 200) = .234, p = .629$.

Looked at differently, under high uncertainty, women ($M = 4.84, SD = 1.26$) responded more positively to open language than men ($M = 3.89, SD = 1.43$), $F(1, 200) = 12.70, p < .000$. Men and women did not, however, differ in response to closed language under the same conditions (Men $M = 4.57, SD = 1.40$; Women $M = 4.71, SD = 1.19$), $F(1, 200) = .25, p = .621$. In addition, although there was no significant difference in levels of engagement for women in response to open language under high ($M = 4.84, SD = 1.26$) versus low uncertainty ($M = 4.38, SD = 1.51$), $F(1, 187) = 3.08, p = .081$, men responded better to open language under low uncertainty ($M = 4.43, SD = 1.37$) than under high uncertainty, ($M = 3.89, SD = 1.43$), $F(1, 217) = 4.56, p = .034$. Further, responses to closed language did not differ as a function of uncertainty for either men or women $F_s < .38, p_s > .539$. As such, the total pattern is such that whether participants responded to open language under high uncertainty constructively or destructively dependent on whether they were female versus male respectively. These interactions are shown in *Figure 3.5*.

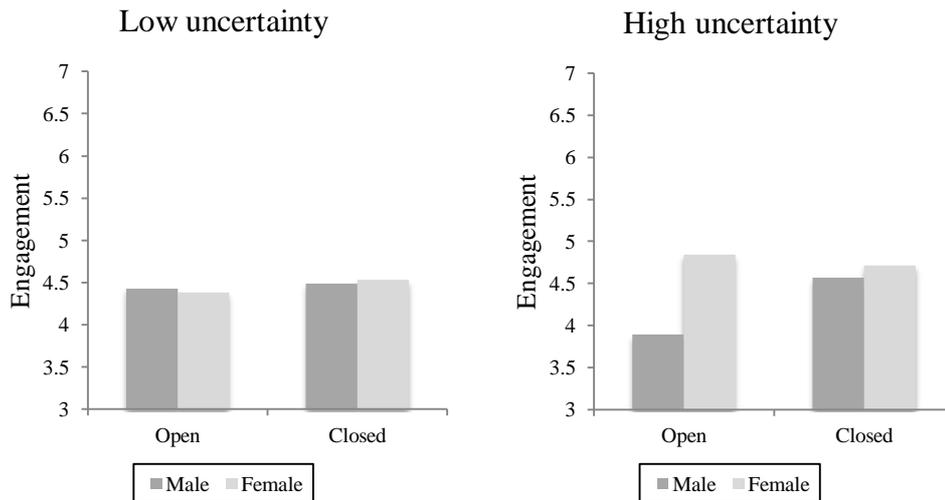


Figure 3.5. The interaction of gender, language and uncertainty on reported engagement with the message

The analysis of perceived understanding of the message revealed no main effects of language, $F(1, 400) = .04, p = .84$, uncertainty, $F(1, 400) = .35, p = .555$, advice, $F(1, 400) = .032, p = .857$, or gender, $F(1, 400) = 2.37, p = .124$. There was a significant main effect of age, $F(1, 400) = 7.79, p = .006$, and a marginal main effect of science training, $F(1, 400) = 3.44, p = .064$. Although there was a significant two-way interaction between Gender x Advice, $F(1, 400) = 3.80, p = .052$, it should be noted, that this variable was measured before the advice manipulation and therefore this result likely to be spurious. Beyond this there was also a significant Gender x Uncertainty interaction, $F(1, 400) = 4.97, p = .026$, see Figure 3.6, below.

Probing of this Gender x Uncertainty interaction revealed that women ($M = 5.20, SD = 1.22$) reported higher understanding than men ($M = 4.81, SD = 1.37$) under conditions of high uncertainty, $F(1, 408) = 4.63, p = .032$. When uncertainty was low, female ($M = 4.85, SD = 1.31$) and male ($M = 4.98, SD = 1.30$) reported similar levels of understanding, $F(1, 408) = .46, p = .497$. Contrary to what might be expected on

the basis of the above, this pattern was not further moderated by language¹⁶, and there were no further significant two or three-way interactions involving these variables, $F_s < 2.34, p_s > .11$.

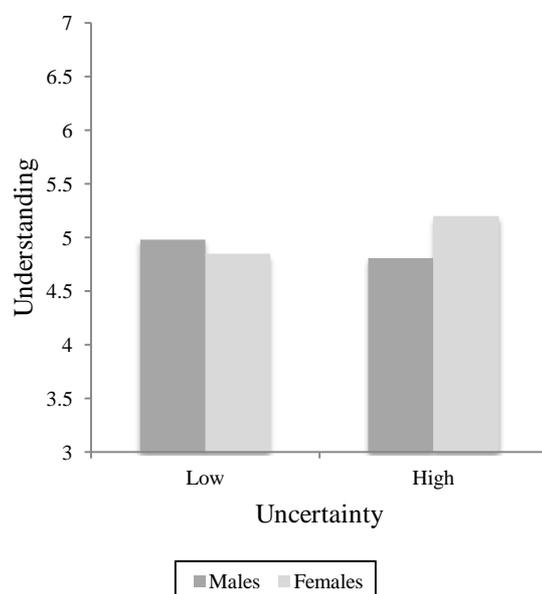


Figure 3.6. The interaction of uncertainty and gender on perceived understanding of the message

Linford Centre trust. With the inclusion of gender in the analysis, there were no main effects of uncertainty or advice, $F_s < .296, p_s > .587$, although the effect of language did become marginal, $F(1, 399) = 3.24, p = .072$. There was a significant main effect of science training, $F(1, 411) = 3.84, p = .051$, and gender, $F(1, 399) = 15.42, p < .001$. Females reported higher trust in the Linford Centre ($M = 4.96, SD = 1.26$) compared to males ($M = 4.32, SD = 1.49$). The main effect of gender was, however qualified by uncertainty and language use; resulting in a significant three-way interaction, $F(1, 399) = 5.71, p = .017$. Decomposing this interaction revealed

¹⁶ Though not statistically moderate by language, the Gender x Advice interaction was marginally significant in the open condition, $F(1, 223) = 6.05, p = .015$, and not the closed language condition, $F(1, 189) = .19, p = .663$. Simple effects analysis reveal females ($M = 5.38, SD = 1.15$) reported higher understanding than men ($M = 4.78, SD = 1.30$) under conditions of high uncertainty, $F(1, 219) = 6.05, p = .015$. Further, females responded better to open language when uncertainty was high ($M = 5.38, SD = 1.15$) comparative to when uncertainty was low ($M = 4.70, SD = 1.35$), $F(1, 219) = 7.21, p = .008$.

that this was driven by a significant Gender x Language interaction under high uncertainty, $F(1, 204) = 5.88, p = .016$, but not low uncertainty, $F(1, 207) = .18, p = .675$. Under conditions of high uncertainty, the use of open communication elicited higher trust from females ($M = 5.25, SD = 1.43$) than males, ($M = 3.96, SD = 1.25$), $F(1, 200) = 25.56, p < .001$. When closed language was used under the same conditions, men and women did not differ, $F(1, 200) = 1.97, p = .162$. See *Figure, 3.7* below.

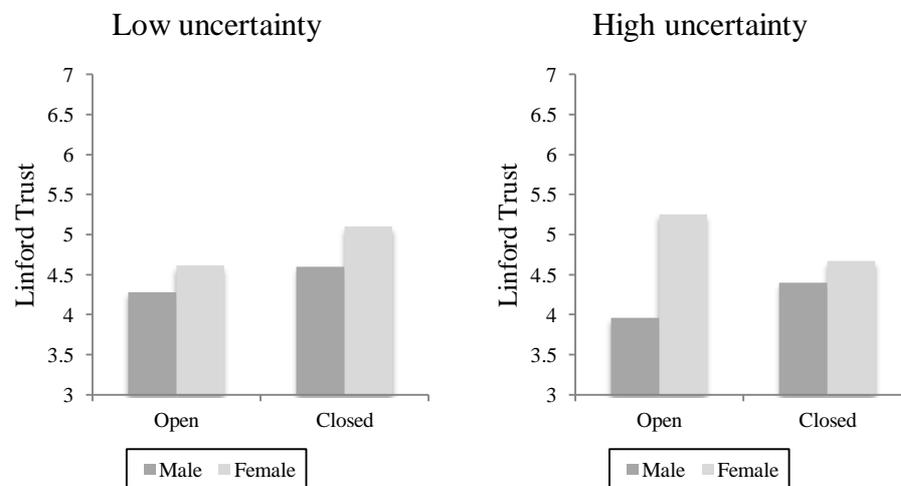


Figure 3.7. The interaction of language, uncertainty and gender on reported trust of the Linford Centre

Looked at differently, it can also be seen that women tended to perceive the Linford Centre as more trustworthy in response to open communication when conveyed under high uncertainty ($M = 5.25, SD = 1.43$) than under low uncertainty conditions, ($M = 4.61, SD = 1.31$), $F(1, 187) = 6.62, p = .011$, whereas uncertainty did not affect women's responses to closed communication, $F(1, 187) = 1.51, p = .221$.

There were no further significant two or three-way interactions involving these variables, $F_s < 2.80, p_s > .095$.

Global climate change belief. Including gender, $F(1, 400) = 3.49, p = .062$, in the analysis of beliefs in climate change revealed a marginal Gender x Language x

Advice interaction, $F(1, 400) = 3.45, p = .064$. There were no further significant two or three-way interactions involving these variables, $F_s < 2.80, p_s > .095$.

The Gender x Language x Advice interaction is depicted in *Figure 3.8*, below. This interaction was driven by the Gender x Language interaction when advice was present, $F(1, 180) = 4.02, p = .046$, rather than when this was absent, $F(1, 232) = .42, p = .519$. For men exposed to advice, belief was higher when this advice was communicated using a closed language style ($M = 4.73, SD = 1.12$) rather than an open language style ($M = 4.19, SD = 1.66$), $F(1, 176) = 3.76, p = .054$. For women under the same conditions, belief in climate change was not affected by communication style, $F(1, 176) = .81, p = .371$.

Looking at this interaction differently, it can also be seen that providing advice in combination with an open language significantly reduced men's belief in climate change ($M = 4.19, SD = 1.66$) relative to women's ($M = 4.96, SD = 1.06$), $F(1, 176) = 7.92, p = .005$, and in comparison to when advice was not provided ($M = 4.80, SD = 1.28$), $F(1, 219) = 6.94, p = .012$. When male participants were exposed to a closed language, the presence or absence of advice did not affect beliefs ($M_s = 4.73$ & $4.66, SD_s = 1.12$ & 1.51), $F(1, 185) = .064, p = .801$.

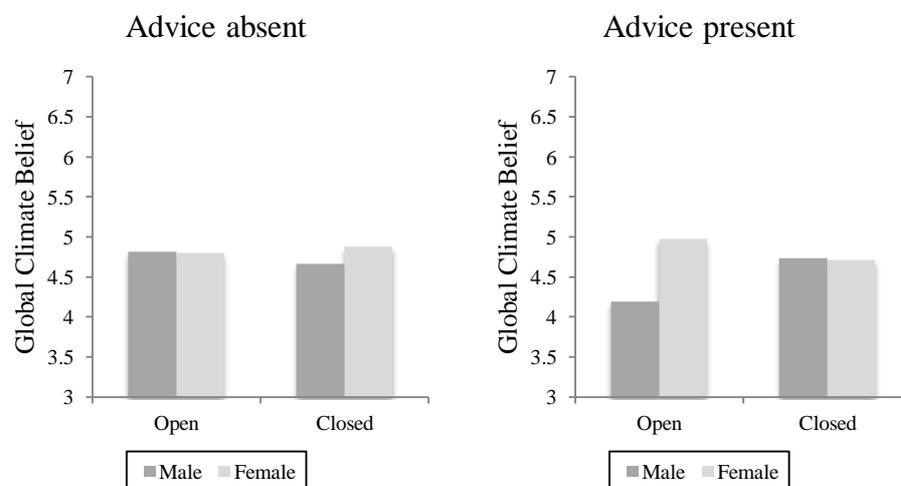


Figure 3.8. The interaction of language, advice and gender on global climate change belief

For female participants, the provision or absence of advice had no effect on belief, regardless of whether this was combined with open ($M_s = 4.97$ & 4.81 , $SD_s = 1.06$ & 1.20) or closed language ($M_s = 4.71$ & 4.88 , $SD_s = 1.36$, 1.09), $F(1, 219) = .342$, $p = .559$, $F(1, 185) = .412$, $p = .522$.

Personal risk perception. Including gender in the analysis of risk perceptions also revealed a significant Gender x Language x Advice interaction, $F(1, 400) = 7.36$, $p = .007$. There were no further main or interactive effects, $F_s < 2.55$, $p_s > .111$. The significant three-way interaction is graphed in *Figure 3.9*, below. As can be seen, this was driven by a significant Gender x Language interaction when advice was present, $F(1, 180) = 11.30$, $p = .001$, compared to when advice was absent, $F(1, 232) = .641$, $p = .424$. More specifically, when advice was provided, communicating using an open style had a negative effect on personal risk perceptions among males, ($M = 3.50$, $SD = 1.42$) compared to females ($M = 4.57$, $SD = 1.24$), $F(1, 176) = 14.77$, $p < .001$, and compared to when closed communication was used to deliver the same advice, ($M = 4.11$, $SD = 1.27$), $F(1, 217) = 3.75$, $p = .054$. Conversely, providing advice with an open language increased females' risk perceptions ($M = 4.57$, $SD = 1.24$) compared to when advice was given using a closed style ($M = 3.83$, $SD = 1.45$), $F(1, 176) = 8.02$, $p = .005$. When advice was provided using a closed language, men and women did not differ, $F(1, 176) = .950$, $p = .331$. There were no effects of language among males or females when advice was absent, $F_s < .824$, $p_s > .365$.

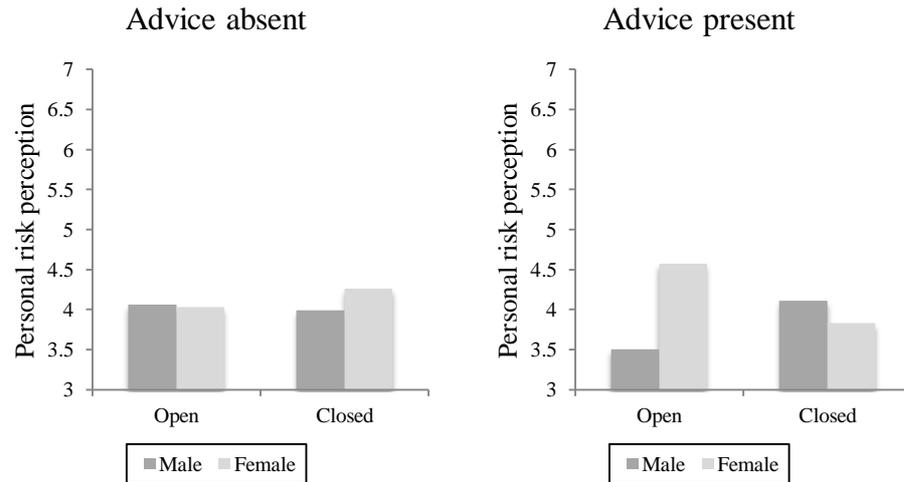


Figure 3.9. The interaction of language, advice and gender on perceptions of personal risk

As can also be seen, among women, in response to an open language providing advice led to a higher personal risk perception ($M = 4.57$, $SD = 1.24$) compared to when advice was not presented ($M = 4.03$, $SD = 1.17$), $F(1, 187) = 4.66$, $p = .032$. The reverse was apparent among men: using open language whilst providing advice led to lower personal risk perception ($M = 3.50$, $SD = 1.42$) relative to the same language without advice, ($M = 4.06$, $SD = 1.47$), $F(1, 217) = 4.12$, $p = .044$.

Efficacy. When gender was included as a variable, the analysis of efficacy revealed a significant Language x Uncertainty x Advice interaction, $F(1, 399) = 4.18$, $p = .042$, and a significant Gender X Language x Advice interaction, $F(1, 399) = 3.82$, $p = .052$. There were no further main effects $F_s < 1.78$, $p_s > .183$, or interactions $F_s < 1.58$, $p_s > .209$ on this variable

Further probing of the Language x Uncertainty x Advice interaction revealed that this was due to a significant Language x Advice interaction under conditions of high uncertainty $F(1, 207) = 3.59$, $p = .060$, rather than low uncertainty, $F(1, 212) = .598$, $p = .440$. When uncertainty was high, and closed language is used, response

efficacy increased in the presence of advice ($M = 4.74$, $SD = 1.37$) compared to the absence of advice, ($M = 4.19$, $SD = 1.45$), $F(1, 203) = 3.44$, $p = .065$, and in comparison to when advice was given using open language, although this was not significant ($M = 4.25$, $SD = 1.53$), $F(1, 203) = 2.48$, $p = .117$. Under low uncertainty, the presentation of advice was equally effective when using both the open ($M = 4.64$, $SD = 1.51$) and closed language ($M = 4.57$, $SD = 1.33$) styles, $F(1, 208) = .066$, $p = .797$. This pattern is depicted in *Figure 3.10*, below.

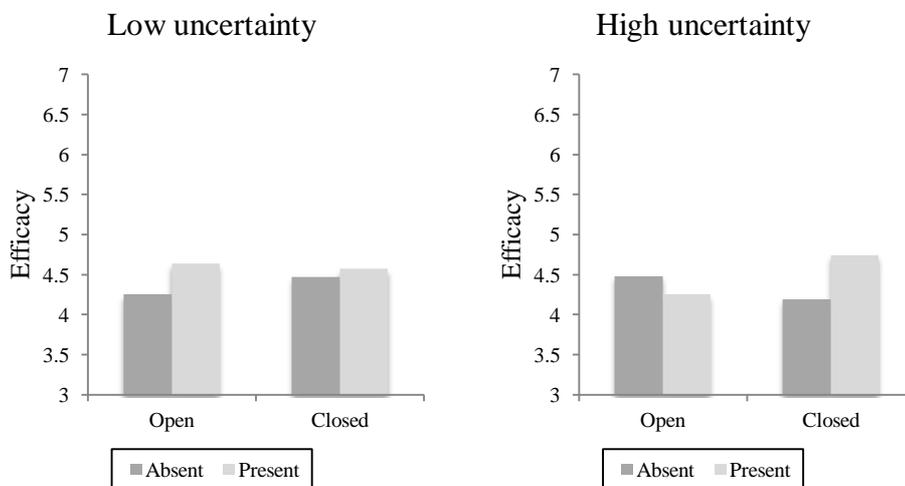


Figure 3.10. The interaction of language, uncertainty and advice on response efficacy

Probing of the significant Gender x Language x Advice interaction (See *Figure 3.11*) revealed that this was due to a significant Language x Gender interaction when advice is present, $F(1, 180) = 3.91$, $p = .050$, rather than when advice is absent, $F(1, 231) = .372$, $p = .543$. When respondents were provided with advice using an open language, females ($M = 4.80$, $SD = 1.34$) felt more efficacious than males ($M = 4.15$, $SD = 1.63$), $F(1, 176) = 4.82$, $p = .030$. Males, on the other hand, felt more efficacious to the presence of advice when communicated in a closed rather than open style ($M = 4.76$, $SD = 1.30$), $F(1, 176) = 4.02$, $p = .047$. Females, however, did not

significantly differ in their level of efficacy in response to advice given as a function of language, $F(1, 176) = .62, p = .431$.

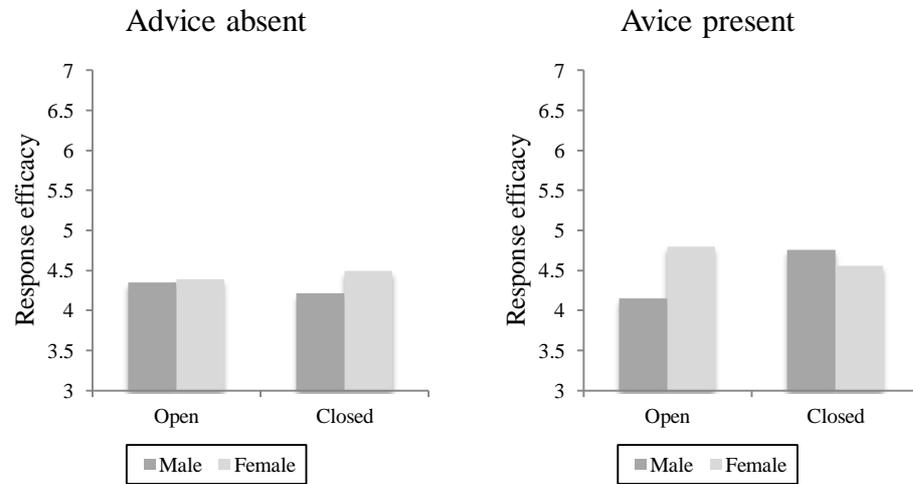


Figure 3.11. The interaction of language, advice and gender on response efficacy

Behaviour. The inclusion of gender in the analysis of household behavioural intentions revealed a marginal Gender x Language interaction, $F(1, 400) = 3.48, p = .063$. When open communications styles were employed, females reported higher household intentions ($M = 5.35, SD = 1.20$) compared to males ($M = 4.91, SD = 1.35$), $F(1, 408) = 6.37, p = .012$. There was also a weak effect among males, $F(1, 408) = 3.23, p = .058$, whereby reported household intentions were higher when language is closed ($M = 5.24, SD = 1.12$) rather than open ($M = 4.91, SD = 1.35$). Female household intentions did not vary as a function of language, $F(1, 408) = 1.03, p = .310$. This pattern is depicted in Figure 3.12.

There were no further main or interactive effects on household intentions, $F_s < 2.37, p_s > .125$. There were also no main or interactive effects of any of the independent variables on travel intentions, $F_s < 2.50, p_s > .115$.

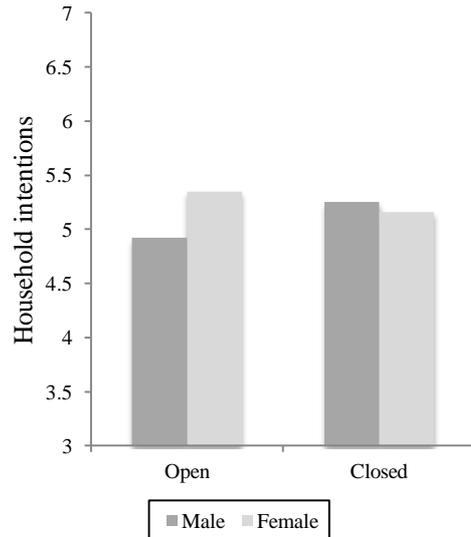


Figure 3.12. Language and gender interaction on pro-environmental household intentions

Summary of gender effects. The above analyses are complex, but did reveal some overarching patterns. Across a variety of measures, men and women seemed to diverge in response to the manipulations: women broadly replicated previous results from the earlier studies, whereas for men opposing results were observed. While women were more receptive to open language under conditions of high uncertainty, and with the provision of advice, men seemed to react against open language, especially when presented under high uncertainty and/or with advice. These diverging responses among men and women explain the absence of effects in the whole sample.

Science training effects

In addition to the possibility that variations in the gender composition of the research samples might explain the divergence between the initial analyses of this study and the previously observed effects – something that was substantiated by the above analyses – I also considered whether science training might also account for some of this variation. My previous studies used scientifically educated, mostly

female, samples. This study incorporated a sample that had wider range of scientific training. As such I tested whether science training shaped responses to the manipulations, controlling for the effect of gender. Level of science training was assessed by one of four possible responses: “I have had no science training at all” ($n = 224, 53.2\%$), “I have had some scientific training through my previous studies” ($n = 114, 27.1\%$), “I have had quite a lot of scientific training through my previous studies” ($n = 41, 9.7\%$), “Most of my previous studies have been in the area of science. As such I have had a lot of training” ($n = 29, 6.9\%$). Thirteen people (3.1%) did not respond, and were treated as missing. For the purposes of these analyses, science training was binary coded; where I retained people with no science training as one response ($n = 224, 53.2\%$), and collapsing the remaining three options (some, a lot, mostly) as the other response ($n = 184, 43.7\%$). The binary coding gave an almost equal split within the sample numbers, as well as its purpose of providing an insight to the broader role that science training has (or not) in the context of climate change communications.

Organisational perceptions. There was no main effect of time on competence scores, $F(1, 381) = .03, p = .866$, and no significant interactions of time with the manipulations, $F_s < 1.24, p_s > .265$. There was no main effect of time on morality scores, $F(1, 380) = .64, p = .426$, however there was a Time x Uncertainty interaction, $F(1, 380) = 4.27, p = .036$, as well as a Time x Science training interaction, $F(1, 380) = 3.94, p = .048$; a marginal Time x Language x Science training interaction, $F(1, 380) = 3.78, p = .053$; and a significant Time x Language x Uncertainty x Advice interaction, $F(1, 380) = 5.16, p = .024$. However, this interaction is driven by the effects at Time 1, $F(1, 208) = 3.24, p = .073$, but not time 2, $F(1, 208) = .35, p = .555$. Similarly, within low uncertainty, there is a significant time effect of advice in

morality scores at time 1, $F(1, 211) = 3.83, p = .052$, but not time 2, $F(1, 211) = 1.17, p = .280$. Advice was only manipulated before Time 2 measures, it is difficult to interpret this interaction and these effects are likely to be spurious. There were no further significant interactions of time with the manipulations, $F_s < 2.65, p_s > .104$.

Engagement with and understanding of the message. Including science training as an additional variable in the analysis of engagement revealed a marginal main effect of language style, $F(1, 400) = 3.51, p = .062$, as well as a significant Science training x Uncertainty interaction, $F(1, 400) = 10.00, p = .002$. Pairwise comparisons revealed a significant effect of science training in the high uncertainty condition, $F(1, 400) = 11.12, p = .001$; whereby when uncertainty is high, people who had had some level of science training ($M = 4.78, SD = 1.23$) felt more engaged with the message than those who had no science training ($M = 4.14, SD = 1.34$). Under lower uncertainty, engagement did not differ as a function of science training, $F(1, 404) = 1.41, p = .236$.

In other words, for people who had had at least some science training, engagement was greater under high uncertainty ($M = 4.78, SD = 1.23$) than low uncertainty ($M = 4.78, SD = 1.23$), $F(1, 404) = 5.12, p = .024$, whereas for people who had no science training, engagement was greater under low uncertainty ($M = 4.60, SD = 1.37$) than high uncertainty ($M = 4.14, SD = 1.34$), $F(1, 404) = 5.15, p = .024$. This interaction is shown in *Figure 3.13*, below. There were no further main or interactive effects on reported engagement with the message, $F_s < 2.93, p_s > .088$.

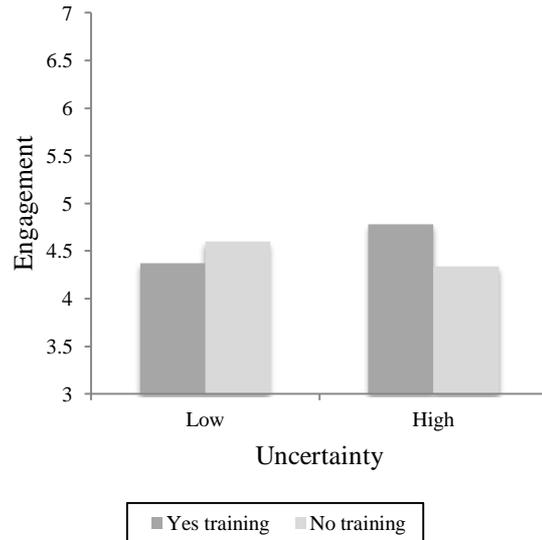


Figure 3.13. Uncertainty and science training interaction on message engagement

The analysis of perceived understanding revealed a marginal main effect of science training, $F(1, 400) = 3.55, p = .060$, with, contrary to logic, people having had no science training reporting slightly higher understanding comparative to people who had science training ($M_s = 5.13$ & $4.87, SD_s = 1.31$ & 1.28). There were no further main or interactive effects on reported understanding of the message, $F_s < 3.18, p_s > .076$.

Trust in the Linford Centre. Inclusion of science training in the analysis of trust revealed a marginal main effect of science training, $F(1, 399) = 3.63, p = .057$, with people having had science training reporting higher trust towards the Linford Centre than those having no science training, ($M_s = 4.79$ & $4.38, SD_s = 1.37$ & 1.46). There was also a significant Science training x Uncertainty interaction, $F(1, 399) = 5.95, p = .015$. Follow-up analyses revealed a significant effect of science training under high uncertainty, $F(1, 403) = 15.06, p < .001$: under high uncertainty, people who had had some level of science training perceived the Linford Centre as more trustworthy ($M = 4.92, SD = 1.39$) than people who had no science training ($M = 4.16,$

$SD = 1.35$). Under low uncertainty, science training did not affect trust, $F(1, 403) = .045, p = .833$. See *Figure 3.14*. There were no further main or interactive effects on trust towards the Linford Centre, $F_s < 2.75, p_s > .100$.

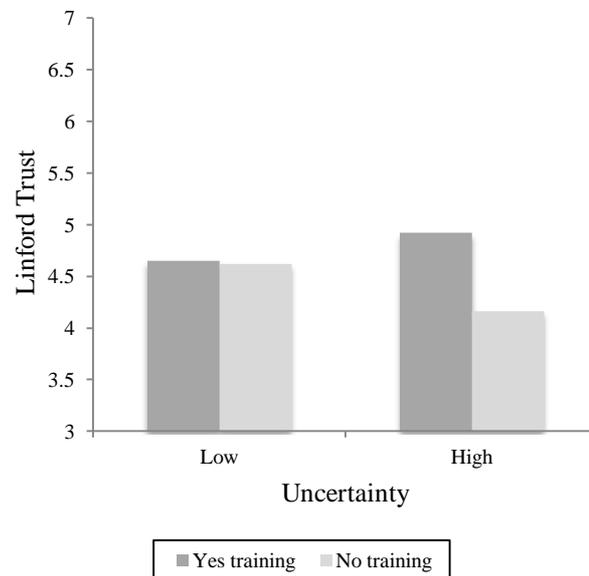


Figure 3.14. Uncertainty and science training interaction on Linford Centre trust

Global climate change belief. Inclusion of science training in the analysis of beliefs did not reveal any significant main effects or interactions, $F_s < 2.05, p_s > .15$.

Personal risk perception. Inclusion of science training in the analysis of risk perceptions also did not reveal any significant main effects or interactions involving this variable, $F_s < .711, p_s > .400$.

Efficacy. Inclusion of science training in the analysis of response efficacy also did not reveal any additional main or interactive effects involving this variable, $F_s < 1.50, p_s > .222$.

Behaviour. When examining general behavioural intentions, there was a significant main effect of science training on overall behavioural intentions, $F(1, 400) = 3.94, p = .048$, those with no science training reporting higher intentions ($M = 5.02, SD = 1.22$) than those with some level of science training ($M = 4.84, SD = 1.28$).

There were no further main or interactive effects on overall pro-environmental behavioural intentions, $F_s < 2.82$, $p_s > .094$.

Although there were no further main or interactive effects on the pro-environmental household behavioural intentions subscale, $F_s < 3.02$, $p_s > .082$, analysis of the travel intentions subscale revealed a significant main effect of science training, $F(1, 400) = 6.73$, $p = .010$. Respondents who had no science training reported stronger pro-environmental travel intentions ($M = 4.92$, $SD = 1.39$) compared to respondents who had had science training ($M = 4.52$, $SD = 1.48$). There were no further main, $F_s < 2.01$, $p_s > .157$, or interactive effects, $F_s < 2.19$, $p_s > .140$.

Summary of science training effects. There was some evidence of an effect of science training, however this was limited to certain dependent variables, namely engagement with the message and organisation trust. The importance of science training within the high uncertainty condition was similar to that seen before within this research – namely, there was an effect within high uncertainty comparative to low uncertainty. Specifically, science training played a positive role in people's engagement and organisational trust when uncertainty was high, compared to those who had no science training under the same conditions. People who had no science training felt more engaged with messages containing low uncertainty comparative to high uncertainty. While these results are intuitive, it is important to recognise that the role of science training in this instance is limited to variables engaging with the message and organisation. When it comes to beliefs and intended actions in response to climate change, there is no significant role played by science training, and instead gender is more significant (as seen in the earlier section).

Age effects

Organisation perceptions. The previous mixed analyses of variance on organisational perceptions were repeated with age as an additional variable. In the analysis of perceived competence, there were no significant main effects or interactions of time with the manipulations, $F_s < 2.33, p_s > .128$.

When examining perceptions of communicator morality, there was a main effect of gender $F(1, 398) = 7.15, p = .008$. There were no further significant main effects or interactions of time with the manipulations, $F_s < 1.82, p_s > .179$.

Engagement with the message and understanding of the message. With the inclusion of age as a fixed factor in the analysis, there were no main effects or interaction effects on engagement with the message, $F_s < 1.44, p_s > .232$. Gender as a covariate has a marginal main effect on engagement with the message, $F(1, 400) = 3.47, p = .064$.

The analysis of perceived understanding of the message revealed no main effects or interactions when including age a fixed factor, $F_s < 2.15, p_s > .144$.

Linford Centre trust. When examining trust towards the Linford Centre, gender carried a significant main effect, $F(1, 400) = 8.12, p = .005$. There was a marginal effect of language, $F(1, 399) = 3.00, p = .085$. There were no further main effects or interactions $F_s < 1.20, p_s > .193$.

Global climate change belief. When age was included as a variable in global climate change belief, there was a main effect of uncertainty $F(1, 400) = 3.99, p = .048$. There were no further significant interactions involving these variables, $F_s < 1.81, p_s > .181$.

Personal risk perception. When age was included as a variable in the analysis of personal risk perception there was a significant interaction of Language x

Uncertainty, $F(1, 400) = 3.97, p = .048$. There were no further significant main effects or interactions involving these variables, $F_s < .825, p_s > .365$.

Efficacy. When age was included as a variable, the analysis of efficacy. There was a marginal main effect of advice, $F(1, 400) = 3.47, p = .065$. There were no further significant interactions involving these variables, $F_s < 2.38, p_s > .125$.

Behaviour. When age is added as a variable on travel behaviour, there were no significant main effects or interactions involving these variables, $F_s < 2.56, p_s > .111$.

When looking at household behaviour, there was a significant main effect of advice, $F(1, 400) = 3.82, p = .053$. There were no further significant interactions involving these variables, $F_s < 1.09, p_s > .374$.

Summary of age effects. In addition to the possibility that variations in the gender and science training composition of the research samples might explain the divergence between the initial analyses of this study and the previously observed effects – something that is substantiated by the above analyses – I also considered whether age might also account for some of this variation. My previous studies used scientifically educated, mostly female, young, samples.

When age is included as a fixed factor in this analysis the results show a marginal main effect of language on Linford Centre trust, a main effect of uncertainty on global belief, and marginal main effect of advice on efficacy. Age does not appear to play a major role or interact with any of the manipulations; the results have been noted here, particularly given the known effect of age on climate change attitudes in the prior literature. For instance, usually older people are more sceptical and have lower scores on environmental values (e.g., DEFRA, 2007; Whitmarsh, 2011; Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011).

Discussion

The aim of this final experiment was to extend the prior work by incorporating the third significant theme that emerged from the qualitative investigation and became interested in the further role that providing behavioural advice (versus not providing this) might play in shaping public responses alongside the interactive effects of language and uncertainty observed in the previous studies. Furthermore I wanted to revisit the informational and peripheral effects of message transmission on a wider and more diverse audience.

Though there were no significant effects that reflected the research expectations when analysing the full sample, analysis on sub-populations within this sample did reveal patterns of effect in response to the manipulations, sometimes in ways that were consistent with previous observations and sometimes in ways that contradicted these. In particular, on the basis of this study, it seems as though the previously observed patterns of effect may have reflected the predominantly female samples being studied. In this study, the responses of women to the language and uncertainty manipulations were very similar to those previously observed in Experiment 1 and (correlationally) in Experiment 2. Women tended to be more responsive to open language, particularly under conditions of high uncertainty. Men, however, showed opposing responses to the same manipulations – they displayed resistance to the open language, particularly when it was combined with high uncertainty. There was also some evidence that these diverging patterns extended to the provision of advice – women generally responded positively to the provision of advice, especially when combined with open language, whereas men tended to react against this combination of factors. These diverging patterns account for the overall null findings in the primary analysis.

Whether people have been scientifically trained or not also seemed to affect levels of engagement with the message, especially when this was overlaid with uncertainty. Understandably, those who were trained in science were able to engage with high uncertainty, whereas people with no science training reported more engagement under low rather than high uncertainty. This pattern was also evident in levels of trust towards the organisation. When uncertainty is high, people with some science training reported that they trusted the Linford Centre more than people who had no science training experience. Although these effects of scientific training are understandable and interesting, they are more limited in their effects than gender in shaping responses to communication, at least in this setting. This is also the case when considering age. In that sense, gender may be a more important variable in relation to scientific communication, and the effects of specific languages and the provision of advice within this.

The effects of age in this study did not appear to have much influence in the results. Perhaps this is because other characteristics, such as gender, were more influential. Furthermore, perhaps the method of recruitment (internet-based) had something to do with this, with previously deemed traits associated with groups of older people (such as more conservative) are not necessarily applicable in this sample, as such traits are not constrained to older people here.

Understanding the gender effects. Gender is broadly considered to be a social construct reflecting culturally determined prescriptions of feminine and masculine characteristics, identities and behaviours (Johnson, Murphy, Zewdie, & Reichard, 2008). The literature also points to differences in the styles of communication among men and women, and their goals when engaging in communication (e.g., Roter & Hall, 2004; Sommers & Lawrence, 1992; Tannen, 1995; Steckler, & Rosenthal,

1985). For example, in workplace situations, women are less direct when they communicate and employ hedging words, such as ‘maybe’ or ‘if’. Men are, in comparison, more direct and more certain about content when they are communicating (Sommers & Lawrence, 1992). Interestingly, women also tend to have a more engaged and warm style of (nonverbal) communication compared to men (Hall, 1984). Indeed – in a study of email content, the use of “we” and “our” was more prominent among females than males (Colley & Todd, 2002).

Aside from these stylistic differences, the literature has also suggested that men and women in Western culture perceive the purposes of communication differently. Men were found to be goal-oriented and result-focused, viewing communicative exchanges as a means towards outcomes, such as obtaining power or dominance. Women, however, seemed to value the process of communication and the social interactions that come with it; as such, women are understood to be more relationship-oriented, valuing the closeness and intimacy within interactions with other people (e.g., Maltz &orker, 1982; Tannen, 1990; Gray, 1992; Eagly, 1987). These differences in the communicative cultures of men and women might help to explain their diverging responses in the present experiment – and indeed may offer an alternative perspective on the research conducted so far.

Recasting our minds back to findings from the qualitative interviews (Chapter 2), climate scientists (who were mostly males within the organisation, see page 43) advocated a deficit model to science communication, where *what* to communicate superseded consideration of how information is communicated (i.e., an informational communication style). In comparison, communicators (who were mostly females in the organisation, see page 44) were more concerned with *how* to communicate the information (i.e., a relational communication style). I would propose that, to some

extent, the differences seen between scientist and communicators in this study, such as language-use, tone of voice and purpose for communicating, mirrors the conclusions within male-female differences in gender communication literature, and indeed the findings in this experiment.

Given the overlap between the scientists model of communication and male communicative preferences more generally, it is perhaps not surprising that men in this experiment responded better to the ‘traditional’ scientific, authoritative, distant way of communicating. Females, being stereotypically closer to the model of communication advocated by the professional communicators, responded more positively to inclusive language and an open communication style, even when uncertainty was high.

While gender and communication research often points to the differences between men and women engaging in communicative exchanges, it also suggests that these are communicative styles that men and women prefer to be the recipient of. Indeed, when communications between men and women operate within their own gendered framework, misunderstandings arise, by virtue of using a different ‘genderlect’, whereby males and females are speaking different dialects (Tannen, 1990). Thus, as males tend to communicate more assertively themselves, when they receive information, they may respond in the same way; preferring low uncertainty and closed communication style. When layering advice on top of these language and uncertainty elements, given that research has shown women to be more proactive and open to information in the field of health of health promotion (e.g., Atkinson, Saperstein, & Pleis, 2009; Jones & Fox, 2009), it may be unsurprising that women were more inclined to engage with behavioural advice (especially under high uncertainty and/or open language); with men opposed to the provision of advice

(particularly when uncertainty is high or relational language is used). Males, however, responded to advice giving when the information provision is certain, and the method of communication is direct and distant.

This gender divergence in communication styles also maps on to research that shows the gender of the perceiver determines whether moral or competence indicators are preferred: competence indicators being preferred by men, whereas morality indicators are preferred by women (Wojciszke, 1994). Wojciszke (1994) suggests that this is something that is learnt from socialisation as early as childhood, and cites Eagly (1987) to illustrate the point, “people believe that women more than men ought to manifest the communal qualities . . . and that men, more than women, ought to manifest the agentic qualities” (Eagly, 1987, p. 23). Meaning, males learn that competency (agency) features are appropriate for construing their own behaviour, whereas females learn that moral features (communion) are suitable for construing their own conduct (Eagly, 1987).

Moving beyond the differences in communicative norms (as discussed earlier), and by looking into the stereotypic content of what behaviour is deemed gender appropriate may give insights into findings within my current study. Indeed, as Wojciszke states, there are “differences in what constitutes an appropriate frame of reference in understanding the behaviour of men and women” (1994, p. 231). From this, I would theorise that the gender differences in the acceptance-rejection of the differently framed messages, in addition to the contrasting communication styles, are also a product of a perceived violation of the expected stereotypic content dimension.

When considering the general notion of information provision, despite (often fear-provoking) advice-provision being a well-researched topic within the context of responding to health promotion messages, the literature suggests the consideration of

gender as a causal factor (rather than a differing effects consideration) has been limited (Gelb, Pederson, & Greaves, 2011). Exceptions have shown that women are more likely than men to search for health information online (Atkinson, Saperstein, & Pleis, 2009; Jones & Fox, 2009); indicating that women are more proactive and open to health information.

Identity threat and motivated reasoning. Generally speaking, humans begrudge unwanted advice, especially when it is viewed to threaten aspects within our everyday lives. Indeed, a general problem of climate change campaigns and environmental advocacy are the boomerang effects these may bring (Byrne & Hart, 2009). For example, anti-litter messages have been shown to actually increase, rather than decrease, tendency to litter (Reich & Robertson, 1979). Hart and Nisbet (2013) studied the boomerang effects in the context of climate mitigation policies. They suggest that such effects were due to biasing factors that occur when evaluating information in order to maintain existing beliefs. This draws upon previous research such as motivated reasoning (Kunda, 1990).

So while behavioural advice may have the intention to be positive in responded to climate change, it may have a converse effect that negates this. This appears to be a similar to the concept, psychological reactance, proposed by Brehm (1966). Brehm says, “psychological reactance is conceived as a motivational state directed towards the reestablishment of free behaviours that have been eliminated or threatened with elimination” (p .385). So while advising people to reduce carbon emissions by small behavioural changes, this could just highlight the potential for encroachment on one’s lives and how these changes will be a violation of their freedom to act upon behaviours freely.

In such situations of personal threat, people are motivated to regain the threatened loss of freedoms. For example, people tend to develop attitudes that justify their behaviour and protect their identity (Kunda, 1990; Kahan, Braman, Gastil, Slovic, & Mertz, 2007). Hart and Nisbet (2013) showed this in the context of climate science communication. They suggest that motivated reasoning guide how people interact with available identity cues to influence their identification with the message and/or the messenger. This may lead to their interpretation of the information in ways that reinforce their existing political views. Indeed, Whitmarsh (2011) found that similar perceptions of the credibility and trustworthiness of communicators of climate change information are guided by how individuals view the world.

General Chapter Discussion

The goal of this chapter was to build on the insights from qualitative work (Chapter 2). I developed a series of studies to explore elements of the three themes revealed in the qualitative work: communication processes, challenges, and roles of the climate scientist. Theme One concerned the different ways in which scientists and professional communicators understand the basic process of communication and the goals they pursue in relation to this when communicating. Climate scientists were advocates of the “information-deficit” science communication, whereby technical language and uncertainties are of central importance, and fully educating the public about climate science was the primary goal of communication. This model conceptualises the public as deficient in and ready to absorb scientific knowledge (Wynne, 1991; Gross, 1994). Despite this comment, I should here note that perhaps if I had interviewed climate scientists who specialised in communications with the public, this might have been different. However, while the scientists in my interview sample communicated with the public, the climate scientists did not focus on publics as the audience for their communication efforts (rather, they focussed on policy-makers, industry and other scientists). Communicators, however, adopted a more relational approach to science communication. They preferred to build a relationship with their audience(s) and achieved this through using features of language. Specifically, they advocated adopting a warm and friendly style of communication, which they termed ‘tone of voice’. This is akin to interactive approaches to communication which can also include an informal conversation style, such as using inclusive language (Logan, 2001; Einsiedel & Thorne, 1999).

I started the experimental research by way of a Pilot study to explore the possible effects of communication style (as varied by language use) on audience

perceptions of the communicator. Experiments 1 and 2 focussed on how communication style interacts with the informational content of climate change messages – specifically content that conveys scientific uncertainty, one of the key challenges for climate change communication identified under Theme Two of the qualitative analysis. Both these studies combined the communication style manipulation with a manipulation of uncertainty (lower versus higher) and examined the joint consequences of these factors for audience engagement and action. Sample selection for the Pilot and Experiments 1 and 2 was limited to university students.

Experiment 3 introduced an issue to this design that drew upon Theme Three from the qualitative research: the (conflicting) roles of scientists. In my earlier interviews, scientists had expressed concerns about the provision of guidance and advice on how publics might change their behaviour in response to the scientific information they provide. Specifically, they worried that providing advice and guidance might undermine their image as neutral providers of impartial information. With this in mind, I varied the provision versus absence of clear advice in the message and explored how this, in combination with communication style and uncertainty, shaped trust perceptions and responses. In addition, a much wider sample was selected, more representative of the general public.

There were recurring patterns within the data in the experimental studies presented in this Chapter that suggested that an open communicative style (through inclusive language use) had positive effects when communicating climate change information; perception of communicator morality (rather than warmth or competence) was influential when engaging and acting on climate change communication, particularly in situations of high uncertainty. These patterns appeared to be driven by females' response to information under such conditions. Men, in

contrast, reacted in opposition to open language and high uncertainty. When behavioural advice was provided, the same language-uncertainty patterns were seen among the different gender groups.

In the Pilot and Experiment 1, I showed that when open language was used, the audience perceived the communicator as more moral rather than competent (a marginal effect in the Pilot) or warm. Furthermore, using a closed language style did not influence audience perceptions of communicator competence, morality or warmth.

Experiment 1 showed that uncertainty can be an obstacle when communicating information about climate change. Global climate change beliefs declined when information contained high comparative to low uncertainty. Adopting an open language style engaged respondents more with the message and increased behavioural intentions, under conditions of high uncertainty. Experiment 2 showed correlationally similar patterns of the influence of perceived morality (despite the language manipulation failing) on pro-environmental intentions of household behaviour. Primary analysis of Experiment 3 revealed no main or interactive effects of any of the variables. The large and diverse sample used in the final experiment, however, meant that I could move beyond simply controlling for demographic effects and also explore any interactive effects demographics may have with the manipulated variables. Women were more receptive to open language under conditions of high uncertainty, and with the presence of advice. Men seem to react against open language, when presented under high uncertainty and/or advice. Science training played a small role in communications, limited to certain dependent variables, namely engagement with the message and organisation trust.

Despite the gender divergence in the final experiment, I have consistently shown that audience perceptions of communicator morality were particularly

important when uncertainty was high. As such, I would look towards the uncertainty management model by means of fairness and justice (Van den Bos & Lind, 2002) to give further insight into why this may be. van Prooijen and Jostmann (2013) asserts that “when people experience uncertainty they are more in need for information about the extent to which decision-makers have benevolent intentions, information that people tend to derive from the morality of the decision- makers’ behaviours” (p.109). In two studies examining the influence of uncertainty and perceived morality on belief in conspiracy theories, they provide evidence that perceived morality of authorities influences conspiracy beliefs, particularly when people experience uncertainty. They conclude, “uncertainty leads people to make inferences about the plausibility or implausibility of conspiracy theories by attending to morality information”, (p. 109). They suggest this could be because the situation of high uncertainty is more threatening to oneself (Peeters & Czapinski, 1990), therefore people look for signals of morality to help or harm them. With that, van Prooijen and Jostmann (2013) believed that the perceived morality (or immorality) strongly predicts the extent to which people believe in conspiracy theories under conditions of uncertainty.

In establishing the importance of linguistic features when communicating information, looking beyond the field of social psychology can offer further insights. Education research, for instance, has shown as early as the 1960s that the varying of language, and using words such as “we” reduces the psychological distance between teachers and students, and increases student motivation and learning (Mehrabian, 1969). This stylistic feature, termed ‘verbal immediacy’, has also the effect of increasing information recall (Kelly & Gorham, 1988) and motivation in-class (Christophel, 1990). Research suggests that verbal immediacy is related to receiver

judgments of source competence and character, and also how the communicator perceives the person they are interacting with (i.e., an affective appraisal) (Bradac, Bowers, & Courtright, 1979).

Limitations. It is acknowledged that the measured understanding of the message is *perceived* understanding rather than *actual* understanding. This brings a (potentially) certain limitation in that perceived knowledge and understanding does not necessarily equate to actual knowledge and understanding (e.g., Southwell, Murphy, DeWaters, & LeBaron, 2012; Laugksch, 2000). For example, Southwell, Murphy, DeWaters and LeBaron (2012) examined perceived and actual understanding of energy among the public, specifically measuring three concepts: perceived understanding of energy, demonstrated energy knowledge, and the ability to interpret an energy bill. They found that perceived understanding was not directly equivalent to actual understanding. Therefore, it has been argued that self-reported and actual measures of understanding are conceptually different and therefore consequently lead to different patterns of results when assessed (Ladwig, Dalrymple, Brossard, Scheufele, & Corley, 2012).

Despite this discrepancy between the two measures of ‘understanding’ (i.e., perceived versus actual), some researchers argue that with some science topics, perceived knowledge may be a better assessment of an individual’s knowledge (Kahan, Braman, Slovic, Gastil, & Cohen, 2009; Satterfield, Kandlikar, Beaudrie, Conti, & Harthorn, 2009). Ladwig, Dalrymple, Brossard, Scheufele and Corley (2012) suggest that the premise behind this comes from meta-cognition literature, specifically they say, “knowledge about one’s knowledge plays an important role in a variety of processing tasks” (p.2). This implies that while these are measuring two different constructs of understanding (actual versus perceived) there appears to be

different roles (and benefits) each aspect of knowledge can play when applied in research.

Ladwig, Dalrymple, Brossard, Scheufele and Corley (2012) suggest that this notion of perceived versus actual knowledge (which they term familiarity and factual knowledge respectively), to some extent, may be mapped on to how information is initially acquired and processed (discussed in Chapter 1, *5.1 Dual process models of information processing*). Specifically, perceived understanding is arguably relying on heuristic processing, whereby mental shortcuts guide decision-making, particularly when interest is low. Conversely, actual understanding of a topic may rely more on systematic processing, whereby interest might be high and information is deliberated at a deeper level. In setting the backdrop for this research, I argued that (due to its lack of personal and direct relevance, complexity, and uncertainty) most people will likely process climate change information peripherally or heuristically rather than centrally or systematically (see p.24).

The aim of the experimental studies presented in this chapter was (in part) to examine source influence in the communication process (i.e., heuristic processing). It therefore arguably follows that the ‘understanding’ that is assessed should also be at the heuristic level (i.e., perceived understanding). If the experimental studies had the aim of examining systematic processing (i.e., deliberation over information rather than via peripheral cues), perhaps measures of actual understanding would be more appropriate. In such studies, it would be wise to check whether the information had been properly read and processed (through manipulation checks), as well as testing for actual understanding of the information content.

Future research could further this examination of message content understanding (and its variations). For example, exploration of the relationship

between self-assessed (perceived) understanding and objectively-assessed (actual) understanding with respect to attitudes and behaviours could be compared.

Implications. Within the experimental research presented in this chapter, I broadly compared the informational deficit (distant, closed) and the relational (open, inclusive) styles of communication and their effects on audience perceptions and responsiveness. Experiments 1 and 2 pointed toward positive responses to the relational communication model. Experiment 3, however, is a reminder that not all segments within audiences react to information and its presentation in the same way. Indeed, Experiment 3 suggests there may be a role for the information deficit approach when communicating with a specific audience make-up (i.e., consisting typically of males) and conveying a particular type of information (i.e., low uncertainty). Such findings would support previous literature that promotes the segmentation of audience samples (e.g., Maibach, Roser-Renouf, & Leiserowitz 2009; Anable, Kelay, & Lane, 2006; Barnett & Mahony, 2011).

While previous research has shown the importance that framing climate change information has on audience responsiveness, I would suggest this should not be limited to how the information is represented, such as cost and loss framing (e.g., Spence & Pidgeon, 2010) or how uncertainty itself is worded, (e.g., Budescu, Broomell, & Por, 2009). Understanding audience values and beliefs is important when framing climate change communications; and indeed, tone of voice peripheral to the information content and how language resonates through words are also points to consider in such communications (Moser & Dillig, 2007). Based on my findings, I echo this position, and say that understanding communication processes, and how these shape audience motivations, is potentially the key to managing uncertainty when delivering messages about climate change. With the language manipulations

within this research illustrating such a gender divide, (females preferring open, males preferring closed) I reasoned that these language manipulations tap into the gendered norms of communication (as well as science and professional communicator differences).

This and previous research has highlighted the need for communicators to vary messages according to these diverse values, and depending on the particular goals of communication, potentially to frame message content and tone according to their audiences. Ebring, Goldenbery and Miller (1980) have shown that personal messages, especially interactive messages, have been shown to have a greater impact on attitude and behaviour change. Leiserowitz (2007) argued that a similar strategy should be applied to climate change communication and communicators should “tailor messages and messengers for particular interpretive communities” (p.57).

Though these informational and relational approaches to communication are quite different, I see them as belonging within the concept of managing communicative exchanges through language style. That is, being aware of the different approaches to communication may enable communicators a stronger toolset of relational management achieved through language characteristics. Specifically, as suggested, there are gender differences in the stylistic features, with males tending to be assertive, authoritative and goal-orientated, and females being warm and relationship-oriented. Being aware of these communication differences can help communicators understand and appreciate different sides of communication, thus enabling communicators to adapt the contrasting communication styles to their audience. As such, communication can become more effective by engaging audiences and reducing potential intercultural misunderstandings.

Research on computer-mediated communication (e.g., text-based via email, instant messaging) has shown that verbal similarity increases trust between the actors involved (Taylor & Thomas, 2008; Maddux, Mullen, & Galinsky, 2009). For example, Scissors, Gill, Geraghty and Gergle (2009) used level cooperation within a computer-mediated social dilemmas game as a proxy measure for trust (Riegelsberger, Sasse, & McCarthy, 2003; Rousseau, Sitkin, Burt, & Camerer, 1998), concluding that the type of language convergence is important in establishing trust. They found, while measures of structural (tenses or syntactic components) and stylistic (surface) convergence support the view of communication similarity increasing trust, content (semantic) level convergence is more ambiguous, and levels of trust can depend on the topic. They note “not all similarity is good, and that it can operate independently across different communicative levels” (p.535). Such nuances were not something I explored within the current research programme. Though taking into the account the amount and type of accommodation, and with whom, before it becomes damaging to interactions within the context of climate change communications would need to be considered.

Communication accommodation theory (Coupland, Coupland, Giles, & Henwood, 1988) can give insights into why this process may be effective. Communication accommodation theory suggests that interlocutors converge or adapt their communications to become similar to that used by the person they are communicating with (Giles & Ogay, 2007), (e.g., male-female exchanges). Thomson, Murachver and Green (2001) tested this theory in experiments whereby email communications were manipulated to be with the same or opposite sex. In examining the linguistic content of said emails, they found participants would modify their language style to suit the gender of their correspondent, i.e., convergent

accommodation. In a similar study, Colley and Todd (2002) found that women would significantly accommodate and converge in communication styles more than men. Females would employ affectionate language when signing-off, supporting the view that female communication contains more social warmth comparative to males (e.g., Lakoff, 1975). Furthermore, when males were communicating with females, there were more references to the informational topics (e.g., location), reflecting the male role as information-giver (e.g., Tannen, 1990).

With this in mind, modifying language to align with the audience can help people engage with communication; consideration of your audience and variations within audiences is important, as I discovered in Experiment 3. The series of experiments ended with a large sample ($n = 421$) comprising of a broad distribution of people, which allowed me to test my previous experimental findings beyond the confines of a university campus. While the use of university students (mostly psychology, majority female) as participants had the advantages of convenience and cost, the need for variability and a wider sample to survey was important on gender and science training variables, as shown in Experiment 3. On-campus studies are a reasonable place to develop research ideas and model concepts, but testing these manipulations (in this case language and uncertainty variations) on a diverse population is especially important to assess the generalisability of these findings. This helped provide a fuller picture of the manipulated effects beyond the student subpopulation, and doing so in this case proved fruitful and informative – supported by previous research and theories to help better understand this particular research context.

Better understanding of (sub)audiences' preferred communication styles would enable communicators and organisations to provide (and invest monies in)

services and methods that will enable them to target messages more effectively. I demonstrated how certain subpopulations (specifically females and males) are more responsive to different styles of communication, perceptions of morality and levels of uncertainty. I explained such differences by gendered norms in communication, showing the importance of considering the norms and values of the audience, not just the information contained in the message, thus providing further support for the interactional communication model.

Chapter 4

Moving from the Linford Centre to the Met Office:

Understanding better the origins of perceptions of organisational morality and competence. Quantitative and qualitative findings from a survey

The aim of this study was to better understand the basis of perceptions of competence and morality in climate change communications. The experiments contained in the previous chapter (Chapter 3) focussed on the possibility that open language would foster perceptions of organisational morality and shaping audience engagement, especially under conditions of high uncertainty. Although there was some evidence that language did have such effects, the relationship between communications styles and organisational perceptions was variable across the 4 studies in which this was tested. Despite this, perceptions of organisational morality seemed to be implicated in positive responses across studies – either because they were affected by language manipulations or independently of this. In part, the variable link between language and morality is likely to be due to the reality that language is only one input into organisational perceptions, and a fairly diffuse and subtle one at that. Equally it seems that what signals morality is also in the eye of the beholder, as revealed by the divergent responses of men and women to open language in Experiment 3.

The causes and consequences of perceived morality

Social psychology theories of person perception and stereotypic content suggest that evaluations of others can be shaped typically within two or three dimensions (depending on theoretical perspective), namely competence, warmth and

morality (e.g., Fiske, Cuddy and Glick, 2007; Brambilla, Rusconi, Sacchi, & Cherubini, 2011). Often the constructs of warmth and morality have been grouped together (e.g., Fiske, Cuddy and Glick, 2007), with some studies viewing warmth and morality separable (e.g., Wojciszke, 2005). Research indicates that it is not competence that guides person perception, but rather warmth (e.g. Fiske, Cuddy and Glick, 2007) or morality (Brambilla, Rusconi, Sacchi, & Cherubini, 2011; Wojciszke, 2005).

The theorising backdrop of judgements being based on warmth/ moral dimensions have been connected to a self-regulatory theory (Higgins, 1997) in that we seek cues to guide us to approach pleasure and avoid pain. Thus we makes inferences about whether a person will harm us (someone to avoid) or help us (someone to approach), and this is why perceptions of morality particularly (rather than competence) are the dimensions that drive our evaluations on whether to engage or not (Abele & Wojciszke, 2007; Leach, Ellemers, & Barreto, 2007). In furthering this perspective of morality, Janoff-Bulman, Sheikh and Hepp (2009) propose two distinct forms of morality with each style mapping on to the approach-avoid components. They suggest that *prescriptive morality* is responsive to positive outcomes (i.e., what we should do) is in contrast to *proscriptive morality*, that is sensitive to negative outcomes (i.e., what we should not do).

Given the importance of morality within person perception research, and indeed its importance within this particular research, I wanted to further evaluate the insights already found – qualitatively how people explained the basis of perceptions of morality and competence; and quantitatively in its application to a real world organisation.

The present study

To explore further the factors that might influence perceptions of morality, and perceptions of competence, in response to a real (rather than hypothetical) organisation, I conducted a survey asking participants to rate both the morality and competence of the Met Office¹⁷ and indicate their reasons for doing so.

As with Experiment 3 (Chapter 3), I decided to exclude the dimension of warmth from the present study due to the lack of previous effects in my earlier studies. Furthermore, based on previous literature, it is morality that is important in guiding impressions of others, particularly under conditions of high uncertainty. In addition to assessing these perceptions, I also asked participants to elaborate on what they were thinking about when they provided such ratings. This allowed examination of whether ratings of morality and competence – both positive and negative – are based on substantively different things, or whether similar inputs inform both dimensions. In addition to obtaining elaborations of what people look for to determine morality and competence, the scale responses to these items, in combination with additional questions (e.g., perceptions of scientific uncertainty beliefs about climate change and willingness to take action against this), gave me the opportunity to explore quantitatively the connections between these variables in a more real-world setting than the previous experiments allowed.

Method

Participants

Participants were recruited using a company specialising in online surveys, who use an online loyalty scheme points, enabling respondents to collect points that can later be exchanged for products. This survey took approximately 10 minutes to

¹⁷ The Met Office (an abbreviation for Meteorological Office) is the United Kingdom's national weather service. The Headquarters of the Met Office are located in Exeter, Devon, UK. Further information about the Met Office can be found on their webpage: <http://www.metoffice.gov.uk/>

complete. One hundred and eleven participants took part in this survey, of which 51 (46%) were male and 60 (54%) were female. The age of participants ranged from 19 to 70 years old ($M = 46.54$, $SD = 13.86$).

Procedure and measures

Unlike the previous studies reported in the last chapter, the goal of this study was to elicit peoples existing opinions. As such, there were no manipulations nor any information to be evaluated contained within this survey. Instead, I wanted to know how the public perceived a real organisation – the Met Office – on the dimensions of competence and morality, and to gain insight into the factors that informed these impressions. As such, participants were asked to separately rate the Met Office on indices of competence and morality and following these ratings were asked to describe the reasoning behind the given rating. The reasoning were qualitatively analysed and are presented following the quantitative results. I also included a range of scales to assess broader responses to climate change – including perceptions of uncertainty, belief in climate change, and individual intentions to act – in line with the previous studies. These scales, in combination with the ratings of organisational morality and competence, were analysed quantitatively using regression.

The survey started with a brief introduction outlining the purpose of the research and assuring respondent confidentiality and anonymity. Informed consent was gained before moving on to the content of the survey. I then had a series of 1 to 7 scale responses measuring the respondent's: perceptions of the morality and competence of the Met Office, perceptions of uncertainty in climate science, beliefs about the (human) causes of climate change, perceived consequences of climate change, perceptions of climate change risk, and behavioural intentions. The survey

used in this study can be found in Appendix 4.1. The scale items and reliability scores for each of these measures were as follows:

Organisation perceptions. At the outset, participants were asked how familiar they were with the Met Office and its work (1 = *not at all familiar* to 7 = *very familiar*). Then to assess respondents' perceptions of Met Office competence and morality, ratings on stereotypic traits were captured using a 7-point scale, ranging from 1 = *not at all* to 7 = *extremely*. Items assessing perceived competence were: competent, skilled, able, efficient, professional and incompetent reversed, ($\alpha = .91$), items assessing perceived morality were: moral, trustworthy, honest, sincere and dishonest reversed) ($\alpha = .91$). After completing each subscale (competence then morality) participants were prompted to elaborate on what they were thinking about when they gave these responses and given space to type these thoughts into the survey. The exact wording to probe this was, "Can you tell us a little bit more about what you were thinking of when you answered the questions above? When you rated the Met Office on the adjectives above, was there something you were thinking about that might explain the impression that you have? In the space below, please tell us what you were thinking about when you answered the above questions about your impressions of the Met Office".

Participants were moderately familiar with the Met Office and the work they do ($M = 3.88$, $SD = 1.51$), and generally had a positive impression of the Met Office in terms of competence ($M = 5.30$, $SD = 1.15$, ranging from 1.50 to 7) and morality ($M = 5.33$, $SD = 1.18$, ranging from 2.20 to 7). After giving these brief impressions of the Met Office, participants were asked more general questions about their perceptions of climate science and climate change.

Perceived uncertainty within science and among scientists. Five items measured participants' perceptions of uncertainty within climate science and amongst climate scientists. These items included: "Among scientists, there is disagreement about the causes and consequences of climate change"; "In the science, there is still uncertainty about how much climate change is really happening"; "In the science, there is still uncertainty about the effects climate change might have"; "Scientists generally agree about the causes and consequences of climate change" reversed; and "All things considered, the scientific community are very certain about the nature and extent of climate change" reversed. All items were rated on the 7-point scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*. After appropriate reverse scoring, each of these sets of items was averaged into single index of perceptions of science uncertainty ($\alpha = .75$).

Global climate change belief. As outlined in the chapter presenting the series of experiments (Chapter 3), I combined a range of relevant items into a single index of general belief in the reality of dangerous human-caused climate change ($\alpha = .84$). This general index combines subscales of: climate change belief (e.g., "In my opinion climate change is happening", 3 items, $\alpha = .84$); climate change as an anthropogenic, rather than natural, occurrence (e.g., "In my opinion climate change is man-made", 3 items, $\alpha = .81$); and perceptions of global risk as a consequence of climate change (e.g., "I believe there is a global risk of the consequences of climate change 3 items, $\alpha = .87$).

Personal risk perceptions. As in previous studies, specific perceptions of personal risk were separated from the global belief index and measured through three items: "I feel personally at risk from the consequences of climate change"; "I personally worry about climate change and how it will affect me"; and "For me,

climate change is nothing that I am personally concerned about” (reversed; $\alpha = .73$).

Individual intentions. I measured intentions to engage in pro-environmental behaviours in the same way as the previous studies. Household intentions consisted of items: “Reduce my household energy use”; “Recycle”; “Use less water”; and “Reduce, reuse, recycle” ($\alpha = .90$); and travel-related behavioural intentions consisted of items: “Walk instead of using the car”; “Cycle instead of using the car”; “Use a car less”; “Use public transport instead of the car”; and “Limit unnecessary air travel” ($\alpha = .79$). Each statement was responded to on a 7-point scale, 1 = *not at all willing* to 7 = *very willing*.

Demographics. Finally, I gathered demographic information such as gender and age, and provided a space at the end for further comments. Here respondents were provided with a web link to receive their company reward points. Following this participants were provided with information explaining the purpose of the research. Participants were also provided with contact details for further information.

Quantitative Results

Preliminary analysis

Unlike the earlier studies, there were no gender differences in perceptions of perceived competence, $t(107) = -.09, p = .992$, and perceived morality, $t(107) = -.86, p = .364$, males ($M = 5.30, SD = 1.08, M = 5.43, SD = 1.23$) and females ($M = 5.28, SD = 1.07, M = 5.24, SD = 1.14$). There were also no significant relationships between gender and perceptions of uncertainty, $t(107) = -1.11, p = .260$, (males $M = 5.28, SD = 1.05$; females $M = 4.51, SD = 1.09$) or with belief in climate change ($t(107) = -.34, p = .734$), perceived personal risk, $t(107) = -.21, p = .833$, and household, $t(106) = -.66, p = .511$, and travel intentions, $t(106) = .54, p = .591$. Age was positively correlated with perceptions of uncertainty in science, ($r = .24, p =$

.014). Due to the absence of demographic effects in this dataset, age and gender were not included as control variables in the subsequent analyses.

The item means, standard deviations, correlations and reliability scores for the focal variables are summarised in *Table 4.1*. As shown in the table the strongest correlation is between perceived morality and competence of the Met Office ($p = .001$). There was no significant relationship between perceptions of uncertainty in science and competence or morality ($ps > .569$).

Perceived competence was correlated with a number of variables; belief of global climate change ($p < .001$), household intentions ($p < .001$) and travel intentions ($p = .05$). Perceived morality was correlated with household intentions ($p = .001$) and travel intentions ($p = .023$).

Perceived climate science uncertainty was significantly negatively correlated with global climate change belief ($p < .001$), perceptions of personal risk ($p < .001$), travel intentions ($p = .025$).

Given the strong positive correlation between competence and morality, in the subsequent analyses I controlled for the alternative dimension when examining the role of morality and competence in shaping responses to uncertainty and guiding climate related thoughts and actions.

Table 4.1. Means, SDs, Correlations and Cronbach's alpha for variables in Met Office perceptions survey

Variable	Mean	SD	1	2	3	4	5	6	7
1. Competence	5.30	1.15	(.91)						
2. Morality	5.33	1.18	.79**	(.91)					
3. Perceived uncertainty	4.40	1.07	-.06	-.05	(.75)				
4. Global belief	4.88	1.10	.32**	.31**	-.36**	(.84)			
5. Personal risks	4.18	1.23	.16	.17	-.42**	.67**	(.73)		
6. Household intentions	5.40	1.13	.35**	.31**	-.17	.39**	.28**	(.90)	
7. Travel intentions	4.91	1.29	.19	.22*	-.22*	.42**	.37**	.70**	(.79)

Note: $N = 111$ **. Correlation is significant at the 0.01 level, *. Correlation is significant at the 0.05 level. Reliabilities (Cronbach's α) are on the diagonal.

Moderated Regressions

To develop further the preliminary insights from the bivariate analyses, regression analyses were undertaken in which climate change belief, perceptions of risk and behavioural intentions, were taken as dependent variables. As with the previous studies, my primary interest was in whether and how perceptions of the Met Office, especially perceptions of morality, interacted with perceived uncertainty to influence individual responses. Thus, two-step hierarchical multiple regressions were conducted in which perceptions of the Met Office (competence, morality) and perceptions of uncertainty in climate science were entered in Step 1; and then interactions between Met Office (competence and morality) perceptions with uncertainty were entered at Step 2.

Global climate change belief. The overall model predicting belief in global climate change is significant, $F(5, 103) = 7.35, p < .001$. At the first step, this model was driven by a significant main effect of perceived uncertainty ($\beta = -.34, p < .001$): as reported above, higher uncertainty reduced belief in global climate change. At Step 2 of this model, F Change $(2, 103) = 2.63, p = .077$, there was a marginally significant interaction between perceived competence and perceived uncertainty ($\beta = .31, p = .065$), and a significant interaction between perceived morality and perceived uncertainty ($\beta = -.40, p = .024$). There were no main effects of perceived competence or perceived morality, β s $< .19, ps > .182$. The results are shown in *Table 4.2*.

Table 4.2. Regression analysis predicting global belief

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	4.78	.62		7.69	.000
Perceived Competence	.17	.13	.17	1.23	.220
Perceived Morality	.14	.13	.15	1.10	.275
Perceived Uncertainty	-.35	.09	-.34	-3.97	.000
2. (Constant)	4.43	.64		6.90	.000
Perceived Competence	.13	.13	.13	.95	.346
Perceived Morality	.18	.13	.19	1.34	.182
Perceived Uncertainty	-.26	.10	-.26	-2.73	.007
Competence x Uncertainty Interaction	.25	.14	.31	1.87	.065
Morality x Uncertainty Interaction	-.32	.14	-.40	-2.29	.024

Note:

¹R = .48, adj R² = .20; F(3, 105) = 10.18, p < .001.

²R = .51, adj R² = .23; F(5, 103) = 7.35, p < .001.

To probe the Morality x Uncertainty interaction, I followed the procedures outlined by Aiken & West (1991) and examined the relationship between (centred) uncertainty and belief and values of perceived morality 1SD above and below the mean. This analysis revealed that when perceived uncertainty was low, people were more likely to have stronger climate change beliefs when they perceived Met Office morality is high comparative to when perceived Met Office morality is low, $t = -3.97$, $p = < .001$. When perceptions of uncertainty are high, however, global beliefs are similar to when perceived Met Office morality is low and high. This interaction is graphed in *Figure 4.1*. Looked at differently, when perceived morality is high, global belief is higher when uncertainty is perceived to be low ($M = 5.49$) comparative to high ($M = 4.60$).

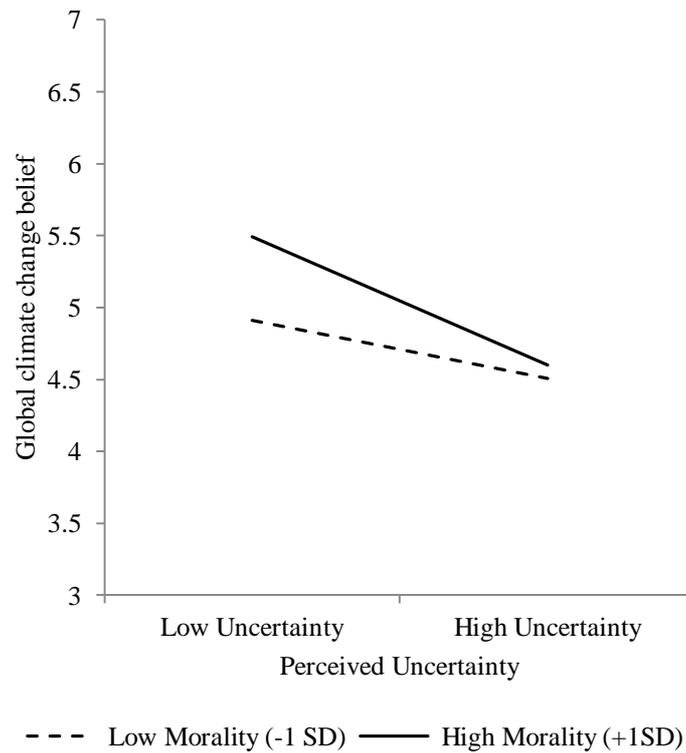


Figure 4.1. Simple slopes predicting global belief with perceived morality and perceived uncertainty

Personal risk perception. When the same analysis was performed on personal risk perceptions, there was again a significant effect of uncertainty at Step 1 ($\beta = -.41$), $F(3,105) = 8.80$, $p < .001$, higher uncertainty was associated with less perceived risk. This effect remained constant at Step 2 ($\beta = -.39$, $p < .001$), and was not moderated by either perceived morality or competence. The full model was significant, $F(5, 103) = 5.26$, $p < .001$, $F\ Change(2, 103) = .17$, $p = .884$. The results are shown in *Table 4.3*.

Table 4.3. Regression analysis predicting perceptions of personal risk

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	5.38	.71		7.61	.000
Perceived Competence	.05	.15	.05	.34	.732
Perceived Morality	.11	.15	.11	.77	.444
Perceived Uncertainty	-.47	.10	-.41	-4.73	.000
2. (Constant)	5.25	.75		7.03	.000
Perceived Competence	.06	.16	.05	.35	.727
Perceived Morality	.11	.15	.11	.76	.451
Perceived Uncertainty	-.45	.11	-.39	-4.00	.000
Competence x Uncertainty Interaction	.01	.16	.01	.03	.973
Morality x Uncertainty Interaction	-.05	.16	-.06	-.33	.740

Note:

¹ $R = .45$, adj $R^2 = .18$. $F(3,105) = 8.80$, $p < .001$.

² $R = .45$, adj $R^2 = .17$. $F(5, 103) = 5.26$, $p < .001$.

Household behavioural intentions. When the same analysis was performed on household intentions, there was a marginally significant effect of competence at Step 1 ($\beta = .28$, $p = .062$), $F(3,104) = 6.12$, $p = .001$, again higher perceived competence was associated with higher household intentions. This effect remained constant at Step 2 ($\beta = .28$, $p = .068$), and was not moderated by perceived uncertainty. The full model was significant, $F(5, 102) = 3.64$, $p = .005$, F Change (2, 102) = .08, $p = .922$.

The results are shown in *Table 4.4*.

Table 4.4. Regression analysis predicting household intentions

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	4.21	.68		6.24	.000
Perceived Competence	.28	.15	.28	1.89	.062
Perceived Morality	.08	.14	.08	.56	.577
Perceived Uncertainty	-.16	.10	-.15	-1.63	.107
2. (Constant)	4.30	.72		6.01	.000
Perceived Competence	.28	.15	.28	1.84	.068
Perceived Morality	.08	.15	.08	.54	.593
Perceived Uncertainty	-.17	.11	-.17	-1.62	.109
Competence x Uncertainty Interaction	-.01	.15	-.02	-.10	.924
Morality x Uncertainty Interaction	.04	.16	.05	.29	.776

Note:

¹ $R = .39$, adj $R^2 = .13$. $F(3,104) = 6.12$, $p = .001$.

² $R = .40$, adj $R^2 = .11$. $F(5, 102) = 3.64$, $p = .005$.

Travel intentions. The model predicting travel intentions was significant, $F = 3.407 (5, 102), p = .020$. At the first step of this model, $F = 2.256 (5, 102), p = .054$, there was a significant negative effect of uncertainty in climate change ($\beta = -.20, p = .032$): Higher perceived uncertainty was associated with reduced pro-environmental travel intentions. There were no effects of competence or morality at this step, $\beta s < .18, ps > .214$. At Step 2, $F \text{ Change } (2, 102) = .57, p = .566$, the effect of uncertainty remained significant ($\beta = -.25, p = .018$) and there were no significant interactions with perceived uncertainty, $\beta s < .15, ps > .453$. The results are shown in *Table 4.5*, below.

Table 4.5. Regression analysis predicting travel intentions

Step/Predictor	B	Std. Error	Beta	t	Sig.
1. (Constant)	4.75	.79		5.99	.000
Perceived Competence	.04	.17	.03	.21	.837
Perceived Morality	.20	.17	.18	1.18	.241
Perceived Uncertainty	-.25	.11	-.20	-2.18	.032
2. (Constant)	5.02	.84		6.00	.000
Perceived Competence	.04	.18	.03	.21	.831
Perceived Morality	.19	.17	.18	1.13	.262
Perceived Uncertainty	-.30	.13	-.25	-2.40	.018
Competence x Uncertainty Interaction	-.04	.18	-.05	-.25	.804
Morality x Uncertainty Interaction	.14	.18	.15	.75	.453

Note:

¹ $R = .30, \text{adj } R^2 = .06. F(3,104) = 3.41, p = .020.$

² $R = .32, \text{adj } R^2 = .06. F(5, 102) = 2.26, p = .054.$

Discussion of Quantitative Analysis

The quantitative aspect of this survey revealed that perceptions of Met Office competence and morality were relatively high—and that these dimensions were also highly correlated.

Comparing these results with other research (Barometer, Met Office, 2013, $n = 1992$) on perceptions of the Met Office, 80% of respondents said they trusted the organisation, ranging from ‘a little’ to ‘a lot’. While my Met Office perceptions study did not have a specific measure of trust, we could combine measures of competence and morality as an indicator measure of trust. Here perceptions of Met Office competence and morality responses were not qualitatively labelled, but instead used a 7-point scaled which was labelled 1 (not at all) to 7 (very much so). As a guide I took just over the mid-point as an equivalent to ‘a little’; with this as a guide upwards, 90% of the present sample having a view from ‘a little’ to ‘a lot’.

Based on the regression analyses reported, perceptions of climate science uncertainty seemed to be the main determinant of responsiveness to climate change. Consistently, as might be expected, the higher the perceived uncertainty, the less people believed in climate change, the less they felt it was a personal risk for them and the less inclined they were to act (at least with pro-environmental transport choices).

Uncertainty. This study has highlighted the different dimensions of certainty. The uncertainty that is dealt with in this chapter is different to the uncertainty presented in the Chapter 3, where experimental studies manipulated the level of uncertainty of climate impacts. Some of this work appears to contradict the findings from the earlier experiments that showed perceptions of organisational morality allow people to engage even under high uncertainty: in this study a converse pattern is shown, where perceived high uncertainty combined with perceptions of high organisational morality seemed to undermine (rather than support) belief in the phenomenon of climate change. One could speculate the reasons for this. Perhaps this was due to the difference in type of uncertainty examined in the respective studies.

Recall, for instance, the previously observed interactions involved manipulations of uncertainty via climate change likelihood impacts. The form of uncertainty presented in this study is to some extent akin to Knight's (1921) probabilistic uncertainty. The uncertainty assessed here was not manipulated in any way. Instead, it was a free-response measure of uncertainty and it referred to uncertainty around the phenomenon of climate change itself, rather than simply its impacts. This form of uncertainty is arguably similar to Knight's (1921) concept of immeasurable uncertainty.

As discussed in the opening chapter of this thesis (*Introduction*), uncertainty can characterise many aspects in the risk assessment and risk communication contexts (from page 9 in particular). From quantifiable errors/ unknowns in the data, to uncertain projections of human/ non-human behaviour - often these are represented by metrics in probabilistic terms (page 9). This is a common form of uncertainty used by climate scientists and within the IPCC reports.

However, uncertainty can also be characterised in other forms. For example, Funtowicz and Ravetz (1990) differentiate between three types of uncertainty. *Inexactness*, i.e. a technical uncertainty concerning errors in empirical quantities; *Unreliability*, which is related to methodological uncertainties, for example, from an incomplete understanding and from the approximations made when describing the structural and functional characteristics of a system under study; and *epistemological* uncertainty (e.g., omissions of processes and parameters due to ignorance – 'ignorance of ignorance').

The European Environment Agency (2001) argued that the term 'uncertainty' was often conflated with other terms, such as 'risk' and 'ignorance'. To clarify the concepts, the EEA propose that *risk* has 'known' impacts and 'known' probabilities (e.g., asbestos causing respiratory disease, lung and mesothelioma cancer, 1965–

present). *Uncertainty*, however, has ‘known’ impacts and ‘unknown’ probabilities (e.g., antibiotics in animal feed and associated human resistance to those antibiotics, 1969– present). Finally, *ignorance* has ‘unknown’ impacts and therefore ‘unknown’ probabilities (e.g., the ‘surprises’ of chlorofluorocarbons (CFCs) and ozone layer damage prior to 1974; asbestos mesothelioma cancer prior to 1959).

Other faces of uncertainty, beyond that of scientific uncertainty, have been recently argued for, such as *social uncertainties*. These are uncertainties over political and social decisions related to climate change (Hulme, 2009). Corner, Whitmarsh and Xenias (2012) conducted experimental work based on Hulme’s distinction between the science of climate change and its social, political and moral implications. The researchers varied newspaper articles that either created scientific uncertainty or political/ moral uncertainty around climate change. While their results showed that science-based editorials were viewed as more reliable and convincing than the editorials that focussed on moral/ political uncertainty, there was no significant attitudinal change following either article (whether it contained moral/ political uncertainty or scientific uncertainty).

Perceived uncertainty is a key determinant of climate change scepticism (Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011). Poortinga, Spence, Whitmarsh, Capstick and Pidgeon (2011) explored uncertainty and scepticism about climate change and the potential impacts of climate change. They applied the scepticism framework of Rahmstorf (2004). This framework distinguishes between *trend* sceptics, who deny there is such a thing as an upward trend in global temperatures; *attribution* sceptics - who accept that the earth’s climate is changing, but do not accept this is due to anthropogenic forces; and *impact* sceptics, those who believe in the occurrence of anthropogenic climate change, but do not think it will

lead to substantial detrimental impacts. They found that uncertainty and scepticism concerning climate change *impacts* were common, while *trend* and *attribution* scepticism were less common. They also found that politically conservative attitudes and traditional values seemed to shape people's responses to social representations of climate change.

Social scientists have suggested that, despite a growing expert consensus opinion of climate change, public scepticism towards climate change has increased in recent years (e.g., Leiserowitz, Maibach, Roser-Renouf, Smith, & Dawson, 2013). This use of the term 'scepticism' strays from the traditionally understood position of organised scientific scepticism (Merton, 1944/73). Nowadays, particularly in the context of climate change, 'scepticism' has become synonymous with disbelief in anthropogenic climate change. However, Corner (2010) asserts that scepticism and non-belief are crucially distinct. He argues that, rather than base their views on (overwhelming) scientific evidence, climate sceptics' opinion is often based upon ideology. When exploring public perception of cold weather events as evidence for and against climate change, Capstick and Pidgeon, (2013) demonstrate that how people interpret cold weather is associated with levels of pre-existing scepticism about climate change, which is in turn related to more general worldviews.

Scepticism and identity threat. The increase of public scepticism towards climate change (Whitmarsh, 2011) appears almost paradoxical given the high levels of public awareness of climate change (e.g., BBC, 2010); and public acceptance of human-induced climate change (e.g., ESRC, 2014); and a scientific consensus of the Earth's changing climate (e.g., IPCC, 2013). The concepts of identity threat and motivated reasoning were discussed earlier in Chapter 3 (specifically in the context of Experiment 3, with advice provision) – similarly this may be applicable here.

Perceptions of higher levels of uncertainty may enable defensive responses toward climate change information (such as lower belief, lower perceptions of risk and lower intentions to engage in pro-environmental travel behaviours). Pre-existing beliefs (i.e., scepticism, perceived uncertainty) have generally been shown to have a strong influence on audience responsiveness (e.g., Corner, Whitmarsh and Xenias, 2012).

The present study has provided evidence that perceived uncertainty (i.e., scepticism) was a strong predictor of global and personal risk perceptions, and travel intentions (but not household intentions). The issue of identity threat and motivated reasoning may again be relevant in interpreting the behavioural intentions results. Thus, the implicit perception that climate change has the potential of encroaching on one's personal life may make people resistant to change, yet where uncertainty is perceived as high, may provide just reasoning to be unresponsive to climate change.

For instance, the results show that uncertainty predicts unwillingness to change travel but not household behaviours. This finding is concurrent with previous research that has shown travel behaviour change being viewed as more challenging compared with other lifestyle changes (e.g., Chatterton, Musselwhite, Lyons, & Clegg, 2009). This may be because travel mode choice is strongly linked to personal motives, such as autonomy (e.g., Ellaway, Macintyre, Hiscock, & Kearns, 2003; Gardner & Abraham, 2007; Hiscock, Macintyre, Kearns, & Ellaway, 2002; Mann & Abraham, 2006; Musselwhite & Haddad, 2010). In a study commissioned by the Department for Transport, Chatterton, Musselwhite, Lyons and Clegg (2009) explored the influence of environmental information on personal travel behaviour. They found strong links between the use of the car and perceived freedom, concluding this link is a key challenge in efforts to change travel behaviour.

Challenges that hinder the reduction of private car use comes from the affective motivations as well as the utility (i.e., cost, time) of the car. Steg, Vlek and Slotegraaf (2001) distinguished between symbolic-affective and instrumental-reasoned motives for car use. *Instrumental* reasons are concerned with the functionality of the car, such as time and costs. *Symbolic* functions of the car include using the car as a status symbol, as a means of self-expression, and prestige. The *affect* aspect refers to the emotions induced by the symbolism of the car, such as power and feelings of sensation. Steg et al. (2001) conclude that instrumental and symbolic-affective meanings of the car are significant features underlying the attractiveness of car use.

Jensen (1999) argues that the car is symbolic of freedom and they believe “that the make of the car says something about one’s personality” (p.21). Akin to this, Mann and Abraham (2006) identified four types of satisfaction linked with car use (personal space, identity, autonomy, and experiential).

Recent qualitative work by Thomas, Walker and Musselwhite (2014) compared focus group discussions regarding carbon reduction targets amongst different travel mode users of the same workplace. Again, travel mode was strongly linked to personal autonomy. Furthermore, Thomas, Walker and Musselwhite (2014) found car drivers and motorcyclists to be most pessimistic and cautious regarding imposing restrictions associated with carbon emissions; whereas than walkers and cyclists showed most awareness and concern.

Recent social psychological research (e.g., Jaspal, Nerlich, & Cinnirella, 2013) makes links between social representations of climate change, identity and travel mode choices. Jaspal, Nerlich and Cinnirella (2013) argue that autonomy associated with car use is not simply at the level of the individual, but is also “informed by

relevant social representations, and the degree to which the individual endorses these as part of their on-going strategy to maintain and serve the identity” (p.120). Indeed, the car in particular can constitute an important element of identity (Mann & Abraham; 2006; Prillwitz, & Barr, 2009).

This can again be related to motivated reasoning or identity-protective cognition (Kunda, 1990; Kahan, Braman, Gastil, Slovic, & Mertz, 2007). This entails the appraisal of evidence in ways that validate pre-existing beliefs and identity, a phenomenon that has recently been linked to climate change perceptions (Whitmarsh 2011; Corner, Whitmarsh, & Xenias, 2012). Car drivers and motorcyclists were found to often shift the emissions blame to larger sources of emissions. This has been suggested to be a defence mechanism, justifying continued driving or motorcycling (Chatterton, Musselwhite, Lyons, & Clegg, 2009; Thomas, Walker, & Musselwhite, 2014).

van Prooijen and Sparks (2014) propose that attenuating information towards one’s pre-existing beliefs and values has the potential of increasing acceptance of human-induced climate change. They explain this in the context of self-affirmation theory (Harris & Napper, 2005; Steele, 1988), whereby when people encounter counter-attitudinal information, they are likely to process this in a biased manner in order to defend beliefs that are part of the self-identity. In addition to how the impact of initial beliefs on the acceptance of anthropogenic climate change information can be attenuated, van Prooijen and Sparks (2014) also found that self-affirmation increased acceptance of climate change risks and individual efficacy only among participants who were initially more sceptical about the impact of human activity

Organisational perceptions. Although the previous experiments led to expectations of interactions between uncertainty and organisational morality, this

interaction was only significant with respect to belief in climate change. Moreover, the form of this interaction was somewhat different to what was previously observed. In the earlier experiments in this thesis, organisational morality (as signalled by language) buffered people against the negative effects of uncertainty and made them more inclined to act under uncertainty. In this study, those who perceived high organisational morality were most affected by uncertainty: if the science was perceived to be uncertain they were less inclined to believe in climate change and conversely when the science was perceived to be certain they were most believing in the phenomena. Those who did not perceive the organisation as moral were not affected by scientific uncertainty.

Qualitative Data Analysis

In addition to the quantitative data, I collected qualitative data concerned with how people explained their perceptions of organisational morality and competence. To assist with the analysis of this qualitative data, I divided participants into two groups based on higher versus lower perceptions of Met Office morality and competence, using the bottom and top quartile of the variable range. The distribution of responses on these variables was not even and did not spread across the entire scale range. As already shown in the descriptive statistics, both competent and moral dimensions achieved a mean score of over 5 on the 7-point scale. The scale range was also truncated at the lower end with very few participants scoring below the scale mid-point of 4. Thus, the upper quartiles on these measures represent very positive perceptions of the organisation (upper quartile *M* competence = 6.17; upper quartile *M* morality = 6.20), and the lower quartiles represents moderate (or ambivalent) rather than explicitly negative perceptions (lower quartile *M* competence = 4.67; lower quartile *M* morality = 4.40). Reflecting this ambivalence, participants within these

lower quartile groups tended to write less when elaborating on their previous ratings, compared to more extended texts provided by those who gave positive scores on each dimension.

Despite the limited data that was obtained about the basis of “negativity” (or more accurately “ambivalence”), when responses were given, positive and negative perceptions seemed to be based on similar criteria to the positive judgements. That is, if one person perceived the Met Office positively in terms of competence because their forecasts were reliable, another might perceive them negatively on that dimension according to the same criteria (i.e., because their forecasts are unreliable). Thus the difference between groups was more one of evaluation of criteria rather than the criteria on which these evaluations were made. Accordingly, when determining themes within the qualitative data, positive and negative responses to each dimension are discussed together, because they reveal very similar underlying judgemental criteria.

The analysis of this data began with myself becoming familiar with the text. I looked for repetition, coding these as I went along. I labelled these patterns of themes that helped explain the data. I then reached a point where new readings of the verbatim would fit previously determined concepts without introducing new themes.

Two central themes emerged from the qualitative examination of the verbatim responses within this dataset. The first concerns points of overlap between perceptions of Met Office competence and morality; and the second concerns points of divergence in articulations between competence and morality. This discussion of these themes will be supplemented with verbatim extracts from the data¹⁸ and the participant’s mean score for the particular dimension they were referring to in their

¹⁸ Minor spelling errors were corrected.

text.

Theme One. Overlap: Accuracy & reliability.

The first and most striking observation is that in articulating the reasons behind their judgements, people generally based their perceptions of the Met Office on the *accuracy and reliability of the weather forecasts* provided. This was almost always the case, and was discussed in relation to both competence and morality. Where this was not the case, this was also interesting and makes up *Theme Two* of this analysis.

Firstly I note that when examining the texts from the lower and upper quartiles (i.e., ambivalent to positive), people were basing their judgements of the Met Office on the same feature being accuracy of weather forecasts. Meaning that, despite having opposing perceptions of Met Office on levels of competence and/or morality, judgements were being made on the same characteristic (i.e., weather forecast accuracy) but the perceptions were in differing directions.

Secondly, evaluating the Met Office based on the (perceived) accuracy of their weather forecasts occurs whether respondents were prompted to talk about competence or morality. That is, when people talked about one content dimension (e.g., morality) they would refer to the alternate dimension (e.g., competence). Indeed, this dimensional commonality was already apparent from the high correlation between these dimensions in the present and all other studies ($r = .79$). As such, it was not surprising to see such overlap qualitatively; clearly perceptions of one tend to inform perceptions of the other.

The following extracts are verbatim responses from four different participants describing the features on which they reasoned their judgements. More specifically,

the four extracts presented below illustrate the commonalities at two levels, a) ambivalent and positive scores; and b) competent and moral dimensions.

On the whole their forecasts are pretty accurate
Respondent 103 (Competent score 6.83)

Couldn't get a weather forecast correct to save
their lives
Respondent 46 (Competent score 3.38)

They appear to know what they are talking about
Respondent 47 (Morality score 7)

They can't predict the weather all the time
Respondent 60 (Morality score 2.60)

While positive and ambivalent perceptions of competence refer to accuracy of weather forecasting, responses among the upper quartile particularly appeared to be more sympathetic of the difficulty in weather forecasting:

Difficult job, getting harder with severe
weather variations - this has not impacted
in the quality and accuracy of their
forecasts.
Respondent 77 (Competent score 6.17)

Unlike those who perceived the Met Office positively in terms of competence, those who were ambivalent in this dimension displayed little understanding of inherently uncertain weather and climate systems. Further, there may be a small role

of respondent lack of understanding of what the Met Office do relating to a lower level of perceived competence. For instance,

As I am not sure what the met office do these are my only answers.

Respondent 45 (Competent score 3.33)

With respect to perceptions of morality, those who perceived the Met Office positively on this dimension also displayed an understanding of the challenges the Met Office faced with respect to forecasting. However, understanding was also expressed by people who were more ambivalent (rather than positive) on this dimension, this was not an uncommon pattern. One could infer that this points to judgements regarding morality drawing more sympathy and understanding than judgements on competence:

I don't think it's their fault they're not very good, it is quite difficult to predict the unpredictable.

Respondent 54 (Morality score 3.60)

Within the free-text responses, competence-based criteria were articulated first even in the context of the subsequent dimension of morality. In part, this reflects the question ordering within the survey; however, when the open-text responses were in reference to morality, respondents would often continue along the same criteria they established for competence. This suggests that when making evaluations of the organisation, people tended to reflect upon features of competence, rather than morality, in the first instance. The two extracts below illustrate the articulation ordering; I observed that the first quote (articulation of only competence) was far

more common and representative within this data than the second extract. Both quotes were in response to morality, not competence.

I think they do their best to produce accurate forecasts, particularly in vital areas like shipping
Respondent 103 (Morality score 6.60)

I trust what they are saying and they usually get it right.

Respondent 86 (Morality score 7)

Within the qualitative responses in this dataset, it is evident that there are lasting effects of perceptions of competence (and morality). Once perceived competence is established, this can lead to habitual behaviours and people will automatically return to the Met Office for information again.

I always check the met office forecast if I travel anywhere, as it is the best indicator of what to expect from the journey and what to take in the way of appropriate clothing.

Respondent 4 (Competent score 6.17)

There was also some indication that the behaviour of third parties can feed in to people's perceptions of Met Office competence – for example, if a separate group uses information provided by Met Office and its services, positive perceptions of Met Office competence may be reinforced or even created. This is potentially amplified if people view the organisation independent from the Met Office also as competent and moral. The below two quotes point to the power of a third-party (in this case the BBC) in shaping perceptions of Met Office competency:

Used by the BBC. Good website. Authority over issuing UK weather warnings. Respected Reputation.

Respondent 110 (Competent score 6.17)

I am mainly influenced by watching the regular forecasts on the BBC.

Respondent 35 (Competent score 6.17)

To summarise, although competence and morality have been theoretically distinguished, there was a lot of overlap between these dimensions ordinarily in people's minds. Criteria that establish competence are equally perceived as being reflective of morality and (to a lesser extent) vice versa. Accordingly when people are thinking through competence (or morality) they are also thinking through the other dimension.

Theme Two. Divergence: Concrete vs. abstract.

The relationship between perceived competence and morality is a complex one, containing much overlap, as set out above. The primary theme was very obvious in the first instance of analysis – perhaps because the theme itself is somewhat descriptive and tangible. The secondary theme, however, was less obvious and was a theme that revealed itself through the course of the analysis: making it a more interpretive observation, rather than descriptive.

Whilst I saw the considerable overlap between the bases for judgements of morality and competence, detailed in theme one, the data also revealed distinct differences between how these dimensions were reasoned and explained. Theme two within this analysis therefore revolves around dimension divergence rather than

dimension overlap. Principally, this difference was not necessarily in the content that was brought to bear on such judgments (i.e., accuracy and reliability of forecasting) but rather in the process through which the dimensions were reasoned.

Notably, evaluations of Met Office competence were expressed in *experiential* terms – for example, the (in)accuracy of previous weather forecasts, the utility of such information, and how the (in)accuracies have been applied in their lives. In essence, judgements of competence seemed to be made according to some very concrete, measureable and tangible criteria. For example, in addition to referring to the accuracy of forecasts (above), some people would further expand on these perceptions, often by referring to other concrete sources or signals of competence. Citing the Met Office consisting of educated employees and using modern technology was a common response; these are also concrete indicators of (in)competency.

The three extracts below illustrate how perceptions of competence are measured via concrete features; the first two quotes are evaluating competency as high, whereas the third quote described the Met Office in lower terms of competence. Note that the quotes below, Respondents 22 and 106, are both referencing technology (in the context of reliable forecasting), however they are coming to different conclusions about the competency of the organisation on the basis of this criteria.

I imagine you would need a science degree and they usually seem to get it right

Respondent 86 (Competent score 6.17)

Seem to be very reliable and use the latest technology.

Respondent 22 (Competent score 6.17)

How poor the weather predictions can be even
with today's technology

Respondent 106 (Competent score 4.50)

In contrast to the concrete indicators that were referred to in assessments of (in)competences, evaluations of *morality* were either inferred from judgements of competence (i.e., they are competent, therefore they are also trustworthy) or morality was simply assumed. For example, many people were unable to specify the reason for their perception of the Met Office as moral, or could not think of any reason why they *would not be* and therefore made their judgment on the absence of indicators.

The two extracts below illustrate how evaluations of morality were construed through evaluations of competence – both texts were given in response to the morality, not competence, questions.

I can normally rely on the Met to give accurate
information

Respondent 49 (Morality score 6.6)

They seem fairly efficient as an organisation.

Respondent 34 (Morality score 6.2)

It is also worth noting that some responses in the context of responding to morality, referenced communication processes. The quotes below show two respondents reasoning the morality of the Met Office, not solely through the content of the information and its accuracy, but the way they have communicated such information with a non-science audience seems to take importance.

I believe they give us the best explanation of the readings they can and put it into layman's terms

Respondent 25 (Morality score 6)

How well they report all the weather conditions.

Respondent 80 (Morality score 7)

Furthermore, the respondent below draws upon the combination of quality of information content with how this is presented as to why they have scored the Met Office highly in terms of morality.

Reliable well presented forecasts

Respondent 22 (Morality score 6.2)

For some people, the Met Office holds a presumed authority and responsible role in society (i.e., being a governmental organisation), and with that comes morality. The next two quotes reveal reasoning Met Office morality through the absence of indicators or on the basis of more implicit assumptions, pointing towards their societal role:

I can't believe the met office would be dishonest -
It's a public body!

Respondent 24 (Morality score 6)

In my eyes, the met office don't lie. It wouldn't be in their interest to do that.

Respondent 12 (Morality score 6.8)

As inferred above, the perceived good intentions of the work done by the Met Office, as well as their role as providing a public (as well as scientific service), is something that accompanies perceptions of morality – and this was a common view among the sample. This may indeed help people accept the uncertainties inherent in their work, and soften reactions when they are inaccurate.

The Met Office provide a public service as well as proper scientific research, in my view, and neither of these things benefit from lying or dishonesty - it had never occurred to me to think these things! Okay, they don't always get the weather forecast right but for genuine mistake reasons, not anything underhand - what would be to gain from that, anyway!

Respondent 21 (Morality score 6.2)

Finally, a common 'reasoning' of morality judgements, without explicit reference to the Met Office being a government body, was that the Met Office are intrinsically moral.

You can trust the forecasters to do the right thing
Respondent 16 (Morality score 6.2)

I trust what they say and I don't think they would gain anything by lying.
Respondent 82 (Morality score 7)

As can be seen from these quotes, perceptions of morality "just are" and morality is assumed in the absence of any specific reason to think otherwise. In this

sense and in comparison to perceptions of competence, morality seems to be reasoned on the basis of more abstract, implicit and inferred criteria. This is consistent with research on values as truisms: whereby beliefs that are widely shared and rarely questioned (McGuire, 1964; Maio, & Olson, 1998). McGuire (1964) describes the characteristics of truisms that people should agree highly with truisms and people should lack cognitive support for truisms. In some ways, this seems similar to concept of appeal to authority, in the sense that positions are accepted without question or without a need to qualify their endorsement.

Discussion of the Qualitative Analysis

The aim of the qualitative aspect of this study was to gain more insight into how people think about morality and competence outside of laboratory manipulation and in response to a real organisation and, relatedly, the things that might influence perceived morality beyond the communication style adopted by an agent, which was the focus of the previous studies. To achieve this aim, rather than simply assessing participants' perceptions of the Met Office in terms of competence and morality scores, I also asked them to explain these judgments and the basis on which they were made. Although this kind of data relies on people's introspections, it nonetheless provides an indication of what competence and morality are in lay thinking.

The data itself suggested two important insights about this. Theme One highlighted the overlap between perceptions of competence and morality. From the explanations provided, it appears that assessments (whether positive or more ambivalent) were informed by similar criteria (mainly the reliability and accuracy of weather forecasting), regardless of which dimension was being considered. Thus, just as morality and competence are correlated measures, they are overlapping concepts and often inferred from similar things.

Theme Two, however, highlighted the points of divergence between these dimensions. Here it was observed that although morality and competence were often inferred from similar things (i.e., content) the ways in which these judgements were arrived at were different (i.e., process). More specifically, evaluations of competence appear to be based on concrete features – that is, things that are tangible, directly observable and measureable. Perceptions of morality, in comparison, seem to be inferred more indirectly – for example, it was reasoned from competence or simply assumed based on other criteria (e.g., the absence of reasons to think otherwise or the apparent trust displayed by others).

I compared this content reasoning with the Met Office’s own public perceptions survey (Barometer, Met Office, 2013). In the Met Office study participants within the 80% subset who viewed the Met Office as trustworthy were also asked their reason for this. Of these, accuracy 35.8%; Expertise/professionalism/qualified 25.8%; Official/government/impartial 10.8%; Proven record, 5%; Wouldn’t knowingly misinform 4.2%; Up to date technology/science 2.5%; Don’t know 14.2%; and Other 1.7%.; i.e., responses to why people trust the Met Office are generally reasoned through competence terms, the top two responses are accuracy (35.8%) and expertise (25.8%). It should be said here that it was unclear whether the responses were open-text format, or pre-defined categories that were later coded thus. That said, similar to my study, competent-related (e.g., accuracy, expertise) features emerged as the common reasoning for trust, with more intangible features (e.g., wouldn’t knowingly misinform) as less reasoned. This shows again that often people are inferring qualities of morality from the concrete features of competence; while to a lesser extent drawing upon more abstract features as a proxy of morality.

Though it is unclear whether respondents' focus of qualitative responses on competence criteria is a methodological artefact (such as order effects) or a genuine effect, the overlap of the morality/ competence descriptions provides a triangulation that competence is a central component of organisational trust.

Interestingly, Janoff-Bulman, Sheikh and Hepp (2009) found that language variations can act as indicators of different types of morality. More specifically, they suggest that *proscriptive morality* (i.e., things we should not do) was perceived as concrete, whereas *prescriptive morality* was perceived as more abstract (i.e., what we should). They drew upon Semin and Fiedler's (1988) four-level linguistic category model – this is a framework of interpersonal language that provides a way of investigating linguistic devices that are used to represent events. Principally, this model differentiates between concrete and abstract within a construct by way of linguistic features. Ranked in terms of increasing abstractness, these are: descriptive action verbs (most concrete), interpretive action verbs, state verbs, and adjectives (most abstract). Semin, Higgins, de Montes, Estourget, and Valencia (2005) suggest in prevention efforts (i.e., proscriptive morality) people used more concrete language, whereas those in promotion efforts (i.e., prescriptive morality) use more abstract language.

Janoff-Bulman, Sheikh and Hepp (2009) go on to postulate that differences in language style aligned with morality type also point towards differences in psychological distance and levels of construal (see Trope & Liberman, 2003). For Janoff-Bulman et al. (2009), temporally and spatially close events contain more concrete detail and are clearly defined, and behavioural strategies highlighting the avoidance of harm (i.e., proscriptive morality) would be more effective. In contrast, temporally and spatially distant events contain less concrete detail and more abstract

levels, and with this greater psychological distance, less urgency is conveyed and the behavioural strategies highlighting promotion (i.e., prescriptive morality) is more effective here.

With this in mind, it may be more fruitful to apply the outcomes of behaviour change associated with climate change (temporally and spatially distant) in abstract terms; rather than concrete everyday restrictions of behavioural prevention (e.g., do not drive).

In applying the concepts by Janoff-Bulman, Sheikh and Hepp (2009) and Semin, Higgins, de Montes, Estourget, and Valencia (2005), abstract language has the potential to encourage distant behaviour by *promotion* (rather than *prevention*). Employing a linguistic signature that is characteristically abstract can encourage *promotion* for certain behaviours. Thus to encourage the *promotion* of behaviours as a response to the (currently abstract) effects of climate change, messages may be more effective if presented in an abstract sense also. They point to examples of advertising where concrete or abstract wording is used as a function of the right strategic inclination to achieve the goal of that production, for example advertisements that use cue sentences regarding strategic approach to promotion goals such as beauty (“L’Oréal, because you’re worth it”), happiness (“Coca-Cola, the taste of life”), and so on. “All of these examples stress a strategic approach orientation to positive outcomes represented as hopes and aspirations (ideals), and they tend to be abstractly represented in language” (Semin, Higgins, de Montes, Estourget, & Valencia, 2005, p.44). Thus, marrying the message to the strategy that best motivates goal achievement for concrete or abstract goals (i.e., promotion abstract; prevention concrete) may be an interesting approach to consider for behavioural change analysts and communicators.

General Discussion

In this study I revisited the fundamental concepts that were the focus of the experimental work: perceptions of competence, morality and uncertainty. Like the previous work presented in this thesis, I was interested in how these things combined to influence individual climate change beliefs, perceptions and behaviours. In this study, however, I was especially interested in exploring qualitatively the features that might inform perceptions of competence and morality of an established organisation, the Met Office. Insight into this was considered important for transitioning from the language-based manipulations used in the experimental work to provide a more detailed analysis of morality that might help organisations, like the Met Office, understand better the ways in which they are perceived by the public and the consequences of those perceptions.

As detailed above, the quantitative results are somewhat different to the results observed in the earlier experimental studies. Earlier in this thesis I showed how high levels of uncertainty can be troublesome when communicating climate change information, but also how this can be cushioned when audiences perceive the communicator as moral, as signalled through their language-use. More spontaneous perceptions of Met Office morality also interacted with perceived uncertainty in this study, but not consistently and not in ways that immediately matched the pattern observed before. Instead, perceived uncertainty alone seemed more important for determining individual responses to climate change. The perception of scientific uncertainty was associated with reduced belief in climate change and reduced individual action tendencies.

Where morality did come into play was in conditioning the relationship between uncertainty and belief in climate change. The relationship between

(un)certainty and belief is present only among those who perceive the Met Office as moral. People who do not see the Met Office as moral are not influenced by scientific uncertainties. This indicates that when situations are uncertain, the audience seeks perceived moral intent of the communicator, to the extent that beliefs are increased, a pattern also seen in previous research (Van den Bos & Lind, 2002; van Prooijen & Jostmann, 2013).

Drawing direct comparisons with the other quantitative work presented within this thesis (Chapter 3) should take into account the nuances between the survey study here and the experimental studies presented in Chapter 3. There are some subtle, yet significant, differences that may be accounting for any disparities seen between these works. Firstly, the present survey was not an experimental study. Thus, rather than experimentally manipulating uncertainty (via probabilistic risks) and organisational perceptions (via language), this study freely assessed those things. In addition to the difference between manipulated versus measured variables, with respect to uncertainty, the previous studies focussed on uncertainty of the impacts of climate change (i.e., probabilistic uncertainty), but nonetheless still communicated to audiences that scientists believed that climate change was real. The measure in this study, however, assessed the degree to which participants' perceived scientific uncertainty about the phenomenon of climate change itself (i.e., ambiguous uncertainty), not just its possible impacts. These different foci of uncertainty may explain somewhat the apparent divergence between the different studies. The findings in this study suggest the effect of perceived morality on behavioural responses will likely be in accordance to whatever level of ambiguity (uncertainty) is perceived i.e., certain would lead to an increase in behavioural intentions in accordance with this

certainty; whereas uncertain would lead to decreased behavioural intentions in accordance to the lack of certainty (ambiguity).

If one considers the specific questions considered in this survey, (p.197), they are more related to perceived uncertainty within science and among scientists. The composite of perceived uncertainty items include: uncertainty among scientists that climate change happening, its causes and consequences, and its potential impacts.

Uncertainty and scepticism. The present results of perceived uncertainty had a strong influence on audience responsiveness, as indicated by predictors of global and personal risk perceptions, and travel intentions (but not household intentions). This finding is in concurrence with previous research that has shown travel behaviour change being viewed as more challenging compared with other lifestyle changes (e.g., Chatterton, Musselwhite, Lyons, & Clegg, 2009). In considering why increased uncertainty reduced pro-environmental travel intentions, but not within the household, could be because travel behaviour is more resistant to change due to its link to identity (e.g., Mann & Abraham; 2006; Prillwitz, & Barr, 2009) and autonomy (e.g., Ellaway, Macintyre, Hiscock, & Kearns, 2003; Musselwhite & Haddad, 2010), in addition to the utility that the car brings (e.g., Steg, Vlek, & Slotegraaf, 2001; Musselwhite & Haddad, 2010). Indeed, car drivers and motorcyclists have a tendency to shift the emissions blame to larger sources of emissions (Chatterton, Musselwhite, Lyons, & Clegg, 2009; Thomas, Walker, & Musselwhite, 2014). This has been suggested to be a defence mechanism, justifying continued driving or motorcycling (e.g., Chatterton, Musselwhite, Lyons, & Clegg, 2009; Thomas, Walker, & Musselwhite, 2014). This may be some way of protecting parts of one's identity that is associated with symbolic-affective (e.g., Steg, Vlek, Goos, & Slotegraaf, 2001; Mann & Abraham; 2006; Prillwitz, & Barr, 2009). Thus, while people may acknowledge environmental

problems associated with driving, there remains a wish to disassociate their own behaviour (e.g., driving) from the cause (a concept similar to that of cognitive dissonance, Festinger, 1957).

Organisational perceptions. It is also worth noting that while the connections between organisational perceptions, uncertainty about the science, and audience responses to that uncertainty were relatively strong in the previous studies, in this study organisational perceptions were more strongly associated with the organisation's weather forecasting role rather than their science (as revealed by the qualitative work), and uncertainty and individual responses to climate change were measured more generally without reference to the organisation. As such, while it is interesting that perceptions of Met Office morality moderated the link between perceived scientific uncertainty and belief in climate change, it is not immediately apparent whether audiences directly attributed the uncertainty to the Met Office or were basing their beliefs on anything the Met Office had communicated to them.

As with the correlations that have been seen in this and the previous studies (Chapter 3), there was considerable overlap between perceived competence and morality. In addition to this qualitative overlap, there were also important differences between people's articulations of competence and morality. People seemed to reason about competence and morality in slightly different ways, even though they ultimately drew on the same information when doing so.

On the basis of the qualitative data, it seems that people tended to assess levels of competency by looking for evidence and examples that support (high competency) or refute (low competency) the ability of the group within a particular domain. In other words, competency (high and low) commonly referred to the (poor) quality, the (in)accuracy and (un)reliability of the information being communicated. While this

was also discussed in relation to perceptions of morality, it was apparent that assessments of morality were given on the basis of less tangible, and more abstract, things. In contrast to competence, morality seemed to be reasoned through deduction. In its essence, morality appears indefinable and immeasurable, whereas competence seems concrete and tangible. Furthermore, the presentation of complex forecast information and the ability to communicate this to non-science audiences, were also important features for people when they talked about assessment of morality. Taken together, this suggests that the quality of informational content can signal competence, whereas the quality of presentation and communication can signal organisational morality.

Past research suggests that morality is the first thing people look for in person perception (e.g., Wojciszke, 2005; Rusconi, Sacchi, & Cherubini, 2011; Leach, Ellemers, & Barreto, 2007). This current (qualitative) data suggests that people were more focused on competence – as implied by the amount articulated around competence. This was the case even when respondents were asked to discuss their reasoning behind their morality scores of the Met Office. This provides evidence that this a key component of organisational trust. We should, however, consider that this may partly be a product of a few issues: the methodology (competence was always asked first); the domain (the focal point was a science organisation, competence is particularly salient in this field); and with competence being concrete it is easier to talk about than morality and its abstract attribute.

Further, it is worth noting that research indicates that competence dominates self-perception whereas morality govern person perception (e.g., Wojciszke, 2005) - this may in part explain why scientists and science organisations perceive they are

being judged by non-scientists as competent; whereas actually they are being judged in terms of their moral content.

Zucker's (1986) three modes of trust production may be relevant to consider here. She proposes *characteristic* based trust, which is dispositional and based on social characteristics; *process* based trust, which is based on previous experience with the organisation; and *institutional* based trust, which is based on reputation and attributes held by an organisation. In considering this in the context of this study, there is a crossover between respondents referring to process based trust (previous experience) and institutional based trust (reputation) of the Met Office.

In addition to the difference in survey populations, the Met Office study differs from the experiments with regarding to the institution being evaluated. The institutions being evaluated are different: in the experiments the organisation was hypothetical, while in this study the Met Office is an organisation well-known to the sample.

Layered on top of this issue is the variation of uncertainty. In the experiments, with the fictitious organisation, the uncertainty was presented and was quite specific. In this study, with the Met Office, uncertainty was not presented nor specified, and therefore ended up being quite vague and subjectively determined. In addition to the ambiguous uncertainty, perceptions of trust towards the institution was specific due to pre-existing awareness/ opinions of the Met Office. Furthermore, respondents' perceptions of the Met Office as climate change communicators are likely to be inferred by perceptions of their role in weather (not climate change).

Limitations. There are some caveats that must be noted when digesting both the quantitative and qualitative work within this study. Making comparisons between this quantitative work and those presented in Chapter 3, studies focussed on

uncertainty of the impacts of climate change vs. assessed the degree to which participants perceived scientific uncertainty about the phenomenon of climate change itself, not just its possible impacts. These are different concepts of uncertainty, which may have implications in the differing effects uncertainty has in moderating the relationship between beliefs and perceived morality. Despite this, perceptions of competence, rather than morality, are important features contributing to impression formation.

Notably, respondents were asked their perceptions of competence first and this may, in part, explain why they had little to say when elaborating on morality (sometimes noting “see previous”). Thus the abstractness of morality might also be an artefact of the order in which these questions were posed. Future studies could explore this further by ensuring that the order of questioning is properly counterbalanced. It would be interesting in itself to see how responses differed when the abstract is prompted first, and then the concrete. In that, was the high referencing to the concrete indicators of competence when asked about morality simply a function of morality following competence within the questionnaire? Or it may be a function of the abstract nature of morality, inferring through competence was the best way participants could verbalise their perceptions of morality. Or would probing morality first yield some further insights into the qualitative features of this content dimension, above and beyond the order effects of the survey.

Implications. These presented findings of public perceptions of the Met Office are consistent with previous opinion polls, particularly the point that accuracy is the most important input into public opinions. For example, a YouGov poll showed around 80% of respondents say they trust the Met Office, with the main stated reason being the accuracy of their weather forecasts (Barometer, Met Office, 2013). Dee

Cotgrove (Met Office Executive Head of Communications) seems to mirror some of the responses within my qualitative work, saying, “The public know that ultimately it is our people - their forecasting, science and technological expertise - which make Met Office forecasts the trusted source of advice” (Barometer, Met Office, 2013). In other words, she also acknowledges that audience perceptions of trust is inferred by concrete attributes associated with their competence in forecasting and their perceived technical expertise.

It should be worth noting that following controversies such as ‘Climategate’ public opinion showed a decrease in trust in climate scientists (e.g., Shuckburgh, Robison, & Pidgeon, 2012; Leiserowitz, Maibach, Roser-Renouf, Smith, & Dawson, 2013; Gavin & Marshall, 2011; Maibach, Leiserowitz, Cobb, Shank, Cobb, & Gullede, 2012; Pidgeon, 2012). Consequently, as the Met Office is seen as primarily a weather-forecasting organisation, any climate research from this source could potentially be treated with higher levels of public trust than climate science specific organisations.

The findings presented in this Chapter point towards morality and competence as elements of trust that can be viewed towards the Met Office. Indeed, Cotgrove recognises this – she also says that, “In the end, trust is not only about doing what you say you’ll do and doing it well. It’s also about being a good listener and responding to what you hear”. Again, as with the earlier quote, here Cotgrove starts by highlighting the competence features of trust (i.e., “doing what you say you’ll do and doing it well”); and then talks about aspects that are not necessarily competence traits, but may be indicators of moral character (such as, “being a good listener and responding to what you hear”).

She goes on to say, “For us at the Met Office it is vital that people trust, listen, and act on our warnings and advice”. These do indeed make for interesting discussion points, given the roles of scientists, forecasters and the organisation as a whole appear mixed and in conflict with regards to being simply informers or also advisors. Indeed, with 80% of respondents claiming to have taken action as a result of a Met Office forecast in the last 12 months (Barometer, Met Office, 2013) – this suggests that the Met Office are in fact aware that their information has behavioural consequences. Rather than seeming to deny such, and in effect contradicting themselves, it may be better that they embrace this and work within this framework. I do acknowledge such behavioural responses are in relation to weather advice and not climate advice, while these are different types of information: it may be confusing to the public to appear to have different approaches to provision of different information.

That said, one could argue that it does not necessarily matter what or how the Met Office communicate, when only 5% of communications with the public is direct from the Met Office (Barometer, Met Office, 2013). The majority of receivers of Met Office (weather) information obtain this via third-party sources; the majority of these people (64%) using the BBC (Barometer, Met Office, 2013). With this in mind, the influence of impression formation the Met Office can have directly with their audience is slim.

Some questions, aimed towards the practical implications, rather than theoretical, would highlight and question what is/has been done to engage the public with the Met Office directly. While the Met Office has various means whereby people can seek information (e.g., via their website) and contact the Met Office in an interactional sense (e.g., Twitter, email enquiries); in light of the figures suggesting that direct communications with the public is a rarity rather than the norm, perhaps

the Met Office, as an organisation, should a) question why is it that direct contact with publics is so low; b) consider ways in which direct communications with the public can be increased; and c) build on the fact that communications at present is done via third-parties. Furthermore, why research (and publish the results) public opinion of their service of only weather information provision, when the organisation also does work in the climate science domain. While this may be helpful in gauging opinion in how people perceive the Met Office in terms of their weather service, but not necessarily so in understanding and building towards public awareness about the climate science work they conduct.

Thinking beyond the organisation-specific implications of this research, there may also be suggestions within these findings that are transferable to climate change communication more generally. In this study, perceptions of the Met were based largely on forecasting accuracy. This is a very concrete piece of information that is communicated with intentions to prompt immediate forms of action. Indeed, the latest figures on the annual public perception survey reveal that 80% claim to have taken some form of action in the last 12 months in response to a forecast (Barometer, Met Office, 2013).

The kinds of behaviours people make in response to forecasts are also concrete, local and engaged for the short-term. When dealing with such concrete behaviour (e.g., weather-related) it may make sense that judgements are strongly based on communicator competence, as the information provided is immediately useful and verifiable. Climate change, however, as a topic is abstract. It is something that is temporally and spatially distant, that cannot be confirmed or refuted by the (in)accuracy of predictions. By virtue of this, the behaviours that could or should be enacted in response to climate change information are also, to some extent, abstracted

and uncertain. The information conveyed in the climate change context may not be of immediate use, nor verifiable for its reliability. Therefore, given the lack of the empirical verification process, it is logical that people rely on more diffuse and abstract notions of trust to assist them when deciding on what they should think and do in response to that information. Indeed, research does show that people's perceptions about impacts of catastrophic climate change are distant temporally and spatially (e.g., Moser, 2010; Milfont, 2010) and given this climate change is not seen as an urgent issue (Moser & Dilling, 2004).

One can relate this to the linguistic features work done by Janoff-Bulman, Sheikh and Hepp (2009). Within their framework, linguistic moral signals are either proscriptive, whereby emphasis is on concrete information about how (not) to behave and misconduct to avoid; or prescriptive, whereby emphasis on abstract behaviours provides more general (as opposed to specific) guidance about morality. In the context of climate change, while specific behavioural features to avoid (e.g., fly planes less) can be communicated, this provides a mismatch in providing information behavioural advice in concrete terms for an abstract problem. It may be more fruitful to frame responses to climate change in an abstract way, marrying the message to the context. Indeed, Semin, Higgins, de Montes, Estourget and Valencia (2005) showed that intentions to engage in specific activities were stronger when there is a fit between message wording and chronic orientation than when there is no fit.

Furthermore, being aware of how people are making judgements about an organisation in terms of competence (concrete) and morality (abstract) may be helpful when communicating about topics that vary in their abstractness. People may indeed judge communications based on perceived organisational competence when those communications refer to the here and now (i.e., definable parameters of competence).

Thus, in this case, the fact that people do perceive the Met Office as positive, both in terms of morality and competence (i.e., trust), is an asset for communication. Yet most of these judgements are being made based on only part of the work they do. Harnessing the already existing trust amongst publics when communicating about a topic that is abstract (climate change) may help overcome some of the barriers to this kind of communications. But where trust is low, inferences based on more concrete terms (i.e., competency forecasting the weather) may be usefully drawn on and applied to the abstract concept (i.e., climate change). Equally, however, if people perceive the Met Office as incompetent, and base this perception on their experience of unreliable weather forecasting, inferences of incompetence may also be extended to other work they do and the broader things they communicate about (i.e., climate change science). Although morality may theoretically dominate perceptions of people and groups, in practice most organisations will want to be perceived as both moral and competent.

Conclusion. This Chapter has studied climate change perceptions and responses in a different context to that presented in the experimental studies. The uncertainty examined in this study measured a more diffuse and ambiguous aspect of uncertainty, thus difference in the apparent effects of ‘uncertainty’, and the specific ways in which this interacted with morality, might plausibly be due to the different types of uncertainty being considered.

Furthermore, the study also showed that perceived (unspecific and ambiguous) uncertainty around climate change goes a long way towards shaping audience responses to belief, perceived threat and (travel) behaviour intentions. Arguably this maps on to previous research in line with work on scepticism and motivated reasoning. This has shown that people who hold more sceptical beliefs are more likely

to reject information if it is seen as a threat to their personal life (e.g., van Prooijen & Sparks 2014; Whitmarsh, 2011).

Specifically, perceptions of organisational morality might increase pro-environmental action in the face of uncertainty about the impacts (but not the phenomenon) of climate change. Conversely, perceptions of organisational morality may make people less inclined to believe in climate change when uncertainty is being expressed about the phenomenon itself (i.e., by a trusted source). In this sense the interactive pattern observed in the final study reflects concordance between the perceived message (climate change is uncertain) and individual beliefs only under conditions when the scientific organisation that might be responsible for that message is perceived as moral and trustworthy.

In sum, on the basis of the results in this study, I conclude that perceptions of communicator morality are based on more abstract criteria, things that are less definable and less measureable than the criteria that inform perceptions of competence. Indeed, perceptions of morality were based upon competent criteria. While it may be challenging to establish audience trust from scratch, being already highly trusted in one area of work may indeed be a benefit when communicating about a topic whereby trust is of high importance. In addition to this, encouraging behavioural change in the context of climate change is complicated by the psychological distance and abstract nature this topic brings. Drawing on work regarding linguistic features of abstract vs. concrete topics and their respective behaviours (e.g., Janoff-Bulman, Sheikh, & Hepp, 2009), it may be worth moving from concrete descriptors of the present and towards abstract goals of the future i.e., rather than advocating avoidance of behaviours in the present for a goal that is

ultimately abstract; aligning the promotion of the end goal which is abstract, in promoting the goal in the abstract.

Chapter 5

General Discussion

Effective communication is central to efforts to engage the public with the important issue of climate change. But the communication of anthropogenic climate change presents many challenges for communicators, scientists and policymakers alike. Most notable among these is the issue of uncertainty. Uncertainty is an inherent feature of the phenomenon, and the science, of climate change. But uncertainty is known to be a barrier to effective communication, and something that can undermine perceptions of communication sources. This raises the important question of how uncertainty can best be managed in the communication of climate change. This broad question was the focus of the research contained within this thesis. In this final chapter, I summarise the key ideas behind this work, the findings that were produced and their possible meaning for both theory and practice.

1. Summary of Results

In the current research programme, I drew on what has been established in earlier works of social and environmental psychology from areas of risk perception, trust and impression formation. Specifically, past research has argued and demonstrated that the informational content of messages is not always processed independent of its source. Accordingly, how sources are perceived – in terms of credibility, trustworthiness and morality – is an important factor in the process of communication. Moreover, recent research has established that these source factors might become especially significant under conditions of uncertainty or ambiguity.

To understand better the roles of source factors and uncertainty in the process of climate change communication, I explored the total communicative sequence: the source, the informational content, and the recipient in the communications process. Empirically, I achieved this goal by (1) interviewing originators and communicators of the information of climate change to better understand their perspective, and; (2) I considered the content of the information, specifically its level of uncertainty, how audiences responded to variations in this informational content (and its varying levels of uncertainty) and the role of source factors (specifically communication styles) in shaping those responses. Finally, (3) I explored in more detail the nature and origins of public perceptions of a real-world scientific organisation. By triangulating the research to explore questions from different sides of the communication process I hoped to provide a more complete understanding that connects to the specific concerns of the actors involved in this process. Below, I briefly summarise the key insights that have emerged from each of these pieces of the empirical work.

1.1 Chapter 2. Interviews. The first empirical chapter reported the findings from a qualitative study involving interviews with climate scientists and professional communicators from the same science organisation. Three broad themes were identified in the interview data. *Theme 1* predominately represented the *Communication Process(es)* involved in climate change communications, specifically how scientists and communicators perceive their audiences, how messages were produced, and what was seen to be effective communication. *Theme 2* represented the perceived *Communication Challenges* around climate change communication, specifically the challenges inherent in the subject (such as uncertainty) and the challenges concerning relationships with people. *Theme 3* represented the perceived *(Conflicting) Roles of Climate Scientists*, specifically how scientists view themselves

as providers of objective information, and also how scientists hold a view of how the public perceives them (meta-stereotype). This theme also revealed how their professional role can often conflict with their personal roles and goals.

These interviews, and the themes they revealed, provide an insight into the language and use of uncertainty. Among scientists, uncertainty is a function of their professional role and was seen as inherent to climate science. Because of this, fully communicating uncertainties was something they saw as important. But uncertainty seemed to also perform a function of maintaining status and boundaries for scientists towards non-scientists (e.g., policymakers, communicators, and publics). This psychological role was something that was often explicitly expressed by communicators, but also implicitly revealed through discourse with some scientists. For instance, communicators expressed the view that the language of uncertainty (alongside other science specific language-use) has a role in allowing scientists to show their ‘scientific prowess’, whereby scientists can show-off their competence as well as protect their integrity as a scientist – both in the eyes of publics and fellow scientists alike. Further, uncertainty and technical language use can serve a number of legitimate functions in scientific communication.

From these themes, I concluded that climate scientists and professional communicators work from different models of communication. For scientists, transferring as much scientific information as possible, highlighting the uncertainties, and maintaining technical language was the priority. I argued that this represents an ‘informational’ model of communication. For communicators, however, understanding their audience, and simplifying language was their focus. Conveying (complex) scientific information while maintaining a warm and friendly style of communication – which they called ‘tone of voice’ – was also important. These things

combine to suggest that professional communicators were operating within a more ‘relational’ model of communication. These insights are interesting in and of themselves, but they also informed the experimental work that followed.

1.2 Chapter 3. Experiments. Following on from the interviews, I conducted a series of experiments to explore how some of the themes identified in the interviews might play out when audiences are exposed to climate change communications. Specifically, the three experimental studies examined how the communication of uncertainty (Theme 2) affected audience responses, how this might be shaped by communication processes, specifically the tone of voice adopted by communicators (Theme 1), and other features of the message being communicated, specifically the provision of advice (Theme 3). Building on past research and theory, my key hypothesis was that an open ‘tone of voice’ would signal communicator morality to the audience, and that this would facilitate engagement even, or perhaps especially, under high levels of uncertainty.

To begin this line of enquiry, I first conducted a Pilot study to test the effects different communication styles might have on peoples’ perceptions of communicators. This Pilot study confirmed that a warm ‘tone of voice’ (open language), compared to a corporate and distant tone style of communication (closed language) resulted in perceptions of the source of communication as being significantly more moral, marginally more competent, but not more warm. This was taken as evidence for the assumption that communication styles have implications primarily for the perception of communicator morality.

To explore how communication styles might shape responses to climate change in the context of uncertainty, Experiment 1 again manipulated these language styles and crossed this with a manipulation of lower versus higher uncertainty

embedded within a climate change communication. Following this I assessed a range of responses to the message itself as well as to the broader issue of climate change. The results indicated that higher levels of uncertainty resulted in reduced belief in climate change. Despite this negative effect of higher uncertainty, the results also indicated that participants expressed higher engagement with the message, and stronger intentions to act in climate friendly ways, after being exposed to high uncertainty provided this was accompanied by open rather than closed language. When uncertainty was low, communication style had no effect on these audience responses. Thus the data indicate that perception of morality does shape responses to uncertainty more so than perceived competence, and this is particularly so in conditions of high uncertainty.

To follow up on this, Experiment 2 aimed to replicate the basic finding. In this study, however, the manipulations of communication style and uncertainty were presented together, rather than sequentially, as was the case in Experiment 1. The results of this study did not reveal the expected interaction between the manipulations of communication style and uncertainty and there were no main or interactive effects of the manipulations on any of the dependent variables of interest. Speculatively, this was attributed to the decision to combine these manipulations, specifically it seemed plausible that the communication style manipulation was “lost” in the uncertainty manipulation, and that organisational perceptions might need to be cultivated first in order to shape audience responses to messages that subsequently vary in uncertainty. Furthermore, Experiment 2 was conducted in conditions with more external stimuli (around campus) than conditions of Experiment 1 (in-class). This may have had an effect on the absorption of the subtle (now-combined) manipulations.

Although the experimental aspect of this study failed, the measures of perceived organisational morality and competence were analysed to see if there was any evidence that these spontaneous perceptions of the communicator moderated responses to uncertainty in ways that were consistent with the overarching hypothesis. Indeed, this analysis revealed significant interactions between (measured) perceptions of organisational morality and (manipulated) uncertainty in ways that were consistent with expectations. Specifically, climate-friendly travel intentions increased with higher perceptions of morality, an effect that was amplified under conditions of high uncertainty versus low uncertainty. This pattern is very similar to the experimental effects observed in Experiment 1. Perceived competence was also found to interact with uncertainty, but the pattern here was quite different to that observed for morality. Specifically, travel intentions *decreased* with higher levels of perceived communicator competence – and this was slightly stronger under conditions of high uncertainty. This suggests that morality does shape responses to uncertainty in ways that allow people to maintain engagement even in the face of high uncertainty, and that morality is distinct from, and perhaps more important than, competence.

The aim of Experiment 3 was to build further on these insights. In addition to again separating the manipulations of communication style and uncertainty, returning to the design of Experiment 1, I added a third manipulation inspired by theme three from the qualitative data – the theme connected to the appropriate role of scientists. Recall that the scientists interviewed often expressed reservations about providing explicit advice to their audiences and saw this as potentially conflicting with their status as independent. However, from a communication perspective, the provision of advice would be an important part of effective and meaningful communication. Accordingly I manipulated the presentation of advice after the climate change

message. Again I expected that an open communication style would buffer audiences from the negative effects of higher uncertainty. I also expected that the provision of advice would facilitate audience responsiveness, and that this might be particularly important when audience morality-based trust was cultivated through using an open style.

Contrary to expectations, analyses on the full sample revealed no significant main or interactive effects of any of the manipulations on any of the outcome variables. Unlike the previous studies, however, this study was conducted using a large and diverse sample of participants recruited from the general public.

Accordingly, there was some scope to explore whether the expected results emerged among sub-samples that resembled the participants in my previous studies (mostly female, highly educated) and whether these differed among sub-samples that differed from the previous study participants (e.g., by being male or less educated). Indeed, secondary analysis did reveal effects in response to the manipulations that replicated previous observations, however these effects were confined to particular sub-samples.

Specifically, the previously observed effect of open communication styles in facilitating engagement under high uncertainty was only seen among women: women were again more responsive to open language, particularly under conditions of high uncertainty. Men, on the other hand, displayed the opposite pattern: men were resistant to open language, particularly when this was combined with high uncertainty. A similar pattern of gender-based divergence was observed in relation to the advice manipulation: Women generally responded positively to the provision of advice, especially when combined with open language, whereas men tended to react against this combination of factors. These divergent responses account for the overall absence of significant main or interactive effects of the manipulated variables.

In addition to the role of gender in shaping responses to communication styles and uncertainty, there were effects of science training, although these effects were more limited and occurred only on reported engagement and trust in the organisation. People who were trained in science felt able to engage with high uncertainty, whereas people with no science training reported more engagement under low rather than high uncertainty. Similarly, people who were trained in science reported more trust in the organisation than people who had no science training experience. These effects of scientific training are, to a certain extent, quite predictable but they also confirm some of my assumptions about the uncertainty manipulation.

In sum, the overall pattern of results in this series of experiments provides evidence that linguistic features and consideration of the audience are important when communicating information containing high uncertainty. Two studies (Pilot and Experiment 1) provide some indication that morality can be signalled through an open language style. I further showed that perceptions of communicator morality are particularly beneficial when uncertainty is high, though the final experiment revealed a gender divergence in this respect. Taken together, the package of experiments suggests morality is an important characteristic of the communicator, particularly under conditions of high uncertainty, and especially among women. There was partial support for the original idea that morality is something that is signalled through an open language style.

1.3 Chapter 4. Met Office Perceptions Study. A final empirical study made use of a survey of the general public to assess organisational perceptions of morality and competence in relation to a real-world scientific organisation (rather than the fictional organisation contained in the experiments) and to explore in more detail the basis of these perceptions, as well as to again assess their consequences for responsiveness

under uncertainty. To better understand the basis of perceptions of competence and morality, in this survey I asked participants to rate a known organisation on each of these dimensions, and after rating participants were asked to elaborate and explain what they were thinking about when they did so. I then qualitatively examined these elaborations to gain some insight into how people determine morality and competence. Following this, I assessed perceptions of scientific uncertainty about climate change, belief in climate change, and intentions to engage in climate-friendly actions.

Analysis of the quantitative data produced by this survey revealed that perceptions of scientific uncertainty consistently undermined responsiveness to climate change. That is, higher levels of perceived uncertainty in the phenomenon of climate change were associated with lower belief in climate change, lower perceptions of personal risk from this phenomenon, and lower intentions to engage in climate-friendly travel choices. Consistent with the previous studies, perceived uncertainty also interacted with perceived organisational morality, at least when predicting belief in climate change, however the specific interactive pattern was different from previous observations. In this study, people who saw the Met Office as higher in morality were most affected by uncertainty such that if they also perceived the science to be uncertain they were less inclined to believe in climate change, whereas if they saw the science to be certain they were most believing in the phenomenon. Those who did not perceive the organisation as moral were not affected by scientific uncertainty when reporting their belief in climate change.

The qualitative examination of the open-ended elaborations that followed ratings of competence and morality revealed two broad themes. *Theme One* highlighted the *overlap* between perceptions of competence and morality.

Specifically, when making judgements (whether positive or ambivalent) of the organisation on these content dimensions, people were guided by similar criteria, mainly the reliability and accuracy of weather forecasting. Moreover, reasoning about one dimension (e.g., competence) often also informed reasoning about the other (i.e., morality). As such, there is considerable overlap between these dimensions of organisational perception, as reflected in the strong correlation between them. *Theme Two*, however, highlighted the points of *divergence* between these dimensions. Although morality and competence were often inferred from similar things, the ways in which these judgements were arrived at was different. Judgements of competence appeared to be based on concrete features – that is, things that were tangible, directly observable and measurable. Judgements of morality, however, seemed to be inferred indirectly – for example, being reasoned from competence or simply assumed based on other criteria (e.g., the absence of reasons to think otherwise or the apparent trust displayed by others).

This final study allowed me to revisit the fundamental concepts that were focussed on in the experimental work, being perceptions of competence, morality and uncertainty. This final study highlighted the diverse nature of uncertainty – specifically that impact-based (probabilistic) uncertainty is not the only type of uncertainty in people's minds. This survey also demonstrated again the tendency for perceived morality to interact with perceived uncertainty: however, these interactions suggest that high perceptions of morality will guide responses in accordance with the level of perceived ambiguity (rather than overcoming high manipulated uncertainty as previously seen in the experiments). I also demonstrated some qualitative features that might inform perceptions of competence and morality of an established organisation.

Taken together this gives a better understanding of how a real scientific organisation is perceived by the public and the possible consequences of those perceptions.

2. Theoretical Implications

This was a cross-disciplinary research programme that contributes to existing knowledge, spanning across theories and research.

2.1 Science Communication. When considering public communication of science, two traditions have been commonly cited, namely the science dialect and the interactive model (Einsiedel & Thorne, 1999). The science dialect, also known as information deficit frame, is considered to be the dominant model of communicating science (Gross, 1990; Einsiedel & Thorne, 1999). This is despite increasing research presented from social sciences indicating the benefits of an interactive model of science communication such as one that highlights the importance of context, audience beliefs and values (e.g., Sturgis & Allum, 2004; Wynne, 1991; Davies, 1998; Logan, 2001).

Findings from the research presented in this thesis supports this view of the interactive model of communication. I demonstrated how certain subpopulations (specifically females and males) are more (or less) responsive to different styles of communication. Such differences can be explained by gendered norms in communication, highlighting the importance of considering the norms and values of the audience. In other words, communicators employing the interactive and relational approaches to science communication should recognise that a combination of certain conditions among particular audiences will influence their responsiveness to the communication. For instance, where low uncertainty is being communicated to males, a distant one-way flow of science communication may be appropriate. Although one

could interpret the finding of the one-way flow preference for males as an information deficit approach, being aware of a preferred style of communication among this sub-population is actually a relational approach.

2.2 Uncertainty. The works contained within this thesis can partially substantiate previous research around the notion of uncertainty being a discursive tool (e.g., Dunwoody 1999) in boundary constructions between scientists and others. During interviews, communicators who work alongside climate scientists articulated the view that uncertainty can be used to maintain some kind of distance and authority within the organisation itself. This is also suggested when studying the scientist discourse. Experimentally, I demonstrated that communication of probabilistic uncertainty can, but not always, reduce the belief that climate change is happening.

2.3 Trust. In developing conclusions about the importance of trust in communicative settings, I indicated that perceptions of trust are (in part) the result of how communicators present themselves (e.g., through language use), and how they are seen as competent and moral.

Within the quantitative research presented in this thesis, I measured trust towards an organisation via ratings of content dimensions, labelling this as perceived morality/ competence. As discussed in the opening chapter there are varying definitions of trust – though in social psychology trust is often viewed as the composite of morality and competence. The research contained within this thesis demonstrates the distinctness between competence and morality, while showing these are key components of trust.

Trust has often been viewed as diffuse and complicated. The following extract illustrates the ways in which trust is described as a complex and multidimensional concept, yet still pointing to the two central components of competence and morality:

Special care must be taken with the evidence set out above concerning trust, since this word has so many meanings. "We trust you" may mean that we believe you can give us right answers and reliable information. It may mean that we believe that you are honest, and will tell us all that you know. Or it may mean that we trust your judgement, and rely on you for decisions which are wise, impartial, ethical and in the public interest. We may trust you in one of these ways, without trusting you in the others. In this case, if a pollster asks us whether we trust you, what are we to say?

House of Lords (2000, 2.29)

2.4 Uncertainty and trust. The findings within this thesis reveal that perceptions of morality-based trust have positive effects on audience responsiveness to messages containing high uncertainty about the impacts of climate change. Previous research has shown that probabilistic uncertainty (i.e., risk) and trust are intertwined. For some theorists, risk is considered a precursor to trust (e.g., Deutsch, 1958; Mayer, Davis, & Schoorman, 1995; Giffin, 1967), taking an *associative* view (Eiser, Miles, & Frewer, 2002). Whereas others take a *causal* perspective (Eiser, Miles, & Frewer, 2002) where in that trust is prerequisite of perceptions of risk and effective risk communication (e.g., Kasperson, Golding, & Tuler, 1992; Poortinga & Pidgeon, 2003). Results here support previous findings that perceptions of a moral communicator can shape responses to uncertainty (Van den Bos & Lind, 2002; van Prooijen & Jostmann, 2013).

Although the language manipulation was not consistent across all of the experiments, the role of perceived communicator morality was repeatedly shown to

have positive effects on messages that contained high uncertainty. This supports the perspective from the uncertainty management model of justice (Van den Bos & Lind, 2002; van Prooijen & Jostmann, 2013) that posits when experiencing uncertainty people look for signs from the communicator/speaker/decision-maker that point towards their morality. Therefore, it makes sense that previous literature has indicated that perceptions of trustworthy sources are important features in risk communications (e.g., Poortinga & Pidgeon, 2003).

The results presented in this thesis indicate that perceptions of morality do indeed interact with high uncertainty, though the effects may be different depending on the form of uncertainty they are interacting with. As such, this can (sometimes) overcome the negative effects of uncertainty (Chapter 2, Experiments 1, 2 & 3). Though sometimes the interactions between morality and uncertainty do not necessarily help overcome uncertainty, but rather guide responses in accordance with the level of ambiguous uncertainty perceived (Chapter 4, Survey quantitative results). This would suggest that communicators might benefit by being aware of the form of uncertainty they are communicating.

2.5 Uncertainty: Probabilistic vs. ambiguous. As already mentioned, the measures of perceived uncertainty captured within the survey (Chapter 4) are different from those obtained within the experiments (Chapter 3). I would suggest the perceptions of uncertainty around climate change measured in the survey (presented in Chapter 4) are more associated with climate change the phenomenon (rather than its specific impacts). As such, it is likely this measurement is representing ambiguous uncertainty rather than probabilistic uncertainty (Knight, 1921). I found the interactions of the ambiguous uncertainty (Chapter 4) interacted differently with perceived morality than the probabilistic form of uncertainty (Chapter 3).

Specifically, not only did ambiguous uncertainty reduce belief in climate change (as also seen with probabilistic uncertainty, Chapter 3), but also when interacting with perceived morality it guided belief responses in accordance to the perceived level of ambiguity. As a result of this, when perceptions of morality interact with ambiguous uncertainty (rather than probabilistic uncertainty), the morality-based trust relationship continues to the point of reducing climate friendly behavioural intentions.

Such implications are powerful in a real world sense. Let us consider the context in which laypersons encounter uncertainties about climate change. Absorbing information about climate change via the media is likely to inform people through a more general debate played out by politicians, non-governmental organisations and (conflicting) scientists; discussing its occurrence, causes and what should (not) be done at an individual to international level. If climate sceptics are vocal in their perspective around human-induced climate change, and people trust them, then people will be more inclined to believe what they say and act in accordance with that. I have shown that such perceptions of communicator morality can, in part, be fostered through language used. Callaghan and Augoustinos (2013) showed how sceptical scientists discursively employ an interactive style of communication compared to consensus scientists who relied on a deficit model. Though their findings did not necessarily relate this to trust *per se*, it seemed theoretically as though the process of communication and the stylistic features could (dis)engage audiences.

Taken with the work presented in this thesis, it seems reasonable to suggest that the interactional model of communication increases engagement through increasing perceptions of morality-based trust. As this research suggests, different forms of uncertainty can lead to differing behavioural responses when interacting with morality. Therefore it is important to understand the parameters of uncertainty that is

being presented to audiences. When considering this one must also consider how the form of uncertainty relates to climate change communications in different settings.

Climate change communications from scientists and scientific bodies (such as the IPCC and the Met Office) are likely to refer to probabilistic likelihood of impacts. However, research has shown that the mass media are the main source of climate change information and the main factor shaping people's awareness (Carvalho & Burgess, 2005; Carvalho 2010). As a result it is likely that representations of uncertainty via the media will be ambiguous uncertainty around the nature of climate change rather than its probabilistic impacts. Indeed, the media conveys uncertainties around science without ever mentioning the word 'uncertainty' in stories (Dunwoody 1999; Corbett & Durfee, 2004). Although the evidence points to a scientific consensus on climate change and its causes, the media tends to portray the competing scientific positions with equal coverage, giving the impression of a balance in expert opinion (Dunwoody 1999; Sharples, 2010).

One could speculate as to whether these equal portrayals of scientific opinion are in the name of 'fair and balanced' reporting or a story containing debate and controversy is more appealing from a journalistic perspective. However, beyond journalistic practices, the media is the arena where the scientific arguments and (competing) positions of the different social actors build their trust and credibility (i.e., perceptions of competence and morality), and these are principally constructed by discourses in the media (Boykoff & Boykoff, 2004; McCright & Dunlap, 2000).

One should therefore be aware that all of the experimental manipulations within this thesis were presented as deriving from a science organisation – and the uncertainty presented was probabilistic. This was, in part, driven by the concern of the CASE partner, the Met Office, wanting to improve their climate science

communications to non-science audiences. In part, it also seems sensible to conduct the research from the position of the originators of the information also being the source of that information. However, because previous research suggests this is not how people generally absorb climate change information, I would suggest the benefits of examining the language and uncertainty manipulations as depicted outside of the organisational specific setting, but more akin to a broader message transmission that people are more likely to encounter (e.g., via a newspaper article). Such follow up research could also explore how the nature of manipulated ambiguous uncertainty interacts with morality (and competence). For example, rather than compare low versus high probabilistic uncertainty, future research could run a series of studies comparing the effects of ambiguous versus probabilistic uncertainty. Even though we can infer these differences based on the experiments (using probabilistic uncertainty) and the survey (using ambiguity uncertainty), it would of course be wise to examine these issues again within the same study.

2.6 Person perception theory. The experimental and survey work was guided by the three-dimensional (competence, morality and sociability) theory of stereotype content (Leach, Ellemers, & Barreto, 2007). I showed that perceptions of communicator warmth were not affected by the linguistic manipulations. Perceptions of competence appear to have a small and inconsistent influence, in that higher levels of perceived competence reduced travel behaviour intentions, an effect that was slightly stronger under conditions of high uncertainty compared to lower uncertainty (Experiment 2, Chapter 3). Perceived competence also influenced organisational trust in study (Experiment 2, Chapter 3). My research indicates that perceptions of morality consistently played a more important role in guiding audience responses to uncertainty in climate communications, particularly when interacting with higher

probabilistic uncertainty. Even in the qualitative part of the survey study presented in Chapter 4 people tended to articulate features representing competence, it was quantitatively demonstrated that perceptions of morality guided behavioural intentions as a response to uncertainty.

As such, I would propose the findings within this body of work are consistent with earlier person perception research showing that perceived morality is the primary dimension that guides people on engaging or not with others (Brambilla, Rusconi, Sacchi, & Cherubini, 2011; Chen, Jing, & Lee, 2014).

Interestingly, and unexpectedly, perceived competence played a lesser role in responsiveness to information, indeed, sometimes high levels of perceived competence undermined responsiveness under uncertainty (Experiment 2). The patterns regarding advice provision were consistent with the gender divergences found within Experiment 3. Generally women were found to be more receptive to advice than men, particularly when uncertainty is high and open language is used to communicate the information.

In the context of the findings presented in Chapter 2 which showed that scientists view competency and (accurately and fully) communicating the information as their primary goal. They also assume that the perception of their expertise (and neutrality) is their most important asset. However, the quantitative findings presented in this thesis indicate that perceptions of communicator morality are the important characteristic when guiding audience responsiveness to the information contained within messages (Chapter 3) and when no information is presented (Survey quantitative results, Chapter 4). This is in line with previous work conducted by Wojciszke (2005), where he suggests the competence dimension is dominant when perceiving oneself, but the morality dimension governs perceptions of others. This is

in addition to pre-existing beliefs (i.e., scepticism, perceptions of uncertainty) being a very strong influence on audience responsiveness (Chapter 4).

2.7 Identity threat and scepticism. The results have shown that some aspects of climate change communication can lead to potential boomerang effects, resulting in information campaigns having unintended converse effects (Hart & Nisbet, 2013). Concepts such as psychological reactance (Brehm, 1966) and motivated reasoning (Kunda, 1990; Kahan, Braman, Gastil, Slovic, & Mertz, 2007) have been proposed as forces that may lead to such boomerang effects. The results from the final experiment presented in Chapter 3 and the snapshot survey presented in Chapter 4 points to the importance of considering such unintended consequences that may stem from perceived threats to an individual. The negative effects may be a consequence of motivated reasoning in order to protect potential threats to one's identity (Kunda, 1990; Kahan, Braman, Gastil, Slovic, & Mertz, 2007). Such rejection of information may be simply a mechanism for justifying continued climate-unfriendly behaviours (e.g., Chatterton, Musselwhite, Lyons, & Clegg, 2009; Thomas, Walker, & Musselwhite, 2014).

2.8 Future work. The findings contained within this thesis are broadly consistent, with some deviations that cloud the overall picture. I will now suggest ways in which this work could be taken forward in order to strengthen our understanding of the relationship between language use and perceptions of morality; and of the consequential influence of perceived morality (and further exploration of this compared to competence) on behaviour when interacting with high uncertainty.

2.8.1 Propensity to trust. Though I have shown that communicators can signal morality through language use, it may be worth reminding ourselves that communicator characteristics are arguably owned by audiences in receipt of the

communications. While it has been fruitful to show what influences perceptions of trust (i.e., competence and morality), trust involves two parties: a trusting party (trustor) and a party to be trusted (trustee) (Driscoll, 1978). Therefore the extent to which perceived competence and morality interacts with an individual's propensity to trust may also provide some illumination in the whole process. In considering one's propensity to trust (i.e., general willingness to trust others) rather than simply examining how people respond to sources as being trustworthy or not, and how the two interact may help further understand the dynamics of trust between trustor and trustee in climate change communications.

Propensity to trust is proposed to be a stable within-party factor that will affect the likelihood the party will trust, potentially a trait that is stable across situations. Thus, future research may wish to explore whether an individual's propensity to trust influences how much trust one has for a trustee prior to interactions with that person. I would suggest that it would be worth exploring the extent to which general propensity to trust connects to perceptions of trust in (uncertain) climate change communications. Here one can apply models of trust developed within organisational settings where it is suggested that to fully understand the dynamics of trust it is also important to consider the individual's propensity to trust, *as well as* their perceptions of the source (Driscoll, 1978; Mayer, Davis, & Schoorman, 1995). For Farris, Senner, and Butterfield (1973) trust is defined as "a personality trait of people interacting with peripheral environment of an organization" (p.145). With this approach trust is viewed as a trait that leads to a generalised expectation about the trustworthiness of others. In the proposed model this trait is referred to as the propensity to trust.

Such an approach would give an indicator to an individual's likelihood to trust and to what extent this may influence perceptions of trust towards communicators of

climate change. With the notion that the climate change information tends to be interpreted in the context of existing attitudes/values/beliefs; it is plausible to take the view that perceptions of trustworthiness can also be played out in the context of existing pre-dispositions to trust. This may prove to be an interesting avenue for future research.

2.8.2 Language, morality and gender. In this research I demonstrated how stylistic differences of language could shape moral perceptions of the communicator, and when doing so could affect people's willingness or ability to engage with messages that contain high levels of uncertainty. I have suggested that open language used within the experiments is a signal of communicator morality. The lack of consistent effects of language on communicator perceptions may be because of the weak signal contained in the language manipulations. As such, I would maintain that the findings from this aspect of the research provide partial support for the idea that language features can increase perceptions of morality given certain conditions (e.g., among females). Furthermore, in contrast to this there was an absence of any main or interaction effects with uncertainty on the dependent variables when using the closed language – the exception being in the final experiment where men were more responsive to this style than the open style alternative. Indeed, the final experiment was rather illuminating to the demographic differences of audience responsiveness towards language, uncertainty and advice. Women were generally more accepting of open language styles, under high uncertainty. These findings would support previous literature that advocates for the segmentation of audience samples (e.g., Maibach, Roser-Renouf, & Leiserowitz 2009; Anable, Kelay, & Lane, 2006; Barnett & Mahony, 2011).

2.8.3 *Morality and uncertainty.* A broader examination of manipulating source characteristics (e.g., morality) beyond using an ‘open’ style would be interesting. One would need to further examine the influence of perceived morality, particularly when interacting with uncertainty, through experimental studies that contain more explicit manipulations of communicator features in these dimensions. For example, rather than varying language, stronger manipulations may be achieved through depicting the communicator as having certain stereotypic traits – for instance, using words associated with (in)competence and (im)morality when describing characteristics of the communicator. van Prooijen & Jostmann (2013) conducted experiments looking in to similar effects of morality and uncertainty on the impact of perceived morality of authorities on conspiracy beliefs when in conditions of uncertainty. In their two studies uncertainty was made salient subjectively by asking participants to think about a time when they felt uncertain versus neutral, such as watching TV. Manipulations of organisation morality were contained in fake reports presenting an institution as moral or immoral.

2.8.4 *Uncertainty: Probabilistic vs. ambiguous.* The results in this work also indicate that different forms of uncertainty may lead to different behavioural responses when the communicator is perceived as more, rather than less, moral. As I suggested earlier in this Chapter (section 2.5), the impact of morality on behavioural intentions is in accordance with level of perceived ambiguity of the climate change phenomenon. In comparison, the effect of morality on behavioural intentions in response to probabilistic uncertainty in the form of likelihood impacts seems to override the informational uncertainty leading to more climate friendly behaviours. I have suggested ways in which the effects of ambiguous versus probabilistic

uncertainty on communicator perceptions and audience responses could be examined in future (see *section 2.5*).

Given that most lay people encounter climate change information and its uncertainty through media outlets (Carvalho & Burgess, 2005; Carvalho 2010), I would be inclined to believe that ambiguous uncertainty (i.e., around the phenomenon of climate change) is likely to be more representative of layperson encounters with climate information than probabilistic uncertainty (such as likelihood impacts).

3. Practical Implications

As a cross-disciplinary research programme this contributes to practices in a number of ways.

3.1 Science communication. The communication of climate (change) science, and science in general, has traditionally assumed publics are deficient in their knowledge and that any problems of understanding stem from this (Gross, 1994). This “deficit approach” seemed most prominent among the scientists interviewed – in that the effectiveness of messages was seen as being based solely on the information contained within them. Thus any failure of communication is viewed as down to problems with the content of the message, or with the audience’s inability to understand it properly. This approach gives little consideration to the context within which individuals receive information and how this can shape engagement and (perceived) understanding. A broader perspective calls attention to these contextual inputs – specifically to the relationships between communication sources and audience – and how these shape motivations in communication and the outcomes of this.

In the present research, I have demonstrated that communication style can inspire greater perceptions of morality of the communicator than traditional science dialects. Though the closed/ corporate language used in the experimental work may not necessarily equate to a traditional science dialect *per se*, the open style is in distinct contrast to traditional science dialect. Adapting one's communication style in a manner advocated by professional communicators (i.e., a relational communication style), may, under certain conditions, nurture a long-lasting trust akin to that of relational trust (Rousseau, Sitkin, Burt, & Camerer, 1998). As such, it may be that modifying their language can help organisations shape the impression people have of them, and improve audience responses to the organisation's climate change information.

3.2 Uncertainty. For climate science organisations like the IPCC and the Met Office, it may also be useful to be aware of the categories of uncertainty that are prominent in the public sphere. The public's broader experience of uncertainty (i.e., ambiguous uncertainty) is not the same that the IPCC and Met Office seek to communicate (i.e., probabilistic uncertainty). Specifically, the majority of climate change information that people consume comes through the media rather than from climate scientists or formal reports, such as IPCC assessments (Carvalho & Burgess, 2005; Carvalho 2010).

Therefore, given that high levels of morality (a central component of trust) interact with general uncertainty differently to specific presentations of probabilistic uncertainty, one way to increase engagement with a wider audience is to get involved in the discussions about the broader uncertainties around climate change in the mass media in a way which demonstrates high certainty around the occurrence of human-induced climate change, whilst recognising specific impacts is variable. This is

something advocated by Corbett and Durfee (2004) who state that uncertainty should not necessarily be denied or particularly highlighted, but it is important to “place the uncertain finding in the proper and objective context of the scientific process” (p.143).

3.3 Advice provision. Science organisations typically prioritise projecting the impression of neutrality and independence, and as such may take a non-advisory stance in issues like climate change. Indeed, the climate scientists interviewed in Chapter 2 felt very strongly that the provision of advice was beyond their role, and that doing this could potentially compromise their reputation and authority. However, contrary to these fears the findings from Experiment 3 showed that information accompanied with generic behavioural advice does not result in negative perceptions of the source, and does not have detrimental effects on responses to the information, at least not uniformly so. Of course, some (e.g., men) may prefer not to be given advice, but others (e.g., women) may be responsive to this.

The variable effects of advice provision notwithstanding, it is clear that scientists do sometimes feel advice is appropriate and do not express the same level of reputation concern about this. For example, if one considers extreme weather events, scientific organisations involved in weather are forthcoming about warning and advising the public to take action. Under the guidance of the National Severe Weather Warnings¹⁹, weather warnings are colour coded: yellow (be aware), amber (be prepared), and red (take action). When communicating such warnings, those responsible would naturally assume, and indeed desire, that the public will respond and “take action”. This reveals a distinctly different organisational attitude when it

¹⁹ <http://www.metoffice.gov.uk/public/weather/warnings/#?tab=map&map=Warnings&zoom=8&lon=-3.53&lat=55.50&fcTime=1393977600>

comes to the behavioural advice with respect to weather, in comparison to behavioural advice in relation to climate change.

With this in mind, the hesitation of scientists may be more about the political nature of the domain rather than the provision of advice *per se*. The provision of advice about climate change invariably has political connotations. In addition, the spatial and temporal features of climate change may make it easier for scientists – as well as the public – to defer responsibility for taking action on this. However, if human-induced climate change is considered “extremely likely” by scientists themselves, and if the projected impacts of this are as reliable as projections in other domains (e.g., weather forecasting), then one could be entitled to question the inconsistent attitude about advice provision across these domains. Although it is beyond the scope of this thesis to address that issue, it can be said that advice provision may not be as detrimental as scientists fear. Moreover, from a communication perspective, it seems somewhat odd to convince the public of the urgent reality of climate change without also advising about behavioural options in response.

3.4 Identity threat. Some of the findings presented in Chapters 3 and 4 can be interpreted in the context of identity threat and motivated reasoning. These theories suggest that information is attenuated to and evaluated in ways that validate pre-existing beliefs and identity (e.g., van Prooijen & Sparks, 2014; Harris & Napper, 2005; Steele, 1988). Communication implications from this would be to avoid messages that may potentially threaten existing behaviours and identity, but instead focus on motivational aspects within messages. A specific example drawing on findings within this thesis would be in considering why increased uncertainty reduced pro-environmental travel intentions, but not within the household (Chapter 4).

Interpreting this through an identity threat lens, such reluctance to change travel behaviour may be because due to its link to identity and freedom (e.g., Chatterton, Musselwhite, Lyons, & Clegg, 2009; Thomas, Walker, & Musselwhite, 2014). Thus, in this example it may be more effective to avoid messages that bluntly say to cut down car-use, but rather focus on social and economical benefits of cycling more.

4. Methodological Insights

This program of research showed how different methodologies can be successfully used together to arrive at a more complete understanding of climate change communication. Situating this research within a pragmatic epistemology and combining quantitative/ qualitative methodologies resulted in an insightful and interesting piece of research. Moreover, the iterative and flexible approach allowed the research presented here to develop organically.

In starting this research with qualitative interviews (Chapter 2) I provided a deeper insight into the process of communication from the perspective of two key actors within that, this work also substantially informed the experimental studies that followed. The shift to experimental designs allowed me to investigate the themes that emerged from the qualitative data - specifically how these themes related to audience responses (Chapter 3). The final survey (Chapter 4) enabled me to then take the ideas learnt from the experimental work and apply them to a real organisation, rather than the hypothetical organisation used in the experimental work. Within the final survey (Chapter 4) there was the opportunity to probe deeper into how such perceptions were built, by qualitatively examining the verbatim responses. Thus, this iterative approach allowed me to take each piece of research further and feed into the next studies.

Together these studies closed the circle between sources of information,

communication specialists, audiences, and back to the real organisations involved in this activity.

In my opinion, it is restricting to commit to either one of the binary epistemological traditions (be it positivist or constructivist) and applying a single method approach design to research. Instead, I would advocate the application of a pragmatist epistemological framework (e.g., Creswell & Plano Clark, 2007; Morgan & Smircich, 1980; Johnson & Onwuegbuzie, 2004; Maxcy, 2003; Guba & Lincoln, 2005; Creswell, 2003) and mixed methodology (e.g., Snape & Spencer, 2003; Greene, Caracelli, & Graham, 1989; Yardley & Bishop, 2008; Lee, 1991). Key to the pragmatist approach is that the research is not fitted to the method, but rather the methods are flexible in approaching the research of interest.

Within the research presented in this thesis, the flexible and iterative nature of a pragmatic approach and mixed methods was appropriate and fruitful in their application. This allowed the exploration of the perspectives of different actors within a communications process. For example, studying the issue of uncertainty qualitatively provided a better understanding of its challenges and importance to communication in the eyes of the scientist. During this qualitative work I also gained insights into how communicators perceive scientists to construct uncertainty and to what effect (as also implicitly seen in discourse of scientists). I then took a quantifiable representation of uncertainty (in the form of impacts likelihoods) to investigate how audiences respond to this.

5. Strengths and Limitations

Although this research has produced some important insights, there are of course limitations that should be considered when digesting the results presented here and their interpretations.

The findings from the qualitative work presented in Chapter 2 had its limitations in the sense of being carried out within a specific and sole organisation, and location. The findings may well be context focussed, highlighting specific organisational values and workplace nuances. Despite this, the findings from this piece of research can deepen understanding of communication practices.

Notably, Experiments 1 and 2 were carried out among a student campus-based sample. However, there were cost, time and logistical benefits in using this recruitment method. Convenience-sampling methods such as this made for a good arena to build ideas and test theories. Experiment 3, in contrast, consisted of a large and non-student population that allowed me to look beyond the university campus community. I note that this sample was not strictly random in that, though the sample was broad and large (>400), these people had voluntarily joined the online loyalty programme to participate in surveys. That said, the data provided from this sample was insightful and reminded us that, while using a student sample has its uses, it should not be the only sample of study (often consisting of young, female, first year psychology students). I was able to draw conclusions from the Pilot and Experiment 1 and 2 (student samples). When moving to a wider sample, I was able to get a better insight into the patterns previously seen, validating these findings.

Drawing upon epistemological insights, certain limitations are apparent when considering the manipulations of climate change impacts in the experimental work. For instance, though these were presented in a positivist fashion (i.e., probabilities

indicating a logical and mathematical process behind the knowledge), and responses were quantifiable (i.e., measured on a scale), we as researchers tend to assume respondents will perceive such impacts as intended. However, as Budescu, Broomell and Por (2009) have shown, respondents' judgments of probabilities vary somewhat: interpretations vary between participants and they vary from organisational (IPCC) guidelines. The final study (Chapter 4) explored responses to perceived uncertainty when said 'uncertainty' was not predefined (i.e., when not presenting climate impacts). In this instance the participant constructed the 'uncertainty', and each participant responded within his or her own construction of uncertainty. Both measures of climate change uncertainty are useful to engage in and explore, though each has their own strengths and limitations. Being aware of these limitations are important in digesting the findings. Utilising a mixture of methods approach can help in overcoming particular weaknesses that some methods and epistemological frameworks may bring.

Relatedly, while the experimental designs could help control aspects of interest (such as the manipulations of language and uncertainty), we do not know what is salient in people's mind when responding to the surveys exploring uncertainty. For example, Capstick and Pidgeon (2013) have suggested that when participants respond in weather and climate studies, results may inadvertently be framed by the cultural elements i.e., people of the UK hold a certain cultural significance towards the weather. Broadly speaking, it should be acknowledged that there may be a limited generalisability beyond the UK, as all responses will, to some extent, be framed within UK frames of reference.

Another limitation of this work was discussed earlier in this chapter (section 2.8.3). That is, although I have inferred that open language shapes perceptions of

morality, the actual evidence for this has been variable across the experiments. However, this does not mean to say that perceptions of communicator morality are not central to the communications process. Indeed, some of the observed effects of perceived morality were demonstrated on important outcome variables independent of the language manipulation. Specifically, in the studies where language variation was not used as the proxy for morality perceptions (Experiment 2 in Chapter 3, and the survey in Chapter 4), perceptions of morality were still a key variable that determined responses to uncertainty about climate change.

The audience of focus in the quantitative parts of this thesis is limited to individual-based public audiences. In future research, it would be interesting to examine how the findings presented in this thesis would apply to a wider audience of climate change communication (such as policy-makers). Furthermore, it would also be fruitful in future to widen the behavioural responses from individual ‘private-sphere’ actions (such as household/ travel choices) to ‘public-sphere’ actions (such as voting behaviour/ policy acceptance).

As with all social science research, nothing is perfect. It is important to be aware of what and where weaknesses exist. Some of the limitations in this research were overcome in approaching the work from multiple directions i.e., using mixed methods and recruiting different samples. Where weaknesses could not be overcome during the course of the research, the best we can do is be aware of the weaknesses, learn from it and make changes in any future research.

6. Concluding remarks

In recognising the importance of effective climate change communications in shaping attitudes and behaviours in response to changing climates, I studied the dynamics of such communications from the perspective of three key actors: scientists, communicators and publics. I also explored the challenges inherent in effective climate change communications, specifically the issue of uncertainty – including how uncertainty is perceived and described by scientists and communicators, and how audiences responded to this. I showed that varying the language peripheral to the probabilistic uncertainty can have effects on how people responded to the information contained. For example, open language styles (which sometimes signalled morality) seemed to encourage positive responses to uncertainty (particularly among females), whereas closed language seemed more neutral in its effects on audience responses to uncertainty (although males did seem more receptive to this style in at least one study). The research here also points to the importance of how different subpopulations may respond differently to different communication styles, the information content, and the provision of advice. Therefore, addressing the scientific uncertainties in communication of climate change may not necessarily mean altering the content of information itself. Rather, modifying the language peripheral to the information that contains uncertainty, and attending to the ways in which audiences perceive the sources of uncertain information, may help to engage in effective communication around the complex issue of climate change.

References

- Abele, A. E., & Wojciszke, B. (2007). Agency and communion from the perspective of self versus others. *Journal of Personality and Social Psychology*, *93*(5), 751.
- Ackroyd, S. (2004). Some implications of critical realism. *Critical realist applications in organisation and management studies*, 127. In Fleetwood, S., & Ackroyd, S. (Eds.). (2004). *Critical realist applications in organisation and management studies*. Psychology Press.
- Allison, S. T., Messick, D. M., & Goethals, G. R. (1989). On being better but not smarter than others: The Muhammad Ali effect. *Social Cognition*, *7*(3), 275-295.
- Allum, N., Sturgis, P., Tabourazi, D., & Brunton-Smith, I. (2008). Science knowledge and attitudes across cultures: A meta-analysis. *Public understanding of science*, *17*(1), 35-54.
- Allport, G. W. (1954). *The nature of prejudice*. New York: Addison- Wesley.
- Anable, J., Lane, B., & Kelay, T. (2006). An evidence base review of public attitudes to climate change and transport behaviour. *London, Department for Transport*.
- Atkinson, N. L., Saperstein, S. L., & Pleis, J. (2009). Using the internet for health-related activities: findings from a national probability sample. *Journal of Medical Internet Research*, *11*(1).
- Barber, B. (1983). *The logic and limits of trust* (Vol. 96). New Brunswick, NJ: Rutgers University Press.
- Barnett, C., & Mahony, N. (2011). Segmenting Publics. Available at

http://www.publicengagement.ac.uk/sites/default/files/publication/segmenting_publics_2_nov_2011.pdf

Blaikie, N. W. (1991). A critique of the use of triangulation in social research. *Quality & quantity*, 25(2), 115-136.

Brehm, J. W. (1966). A theory of psychological reactance. *New York*.

British Broadcasting Corporation. (2010). BBC climate change poll – February 2010.

Accessed 29 December, 2014 from

http://news.bbc.co.uk/1/hi/shared/bsp/hi/pdfs/05_02_10climatechange.pdf

Barometer, Met Office magazine (2013). A matter of trust.

http://www.metoffice.gov.uk/media/pdf/b/r/Barometer_Issue_23.pdf

[Accessed March 2014]

Berger, C. R., & Calabrese, R. J. (1975). Some explorations in initial interaction and beyond: Toward a developmental theory of interpersonal communication.

Human communication research, 1(2), 99-112.

Bertolotti, M., Catellani, P., Douglas, K. M., & Sutton, R. M. (2013). The “Big Two” in Political Communication. *Social Psychology*, 44(2), 117-128.

Billig, M. (2011). Writing social psychology: Fictional things and unpopulated texts.

British Journal of Social Psychology, 50(1), 4-20.

Blake, J. (1999). Overcoming the ‘value- action gap’ in environmental policy:

Tensions between national policy and local experience. *Local environment*, 4(3), 257-278.

Blendon, R. J., DesRoches, C. M., Benson, J. M., Herrmann, M. J., Taylor-Clark, K., & Weldon, K. J. (2003). The public and the

smallpox threat. *New England Journal of Medicine*, 348(5), 426-432.

Bord, R. J., Fisher, A., & O’Connor, R. E. (1998). Public perceptions of global

- warming: United States and international perspectives. *Climate Research*, 11(1), 75-84.
- Bourdieu, P. (2000). *Pascalian meditations*. Stanford University Press.
- Boykoff, M. T., & Boykoff, J. M. (2004). Balance as bias: global warming and the US prestige press. *Global environmental change*, 14(2), 125-136.
- Bradac, J. J. (1990). Language attitudes and impression formation.
- Bradac, J. J., Bowers, J. W., & Courtright, J. A. (1979). Three language variables in communication research: Intensity, immediacy, and diversity. *Human Communication Research*, 5(3), 257-269.
- Brambilla, M., Rusconi, P., Sacchi, S., & Cherubini, P. (2011). Looking for honesty: The primary role of morality (vs. sociability and competence) in information gathering. *European Journal of Social Psychology*, 41(2), 135-143.
- Brambilla, M., Sacchi, S., Rusconi, P., Cherubini, P., & Yzerbyt, V. Y. (2012). You want to give a good impression? Be honest! Moral traits dominate group impression formation. *British journal of social psychology*, 51(1), 149-166.
- Brigham, J. C. (1971). Ethnic stereotypes. *Psychological Bulletin*, 41, 15-38.
- Bromiley, P., & Cummings, L. L. (1995). Transactions costs in organizations with trust. *Research on negotiation in organizations*, 5, 219-250.
- Brown, P. (1987). *Politeness: Some universals in language usage* (Vol. 4). Cambridge University Press.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77 - 101.
- Burgess, J., Harrison, C. M., & Filius, P. (1998). Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning A*, 30(8), 1445-1460.

- Burns, T. W., O'Connor, D. J., & Stocklmayer, S. M. (2003). Science Communication: A Contemporary Definition. *Public Understanding of Science*, 12(2), 183-202.
- Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis* (Vol. 248). London: Heinemann.
- Callaghan, P., & Augoustinos, M. (2013). Reified versus consensual knowledge as rhetorical resources for debating climate change. *Revue Internationale de Psychologie Sociale*, 26(3), 11-38.
- Camerer, C., & Weber, M. (1992). Recent developments in modeling preferences: Uncertainty and ambiguity. *Journal of risk and uncertainty*, 5(4), 325-370.
- Cameron, D (2014). House of Commons Wednesday 26 February 2014 Oral Answers to Questions.
<http://www.publications.parliament.uk/pa/cm201314/cmhansrd/cm140226/debtext/140226-0001.htm> [Accessed March 2014]
- Capstick, S. B., & Pidgeon, N. F. (2013). Public perception of cold weather events as evidence for and against climate change. *Climatic Change*, 1-14.
- Carvalho, A. (2010). Media (ted) discourses and climate change: a focus on political subjectivity and (dis) engagement. *Wiley Interdisciplinary Reviews: Climate Change*, 1(2), 172-179.
- Carvalho, A., & Burgess, J. (2005). Cultural circuits of climate change in UK broadsheet newspapers, 1985–2003. *Risk analysis*, 25(6), 1457-1469.
- Chaiken, S. (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of personality and social psychology*, 39(5), 752.
- Chaiken, S. (1987). The heuristic model of persuasion. In Olson, J. M., & Zanna, M.

- P. (1993). Attitudes and attitude change. *Annual review of psychology*, 44(1), 117-154.
- Chaiken, S., & Maheswaran, D. (1994). Heuristic processing can bias systematic processing: effects of source credibility, argument ambiguity, and task importance on attitude judgment. *Journal of personality and social psychology*, 66(3), 460.
- Chatterton, T. J., Coulter, A., Musselwhite, C., Lyons, G., & Clegg, S. (2009). Understanding how transport choices are affected by the environment and health: Views expressed in a study on the use of carbon calculators. *Public health*, 123(1), e45-e49.
- Chen, F. F., Jing, Y., & Lee, J. M. (2014). The looks of a leader: Competent and trustworthy, but not dominant. *Journal of Experimental Social Psychology*, 51, 27-33.
- Collins, H. M., & Evans, R. (2002). The third wave of science studies studies of expertise and experience. *Social studies of science*, 32(2), 235-296.
- Colley, A., & Todd, Z. (2002). Gender-linked differences in the style and content of e-mails to friends. *Journal of Language and Social Psychology*, 21(4), 380-392.
- Cook, J., & Wall, T. (1980). New work attitude measures of trust, organizational commitment and personal need non - fulfilment. *Journal of occupational psychology*, 53(1), 39-52.
- Cooper, J., Bennett, E. A., & Sukel, H. L. (1996). Complex scientific testimony: How do jurors make decisions?. *Law and Human Behavior*, 20(4), 379.
- Corbett, J. B., & Durfee, J. L. (2004). Testing public (un) certainty of science media representations of global warming. *Science Communication*, 26(2), 129-151.

- Corner, A. (2010) Do climate change sceptics give scepticism a bad name?. The Guardian.<http://www.theguardian.com/environment/blog/2010/feb/22/climate-change-sceptics>
- Corner, A., Whitmarsh, L., & Xenias, D. (2012). Uncertainty, scepticism and attitudes towards climate change: biased assimilation and attitude polarisation. *Climatic Change*, 114(3-4), 463-478.
- Craig, R. T. (1999). Communication theory as a field. *Communication theory*, 9(2), 119-161.
- CRED. (2009). *The psychology of climate change communication: A guide for scientists, journalists, educators, political aides, and the interested public*. New York, NY: Columbia University.
- Creswell, J. (2004). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. Prentice Hall.
- Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*.
- Christophel, D. M. (1990). The relationships among teacher immediacy behaviors, student motivation, and learning. *Communication Education*, 39(4), 323-340.
- Dawes, R. M. (1980). Social dilemmas. *Annual review of psychology*, 31(1), 169-193.
- Davies, S. R. (2008). Constructing Communication Talking to Scientists About Talking to the Public. *Science Communication*, 29(4), 413-434.
- DEFRA (2007) *Survey of Public Attitudes and Behaviours toward the Environment: 2007*, Department for Environment, Food and Rural Affairs, London.
- Deutsch, M. (1958). Trust and suspicion. *Journal of conflict resolution*, 265-279.

- Deutsch, M. (1960). The effect of motivational orientation upon trust and suspicion. *Human relations*, 13(2), 123-139.
- Dietz, T., Dan, A., & Shwom, R. (2007). Support for Climate Change Policy: Social Psychological and Social Structural Influences. *Rural Sociology*, 72(2), 185-214.
- Dirks, K. T., & Ferrin, D. L. (2001). The role of trust in organizational settings. *Organization Science*, 12(4), 450-467.
- Douglas, M., & Wildavsky, A. (1983). *Risk and culture: An essay on the selection of technological and environmental dangers*. Univ of California Press.
- Driscoll, J. W. (1978). Trust and participation in organizational decision making as predictors of satisfaction. *Academy of Management Journal*, 21(1), 44-56.
- Dunlap, R.E., McCright, A.M., 2010. Climate change denial: sources, actors, and strategies. In: Lever-Tracy, C. (Ed.), *The Routledge International Handbook of Climate Change and Society*. Routledge Press, New York, pp. 240–259.
- Dunwoody, S. 1999. Scientists, journalists, and the meaning of uncertainty. In *Communicating uncertainty: Media coverage of new and controversial science*, edited by S. M. Friedman, S. Dunwoody, and C. L. Rogers, 59–79. Mahwah, NJ: Lawrence Erlbaum.
- Eagly, A. H. (1987). Sex differences in social behavior: A social-role interpretation. Hillsdale, NJ: Erlbaum.
- Eagly, A. H., & Mladinic, A. (1994). Are people prejudiced against women? Some answers from research on attitudes, gender stereotypes, and judgments of competence. *European review of social psychology*, 5(1), 1-35.
- Earle, T. C., & Cvetkovich, G. (1995). *Social trust: Toward a cosmopolitan society*.

Greenwood Publishing Group.

- Erbring, L., Goldenberg, E. N., & Miller, A. H. (1980). Front-page news and real-world cues: A new look at agenda-setting by the media. *American Journal of Political Science*, 16-49.
- Eder, K., & Ritter, M. T. (1996). *The social construction of nature: A sociology of ecological enlightenment*. Sage Publications, Inc.
- Einhorn, H. J., & Hogarth, R. M. (1986). Decision Making under Ambiguity. *Journal of Business* 59, 225-250.
- Einsiedel, E., & Thorne, B. (1999). Public responses to uncertainty. *Communicating uncertainty: Media coverage of new and controversial science*, 43-58.
- Einsiedel, E. (2005). Editorial: Of Publics and Science, *Public Understanding of Science*, 16(1): 5-6.
- Eiser, J. R., Miles, S., & Frewer, L. J. (2002). Trust, Perceived Risk, and Attitudes Toward Food Technologies¹. *Journal of Applied Social Psychology*, 32(11), 2423-2433.
- Ellaway, A., Macintyre, S., Hiscock, R., & Kearns, A. (2003). In the driving seat: psychosocial benefits from private motor vehicle transport compared to public transport. *Transportation Research Part F: Traffic Psychology and Behaviour*, 6(3), 217-231.
- Ellsberg, D. (1961). Risk, ambiguity, and the Savage axioms. *Quarterly Journal of Economics*, 75, 643–669.
- European Environment Agency (2001). Late lessons from early warnings: the precautionary principle 1896-2000, Environmental issue report No 22
[Accessed December 29, 2014 from

http://www.eea.europa.eu/publications/environmental_issue_report_2001_22/issue-22-part-17.pdf

- Farris, G. F., Senner, E. E., & Butterfield, D. A. (1973). Trust, culture, and organizational behavior. *Industrial Relations: A Journal of Economy and Society*, 12(2), 144-157.
- Feilzer, M. Y. (2010). Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of mixed methods research*, 4(1), 6-16.
- Feinberg, M., & Willer, R. (2011). Apocalypse soon? Dire messages reduce belief in global warming by contradicting just-world beliefs. *Psychological Science*, 22(1), 34-38.
- Fiske, S. T., Cuddy, A. J. C., Glick, P., and Xu, J. (2002). A model of (often mixed) stereotype content: Competence and warmth respectively follow from status and competition. *Journal of Personality and Social Psychology*, 82, 878-902.
- Fiske, S. T., Xu, J., Cuddy, A. C., & Glick, P. (1999). (Dis)respecting versus (dis)liking: Status and interdependence predict ambivalent stereotypes of competence and warmth. *Journal of Social Issues*, 55(3), 473-489.
- Fiske, S. T., Cuddy, A. J., & Glick, P. (2007). Universal dimensions of social cognition: Warmth and competence. *Trends in cognitive sciences*, 11(2), 77-83.
- Fischhoff, B. (1995). Risk perception and communication unplugged: Twenty years of process. *Risk Analysis*, 15, 137-145.
- Flick, U. (1992). Triangulation revisited: strategy of validation or alternative?. *Journal for the theory of social behaviour*, 22(2), 175-197.
- Fløttum, K., & Dahl, T. (2011). Climate change discourse: scientific claims in a

- policy setting. *Fachsprache*, 3, 205-219.
- Flynn, R., Bellaby, P., & Ricci, M. (2009). The 'value- action gap' in public attitudes towards sustainable energy: the case of hydrogen energy. *The Sociological Review*, 57(s2), 159-180.
- Funtowicz, S., Ravetz, J. (1990) *Uncertainty and Quality in Science for Policy*, Dortchert: Kluwer Academic Publishers.
- Gabarro, J. (1978). The development of trust, influence, and expectations. In A. G. Athos & J. J. Gabarro (Eds.), *Interpersonal behavior: Communication and understanding in relationships*. Englewood Cliffs, NJ: Prentice Hall.
- Gambetta, D. G. (Ed.). 1988. Can we trust trust? In D. G. Gambetta (Ed.), *Trust*: 213-237. New York: Basil Blackwell.
- Gardner, G. T., & Stern, P. C. (2008). The short list: The most effective actions US households can take to curb climate change. *Environment: science and policy for sustainable development*, 50(5), 12-25.
- Gavin, N. T., & Marshall, T. (2011). Mediated climate change in Britain: Scepticism on the web and on television around Copenhagen. *Global Environmental Change*, 21(3), 1035-1044.
- Gelb, K., Pederson, A., & Greaves, L. (2012). How have health promotion frameworks considered gender?. *Health promotion international*, 27(4), 445-452.
- Gergen, K. J. (1999). *An invitation to social construction*. Sage.
- Gieryn, T. F. (1983). Boundary-work and the demarcation of science from non-science: Strains and interests in professional ideologies of scientists. *American sociological review*, 781-795.
- Giffin, K. 1967. The contribution of studies of source credibility to a theory of

- interpersonal trust in the communication department. *Psychological Bulletin*, 68, 104-120.
- Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, 66(4), 290.
- Gilbert, G. N., & Mulkey, M. (1984). *Opening Pandora's Box: A sociological analysis of scientists' discourse*. New York: Cambridge University Press.
- Giles, H., Coupland, J., & Coupland, N. (1991). Accommodation theory: Communication, context, and consequence. In H. Giles, J. Coupland & N. Coupland (Eds.), *Contexts of Accommodation. Developments in Applied Sociolinguistics*. Cambridge University Press.
- Giles, H. Ogay, T. (2007). "Communication Accommodation Theory". In Whaley, B., & Samter, W. *Explaining Communication: Contemporary Theories and Exemplars*. Mahwah, NJ: Lawrence Erlbaum.
- Glaser, B. G. (2001). *The grounded theory perspective: Conceptualization contrasted with description*. Sociology Press.
- Goodwin, J. (2009). The authority of the IPCC first assessment report and the manufacture of consensus. In *National Communication Association convention, Chicago, IL*.
- Goodwin, J. (2011). Accounting for the Appeal to the Authority of Experts. *Argumentation*, 25(3), 285-296.
- Goodwin, J., & Dahlstrom, M. F. (2011). Good reasons for trusting climate science communication. In *American Meteorological Society convention, Seattle, WA*.
- Goodwin, M., & Evans, J. (2012). From Voting to Violence. *Far Right Extremism in Britain*.
- Goodwin, G. P., Piazza, J., & Rozin, P. (2014). Moral character predominates in

- person perception and evaluation. *Journal of personality and social psychology*, 106(1), 148.
- Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems*, 21(2), 135-146.
- Gray, J. (1992). *Men are from Mars, Women are from Venus: a Practical Guide for Improving Communication and Getting What You Want in a Relationship*. Harper Collins, New York
- Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational evaluation and policy analysis*, 11(3), 255-274.
- Gross, A. G. (1994). The roles of rhetoric in the public understanding of science. *Public Understanding of Science*, 3(1), 3-23.
- Guba, E. G., & Lincoln, Y. S. (2005). Paradigmatic controversies, contradictions, and emerging influences. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage Handbook of Qualitative Research*. Thousand Oaks, CA: Sage.
- Hall, J. A. (1984). *Nonverbal sex differences: Communication accuracy and expressive style*. Baltimore: John Hopkins University Press.
- Halliday, M. A. K. (2004). *The Language of Science* (Vol. 5). Continuum.
- Halliday, M. A. K., & Martin, J. R. (1993). *Writing science*. London: Falmer Press.
- Hammersley, M. (1992). Deconstructing the qualitative-quantitative divide. In M. Hammersley. (1992). *What's wrong with ethnography?: Methodological explorations*. Psychology Press.
- Harding, S. G. (1991). *Whose science? Whose knowledge?: Thinking from women's lives*. Cornell University Press.
- Harris, P. R., & Napper, L. (2005). Self-affirmation and the biased processing of

- threatening health-risk information. *Personality and Social Psychology Bulletin*, 31(9), 1250-1263.
- Hart, P. S. (2013). 18 Boomerang effects in risk communication. *Effective Risk Communication*, 304.
- Hart, P. S., & Nisbet, E. C. (2011). Boomerang effects in science communication: How motivated reasoning and identity cues amplify opinion polarization about climate mitigation policies. *Communication Research*, 0093650211416646.
- Higgins, E. T. (1997). Beyond pleasure and pain. *American psychologist*, 52(12), 1280.
- Hilgartner, S. (1990). The dominant view of popularization: conceptual problems, political uses. *Social studies of science*, 20(3), 519-539.
- Hilton, J. and von Hippel, W. (1996). *Annual Review of Psychology*. 47, 237–71.
- Hogg, M. A. (2000). Subjective uncertainty reduction through self-categorization: A motivational theory of social identity processes. *European review of social psychology*, 11(1), 223-255.
- House of Lords (2000). Science and Society 3rd Report. London, HMSO.
<http://www.publications.parliament.uk/pa/ld199900/ldselect/ldsctech/38/3804.htm>
- Hovland, C. I., Janis, I. L., & Kelley, H. H. (1953). Communication and persuasion; psychological studies of opinion change.
- Hovland, C. I., Lumsdaine, A. A., & Sheffield, F. D. (1949). Experiments on mass communication.(Studies in social psychology in World War II, Vol. 3.).
- Hulme, M. (2009). *Why we disagree about climate change: Understanding controversy, inaction and opportunity*. Cambridge University Press.
- Intergovernmental Panel on Climate Change [IPCC]. (2007). Summary for Policymakers. In *Climate Change 2007: The Physical Science Basis*.

Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Irwin, A., & Wynne, B. (Eds.). (1996). *Misunderstanding science?: the public reconstruction of science and technology*. Cambridge University Press.

Janoff-Bulman, R., Sheikh, S., & Hepp, S. (2009). Proscriptive versus prescriptive morality: Two faces of moral regulation. *Journal Of Personality And Social Psychology*, 96(3), 521-537. doi:10.1037/a0013779

Jasanoff, S. (1999). The songlines of risk. *Environmental values*, 8(2), 135-152.

Jasanoff, S. (1996). Beyond epistemology: relativism and engagement in the politics of science. *Social studies of science*, 26(2), 393-418.

Jasanoff, S. S. (1987). Contested boundaries in policy-relevant science. *Social studies of science*, 17(2), 195-230.

Johnson, S. K., Murphy, S. E., Zewdie, S., & Reichard, R. J. (2008). The strong,

- sensitive type: Effects of gender stereotypes and leadership prototypes on the evaluation of male and female leaders. *Organizational Behavior and Human Decision Processes*, 106(1), 39-60.
- Johnson, B. B., and Slovic, P. (1995). Presenting uncertainty in health risk assessment: Initial studies of its effects on risk perception and trust. *Risk Analysis*, 15, 485-494.
- Jones, S., & Fox, S. (2009). *Generations online in 2009* (pp. 1-9). Washington, DC: Pew Internet & American Life Project.
- Jungermann, H., Pfister, H. R., & Fischer, K. (1996). Credibility, information preferences, and information interests. *Risk Analysis*, 16(2), 251-261.
- Kahan, D., Braman, D., Gastil, J., Slovic, P., and Mertz, C. K. (2007). Culture and Identity-Protective Cognition: Explaining the White-Male Effect in Risk Perception. *Journal of Empirical Legal Studies*, 4(3), 465-505.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the Econometric Society*, 263-291.
- Kasperson, R. E., Golding, D., & Tuler, S. (1992). Social distrust as a factor in siting hazardous facilities and communicating risks. *Journal of social issues*, 48(4), 161-187.
- Kazdin, A. E. (1994). *Behavior modification in applied settings*. Thomson Brooks/Cole Publishing Co.
- Kee, H. W., & Knox, R. E. (1970). Conceptual and methodological considerations in the study of trust and suspicion. *Journal of Conflict Resolution*.
- Kellerman, S. (1992). 'I see what you mean': The role of kinesic behaviour in listening and implications for foreign and second language learning. *Applied*

- Linguistics*, 13(3), 239-258.
- Kelley, D. H., & Gorham, J. (1988). Effects of immediacy on recall of information. *Communication Education*, 37(3), 198-207.
- Kelman, H. C., & Hovland, C. I. (1953). " Reinstatement" of the communicator in delayed measurement of opinion change. *The Journal of Abnormal and Social Psychology*, 48(3), 327.
- Kempton, W. (1991). Lay perspectives on global climate change. *Global Environmental Change*, 1(3), 183-208.
- Knight, F. H. (1921). *Risk, uncertainty, and profit*. Boston: Houghton-Mifflin.
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, 8(3), 239-260.
- Kortenkamp, K. V., & Moore, C. F. (2006). Time, uncertainty, and individual differences in decisions to cooperate in resource dilemmas. *Personality and Social Psychology Bulletin*, 32(5), 603-615.
- Kramarae, C. (1981). *Women and men speaking*. Rowley, MA: Newbury House.
- Kramer, R. M. (1999). Trust and distrust in organizations: Emerging perspectives, enduring questions. *Annual review of psychology*, 50(1), 569-598.
- Kuhn, K. M. (1997). Communicating uncertainty: Framing effects on responses to vague probabilities. *Organizational behavior and human decision processes*, 71(1), 55-83.
- Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin*, 108, 480-498.
- Lakoff, R. T. (1975). *Language and womans place*. New York: Harper & Row.
- Laing, R. D., Phillipson, H., & Lee, A. R. (1966). *Interpersonal perception: A theory*

and a method of research.

Lane, B., & Potter, S. (2007). The adoption of cleaner vehicles in the UK: exploring the consumer attitude–action gap. *Journal of cleaner production*, 15(11), 1085-1092.

Larzelere, R. E., & Huston, T. L. (1980). The dyadic trust scale: Toward understanding interpersonal trust in close relationships. *Journal of Marriage and the Family*, 595-604.

Leach, C.W., Ellemers, N., & Barreto, M. (2007). Group virtue: The importance of morality (vs. competence and sociability) in the positive evaluation of in-groups. *Journal of Personality and Social Psychology*, 93, 234-249.

Lee, A. S. (1991). Integrating positivist and interpretive approaches to organizational research. *Organization science*, 2(4), 342-365.

Leininger, M. M. (1985). Ethnography and ethnonursing: Models and modes of qualitative data analysis. *Qualitative research methods in nursing*, 33-72.

Leiserowitz, A. (2007). International public opinion, perception, and understanding of global climate change. *Human development report, 2008*, 1e40.

Leiserowitz, A. A., Maibach, E. W., Roser-Renouf, C., Smith, N., & Dawson, E. (2013). Climategate, public opinion, and the loss of trust. *American behavioral scientist*, 57(6), 818-837.

Lewis, J. D., & Weigert, A. (1985). Trust as a social reality. *Social forces*, 63(4), 967-985.

Ley, P. (1983). Patients' understanding and recall in clinical communication failure. *Doctor-patient communication. London: Academic Press, Inc*, 89-107.

Ley, P. (1998). The use and improvement of written communication in mental health

- care and promotion. *Psychology, health & medicine*, 3(1), 19-53.
- Liberman, N., & Trope, Y. (2008). The psychology of transcending the here and now. *Science*, 322(5905), 1201-1205.
- Lieberman, J. K. (1981). *The litigious society* (pp. 8-25). New York: Basic Books.
- Logan, R. A. (2001). Science Mass Communication Its Conceptual History. *Science Communication*, 23(2), 135-163.
- Lord, C. G., Ross, L., & Lepper, M. R. (1979). Biased assimilation and attitude polarization: The effects of prior theories on subsequently considered evidence. *Journal of Personality and Social Psychology*, 37(11), 2098.
- Lord, C. G., & Taylor, C. A. (2009). Biased assimilation: effects of assumptions and expectations on the interpretation of new evidence. *Social and Personality Psychology Compass*, 3(5), 827-841.
- Lorenzoni, I., Nicholson-Cole, S., & Whitmarsh, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global environmental change*, 17(3), 445-459.
- Lowe, T., Brown, K., Dessai, S., de França Doria, M., Haynes, K., & Vincent, K. (2006). Does tomorrow ever come? Disaster narrative and public perceptions of climate change. *Public understanding of science*, 15(4), 435-457.
- Lyons, G., & Haddad, H. (2008). Commute replacement and commute displacement: the rise of part-day home working. *Transportation Research Record: Journal of the Transportation Research Board*, 2082(1), 1-7.
- Maddux, W. W., Mullen, E., & Galinsky, A. D. (2008). Chameleons bake bigger pies and take bigger pieces: Strategic behavioral mimicry facilitates negotiation outcomes. *Journal of Experimental Social Psychology*, 44(2), 461-468.
- Maio, G. R., Bell, D. W., & Esses, V. M. (1996). Ambivalence and persuasion: The

- processing of messages about immigrant groups. *Journal of Experimental Social Psychology*, 32(6), 513-536.
- Maibach, E., Leiserowitz, A., Cobb, S., Shank, M., Cobb, K. M., & Gullett, J. (2012). The legacy of climategate: undermining or revitalizing climate science and policy?. *Wiley Interdisciplinary Reviews: Climate Change*, 3(3), 289-295.
- Maibach, E. W., Nisbet, M. C., Baldwin, P. K., Akerlof, K., and Diao, G. (2010). Reframing climate change as a public health issue: An exploratory study of public reactions. *BMC Public Health*, 10, 299-309.
- Maio, G. R., Bell, D. W. and Esses, V. M. (1996) Ambivalence and persuasion: the processing of messages about immigrant groups. *Journal of Experimental Social Psychology*, 32, 513–536.
- Maio, G. R., & Olson, J. M. (1998). Values as truisms: evidence and implications. *Journal of Personality and Social Psychology*, 74(2), 294.
- Maltz, D. N., & Borker, R. A. (1982). A cultural approach to male-female miscommunication.
- Mastrandrea, M. D., Field, C. B., Stocker, T. F., Edenhofer, O., Ebi, K. L., Frame, D. J., ... & Zwiers, F. W. (2010). Guidance note for lead authors of the IPCC fifth assessment report on consistent treatment of uncertainties. *Intergovernmental Panel on Climate Change (IPCC)*.
- Maxcy, S. J. (2003). Pragmatic threads in mixed methods research in the social sciences: The search for multiple modes of inquiry and the end of the philosophy of formalism. In A. Tashakkori, & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research*. Thousand Oaks, CA: Sage.
- Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative

- model of organizational trust. *Academy of management review*, 20(3), 709-734.
- Mazur, A. (1981). Media coverage and public opinion on scientific controversies. *Journal of communication*, 31(2), 106-115.
- McCright, A. M., & Dunlap, R. E. (2000). Challenging global warming as a social problem: An analysis of the conservative movement's counter-claims. *Social Problems*, 499-522.
- McEvoy, P., & Richards, D. (2006). A critical realist rationale for using a combination of quantitative and qualitative methods. *Journal of Research in Nursing*, 11(1), 66-78.
- McGuire, W. J. (1964). Some contemporary approaches. *Advances in experimental social psychology*, 1, 191-229.
- Mehrabian, A. (1969). Significance of posture and position in the communication of attitude and status relationships. *Psychological Bulletin*, 71(5), 359.
- Merton, R. K. (1944/1973). *The sociology of science: Theoretical and empirical investigations*. University of Chicago press.
- Michie, S., & Johnston, M. (2004). Changing clinical behaviour by making guidelines specific. *BMJ: British Medical Journal*, 328(7435), 343.
- Milfont, T. L. (2010). Global warming, climate change and human psychology. In V. Corral-Verdugo, C. H. García-Cadena, & M. Frías-Arment (Eds.), *Psychological approaches to sustainability: Current trends in theory, research and practice* (pp. 19–42). New York, NY: Nova Science.
- Mooney, C. C. (2011). *Do scientists understand the public?*. National Institutes of

Health.

- Morgan, G., & Smircich, L. (1980). The case for qualitative research. *Academy of management review*, 5(4), 491-500.
- Morton, T. A., Rabinovich, A., Marshall, D., & Bretschneider, P. (2011). The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications. *Global Environmental Change*, 21(1), 103-109.
- Moser, S. C. (2007). More bad news: The risk of neglecting emotional responses to climate change information. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change: Communicating climate change and facilitating social change* (pp. 64–80). Cambridge, UK: Cambridge University Press.
- Moser, S. C., & Dilling, L. (2011). Communicating climate change: Closing the science-action gap. *The Oxford handbook of climate change and society*. Oxford University Press, USA, 161-174.
- Moser, S. C. (2010). Communicating climate change: history, challenges, process and future directions. *Wiley Interdisciplinary Reviews: Climate Change*, 1(1), 31-53.
- Moser, S. C., & Dilling, L. (2004). Making climate hot. *Environment: Science and Policy for Sustainable Development*, 46(10), 32-46.
- Moser, S. C., & Dilling, L. (2007). Toward the social tipping point: Creating a climate for change. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change: communicating climate change and facilitating social change* (pp. 491–516). Cambridge, UK: Cambridge University Press.
- Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman,

- J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences*, 109(41), 16474-16479.
- Musselwhite, C., & Haddad, H. (2010). Mobility, accessibility and quality of later life. *Quality in Ageing and Older Adults*, 11(1), 25-37.
- Musselwhite, C.B.A., Avineri, E. And Susilo, Y.O. (2014). Legitimising Risk Taking: Articulating dangerous behaviour on the road. *Transportation Planning and Technology*, 37(1), 62-82.
- Nisbet, M. C., & Goidel, R. K. (2007). Understanding citizen perceptions of science controversy: bridging the ethnographic—survey research divide. *Public Understanding of Science*, 16(4), 421-440.
- Nisbet, M. C., & Scheufele, D. A. (2009). What's next for science communication? Promising directions and lingering distractions. *American Journal of Botany*, 96(10), 1767-1778.
- O'Neill, S., Boykoff, M.T., 2010. The role of new media in engaging the public with climate change. In: Whitmarsh, L., O'Neill, S., Lorenzoni, I. (Eds.), *Engaging the Public with Climate Change: Communication and Behaviour Change*. Earthscan, London.
- O'Neill, S., & Nicholson-Cole, S. (2009). "Fear Won't Do It" Promoting Positive Engagement With Climate Change Through Visual and Iconic Representations. *Science Communication*, 30(3), 355-379.
- Obama, B (2014). President Barack Obama's State of the Union Address, 28 January 2014. <http://www.whitehouse.gov/the-press-office/2014/01/28/president-barack-obamas-state-union-address>. [Accessed 3 March 2014].
- Ockwell, D., Whitmarsh, L., & O'Neill, S. (2009). Reorienting climate change

- communication for effective mitigation forcing people to be green or fostering grass-roots engagement?. *Science Communication*, 30(3), 305-327.
- Onwuegbuzie, A. J., & Leech, N. L. (2005). Taking the “Q” out of research: Teaching research methodology courses without the divide between quantitative and qualitative paradigms. *Quality and Quantity*, 39(3), 267-295.
- Oosterhof, N. N., & Todorov, A. (2008). The functional basis of face evaluation. *Proceedings of the National Academy of Sciences*, 105(32), 11087-11092.
- Oreskes, N., & Conway, E. M. (2010). *Merchants of doubt: how a handful of scientists obscured the truth on issues from tobacco smoke to global warming*. Bloomsbury Publishing USA.
- Ouchi, W. (1981). Theory Z: How American business can meet the Japanese challenge. *Business Horizons*, 24(6), 82-83.
- Owens, S. (2000). ‘Engaging the public’: information and deliberation in environmental policy. *Environment and planning A*, 32(7), 1141-1148.
- Patt, A. (2007). Assessing model-based and conflict-based uncertainty. *Global Environmental Change*, 17(1), 37-46.
- Peeters, G., & Czapinski, J. (1990). Positive-negative asymmetry in evaluations: The distinction between affective and informational negativity effects. *European review of social psychology*, 1(1), 33-60.
- Peters, R. G., Covello, V. T., & McCallum, D. B. (1997). The determinants of trust and credibility in environmental risk communication: An empirical study. *Risk analysis*, 17(1), 43-54.
- Petty, R. E., & Cacioppo, J. T. (1979). Issue involvement can increase or decrease persuasion by enhancing message-relevant cognitive responses. *Journal of personality and social psychology*, 37(10), 1915.

- Petty, R. E., & Cacioppo, J. T. (1986). Communication and persuasion: Central and peripheral routes to attitude change.
- Pew Research Center (2009). *Public Praises Science; Scientists Fault Public, Media Scientific Achievements Less Prominent Than a Decade Ago*.
<http://www.people-press.org/2009/07/09/public-praises-science-scientists-fault-public-media/>
- Pidgeon, N. (2012). Climate change risk perception and communication: addressing a critical moment?. *Risk Analysis*, 32(6), 951-956.
- Pidgeon, N., & Butler, C. (2009). Risk analysis and climate change. *Environmental Politics*, 18(5), 670-688.
- Pidgeon, N., & Fischhoff, B. (2011). The role of social and decision sciences in communicating uncertain climate risks. *Nature Climate Change*, 1(1), 35-41.
- Pijawka, K. D. and Mushkatel, A. H. (1991/1992). Public opposition to the siting of the high-level nuclear waste repository: The importance of trust, *Policy Studies Review*, 10, 180–194.
- Pollack, H. N. (2005). *Uncertain science... uncertain world*. Cambridge University Press.
- Polanyi, M. (1958). Personal Knowledge.
- Poortinga, W., & Pidgeon, N. F. (2003). Public perceptions of risk, science and governance. *Centre for Environmental Risk, University of East Anglia, Norwich, UK*.
- Poortinga, W., & Pidgeon, N. F. (2005). Trust in risk regulation: Cause or consequence of the acceptability of GM food?. *Risk Analysis*, 25(1), 199-209.
- Poortinga, W., Steg, L., & Vlek, C. (2004). Values, environmental

- concern, and environmental behavior a study into household energy use. *Environment and behavior*, 36(1), 70-93.
- Potter, J. (1996). *Representing reality: Discourse, rhetoric and social construction*. Sage.
- Prillwitz, J., & Barr, S. (2009). Motivations and barriers to adopting sustainable travel behaviour.
- van Prooijen, A. M., & Sparks, P. (2014). Attenuating Initial Beliefs: Increasing the Acceptance of Anthropogenic Climate Change Information by Reflecting on Values. *Risk Analysis*, 34(5), 929-936.
- van Prooijen, A. M., Sparks, P., & Jessop, D. C. (2013). Promoting or jeopardizing lighter carbon footprints? Self-affirmation can polarize environmental orientations. *Social Psychological and Personality Science*, 4(2), 238-243.
- Prooijen, J. W., & Jostmann, N. B. (2013). Belief in conspiracy theories: the influence of uncertainty and perceived morality. *European Journal of Social Psychology*, 43(1), 109-115.
- Rahmstorf, S. (2004). The climate sceptics. Potsdam: Potsdam Institute for Climate Impact Research. Available at: http://www.pik-potsdam.de/~stefan/Publications/Other/rahmstorf_climate_sceptics_2004.pdf [Accessed 29 December 2014].
- Rehg, W. (2011). Evaluating Complex Collaborative Expertise: The Case of Climate Change. *Argumentation*, 25(3), 385-400.
- Reich, J. W., & Robertson, J. L. (1979). Reactance and norm appeals in antilittering messages. *Journal of Applied Social Psychology*, 9, 91-101.
- Renn, O., & Levine, D. (1991). *Credibility and trust in risk communication* (pp. 175-

- 217). Springer Netherlands.
- Riegelsberger, J., Sasse, M. A., & McCarthy, J. D. (2003). The researcher's dilemma: evaluating trust in computer-mediated communication. *International Journal of Human-Computer Studies*, 58(6), 759-781.
- Roser-Renouf, C., & Maibach, E. (2010). Communicating climate change. In S. Priest (Ed.), *Encyclopaedia of Science and Technology Communication*, pp. 141-147. Thousand Oaks, CA: Sage.
- Roter, D. L., & Hall, J. A. (2004). Physician gender and patient-centered communication: a critical review of empirical research. *Annu. Rev. Public Health*, 25, 497-519.
- Rothman, A. J., & Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: the role of message framing. *Psychological bulletin*, 121(1), 3.
- Rotter, J. B. (1967). A new scale for the measurement of interpersonal trust¹. *Journal of personality*, 35(4), 651-665.
- Rousseau, D. M., Sitkin, S. B., Burt, R. S., & Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of management review*, 23(3), 393-404.
- Sako, M. (1992). *Price, quality and trust: Inter-firm relations in Britain and Japan* (No. 18). Cambridge University Press.
- Schlenker, B. R., Helm, B., & Tedeschi, J. T. (1973). The effects of personality and situational variables on behavioral trust. *Journal of personality and social psychology*, 25(3), 419.
- Scissors, L. E., Gill, A. J., Geraghty, K., & Gergle, D. (2009, April). In CMC we trust: the role of similarity. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 527-536). ACM.

- Semin, G. R., & Fiedler, K. (1988). The cognitive functions of linguistic categories in describing persons: Social cognition and language. *Journal of Personality and Social Psychology*, 54(4), 558.
- Semin, G. R., Higgins, T., de Montes, L. G., Estourget, Y., & Valencia, J. F. (2005). Linguistic signatures of regulatory focus: how abstraction fits promotion more than prevention. *Journal of personality and social psychology*, 89(1), 36.
- Shackley, S. (1996). Global Climate Change and Modes of International Science and Policy. *Internationalism and Science*, 199-222.
- Shackley, S., & Wynne, B. (1996). Representing uncertainty in global climate change science and policy: Boundary-ordering devices and authority. *Science, Technology & Human Values*, 21(3), 275-302.
- Shannon, C. E., and Weaver, W. (1949). *A Mathematical Model of Communication*. Urbana, IL: University of Illinois Press.
- Shanteau, J. (1987). Psychological characteristics of expert decision makers. In J. L. Mumpower, L. D. Phillips, O. Renn & V. R. R. Uppuluri, (Eds), *Expert Judgements and Expert Systems*. Berlin: Springer, pp. 289-304.
- Sharples, D. M. (2010). Communicating climate science: evaluating the UK public's attitude to climate change. *Earth & Environment*, 5, 185-205.
- Shome, D., & Marx, S. (2009). The psychology of climate change communication. *Center for Research on Environmental Decisions. Columbia University*.
- Shore, D. A. (2003). Communicating in times of uncertainty: the need for trust. *Journal of health communication*, 8(S1), 13-14.
- Shuckburgh, E., Robison, R., & Pidgeon, N. (2012). Climate science, the public and the news media. Summary findings of a survey and focus groups conducted in

- the UK in March 2011. Available at: <http://nora.nerc.ac.uk/id/eprint/500544>.
- Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: The role of social trust and knowledge. *Risk analysis*, 20(5), 713-720.
- Siegrist, M., Earle, T. C., & Gutscher, H. (Eds.). (2010). *Trust in risk management: Uncertainty and scepticism in the public mind*. Earthscan.
- Slovic, P. (1987). Perception of risk. *Science*, 236, 280-285.
- Slovic, P., Lichtenstein, S. & Fischhoff, B. (1984). Modeling the societal impact of fatal accidents. *Management Science*, 30, 464-485.
- Snape, D., & Spencer, L. (2003). The foundations of qualitative research. *Qualitative research practice: A guide for social science students and researchers*, 11.
- Spence, A., Pidgeon, N., & Uzzell, D. (2009). Climate change—psychology's contribution. *The Psychologist*, 21, 108-111.
- Sommers, E., & Lawrence, S. (1992). Women's ways of talking in teacher-directed and student-directed peer response groups. *Linguistics and Education*, 4(1), 1-35.
- Sorrentino, R. M., Holmes, J. G., Hanna, S. E., & Sharp, A. (1995). Uncertainty orientation and trust in close relationships: Individual differences in cognitive styles. *Journal of Personality and Social Psychology*, 68(2), 314-327.
- Sparks, P., Jessop, D. C., Chapman, J., & Holmes, K. (2010). Pro- environmental actions, climate change, and defensiveness: Do self- affirmations make a difference to people's motives and beliefs about making a difference?. *British Journal of Social Psychology*, 49(3), 553-568.
- Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis*, 32(6), 957-972.
- Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. F. (2011). Perceptions of climate

- change and willingness to save energy related to flood experience. *Nature Climate Change*, 1(1), 46-49.
- Steckler, N. A., & Rosenthal, R. (1985). Sex differences in nonverbal and verbal communication with bosses, peers, and subordinates. *Journal of Applied Psychology*, 70(1), 157.
- Steele, C. M. (1988). The psychology of self-affirmation: Sustaining the integrity of the self. *Advances in experimental social psychology*, 21, 261-302.
- Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, 29(3), 309-317.
- Steg, L., Vlek, C., & Slotegraaf. (2001). Instrumental-reasoned and symbolic-affective motives for using the motor car. *Transportation Research Part F*, 4, 151-169.
- Storer, N. W. *The Social System of Science*. New York : Holt, Rinehart and Winston, 1966.
- Strauss, A. Corbin (1998) Basics of Qualitative Research. *Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks.
- Sturgis, P., & Allum, N. (2004). Science in society: re-evaluating the deficit model of public attitudes. *Public understanding of science*, 13(1), 55-74.
- Swim, J., Clayton, S., Doherty, T., Gifford, R., Howard, G., Reser, J., Stern, P., & Weber, E. (2009). Psychology and global climate change: Addressing a multi-faceted phenomenon and set of challenges. A report by the American Psychological Association's task force on the interface between psychology and global climate change.
- Tannen, D. (1990). *You just don't understand*. New York: Ballantine.

- Tashakkori, A., & Teddlie, C. (Eds.). (2003). *Handbook of mixed methods in social & behavioral research*. Sage.
- Taylor, S. E. (2011). How psychosocial resources enhance health and wellbeing. In S. Donaldson, M. Csikszentmihalyi, and J. Nakamura (Eds.), *Applied Positive Psychology*. New York: Routledge.
- Taylor, P. J., & Thomas, S. (2008). Linguistic style matching and negotiation outcome. *Negotiation and Conflict Management Research, 1*, 263-281.
- Thomson, R., Murachver, T., & Green, J. (2001). Where is the gender in gendered language?. *Psychological Science, 12*(2), 171-175.
- The Royal Society (1985). *The public understanding of science*. London: The Royal Society.
- Thurmond, V. A. (2001). The point of triangulation. *Journal of Nursing Scholarship, 33*(3), 253-258.
- Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological review, 110*(3), 403.
- Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological review, 117*(2), 440.
- Trumbo, C. W., & Shanahan, J. (2000). Social research on climate change: where we have been, where we are, and where we might go. *Public understanding of science, 9*(3), 199-204.
- Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive psychology, 5*(2), 207-232.
- Vainio, A., & Paloniemi, R. (2013). Does belief matter in climate change action?. *Public Understanding of Science, 22*(4), 382-395.
- Van den Bos, K., & Lind, E. A. (2002). Uncertainty management by means of

- fairness judgments. *Advances in experimental social psychology*, 34, 1-60.
- Van den Bos, K., & Lind, E. A. (2010). The social psychology of fairness and the regulation of personal uncertainty. In R. M. Arkin, K. C. Oleson & P. J. Carroll (Eds.), *Handbook of the uncertain self* (pp. 122-141). New York, NY: Psychology Press.
- Vorauer, J. D., Main, K. J., & O'Connell, G. B. (1998). How do individuals expect to be viewed by members of lower status groups? Content and implications of meta-stereotypes. *Journal of personality and social psychology*, 75(4), 917.
- de Vries, G., Terwel, B. W., & Ellemers, N. (2014). Spare the Details, Share the Relevance: The Dilution Effect in Communications about Carbon Dioxide Capture and Storage. *Journal of Environmental Psychology*.
- Walton, D. (2010). *Appeal to expert opinion: Arguments from authority*. Penn State Press.
- Waterton, C., Wynne, B., Grove-White, R. and Mansfield, T. (2001) *Scientists Reflect on Science: Scientists' Perspectives on Contemporary Science and Environmental Policy*. Centre for the Study of Environmental Change and Institute for Environmental and Natural Sciences, Lancaster University.
- Weber, E. U., & Stern, P. C. (2011). Public understanding of climate change in the United States. *American Psychologist*, 66(4), 315.
- Weber, J. R., & Word, C. S. (2001). The Communication Process as Evaluative Context: What Do Nonscientists Hear When Scientists Speak? Scientists and nonscientists benefit by recognizing that attempts at mutual influence, multiple frames of reference, and "objective" information in science communication are not neutral but evaluated with other social influences. *BioScience*, 51(6), 487-495.

- Whitmarsh, L., (2005). A Study of Public Understanding of and Response to Climate Change in the South of England. Department of Psychology, University of Bath, Bath, UK: unpublished doctoral thesis.
- Whitmarsh, L. (2009). What's in a name? Commonalities and differences in public understanding of "climate change" and "global warming". *Public Understanding of Science, 18*, 401–420.
- Whitmarsh, L. (2011). Scepticism and uncertainty about climate change: dimensions, determinants and change over time. *Global Environmental Change, 21*(2), 690-700.
- Whitmarsh, L., Kean, S., Peacock, M., Russell, C., & Haste, H. (2005). Connecting Science: what we know and what we don't know about science in society.
- Willig, C. (2008). *Introducing qualitative research in psychology*. McGraw-Hill International.
- Wilson, E. J., & Sherrell, D. L. (1993). Source effects in communication and persuasion research: A meta-analysis of effect size. *Journal of the Academy of Marketing Science, 21*(2), 101-112.
- Windschitl, P. D., & Wells, G. L. (1996). Measuring psychological uncertainty: Verbal versus numeric methods. *Journal of Experimental Psychology: Applied, 2*(4), 343.
- Witte, K. & Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education & Behavior, 27*(5), 591-615.
- Wojciszke, B. (1994). Multiple meanings of behavior: Construing actions in terms of competence or morality. *Journal of Personality and Social Psychology, 67*(2), 222.

- Wojciszke, B., Bazinska, R., & Jaworski, M. (1998). On the dominance of moral categories in impression formation. *Personality and Social Psychology Bulletin*, 24(12), 1251-1263.
- Wood, J.T. (2009). *Gendered lives: communication, gender, and culture*, Wadsworth Cengage Learning; Boston, MA.
- Wynne, B. (1996). SSK's identity parade: Signing-up, off-and-on. *Social Studies of Science*, 26(2), 357-391.
- Yardley, L., & Bishop, F. (2008). Mixing Qualitative and Quantitative Methods: A Pragmatic Approach. In C. Willig., & W. S. Rogers (Eds.) *The SAGE Handbook of Qualitative Research in Psychology*. London: Sage.
- Zanna, M. P., & Darley, J. M. (1987). *The compleat academic*. New York, NY: McGraw-Hill.
- Zehr, S. C. (2000). Public representations of scientific uncertainty about global climate change. *Public Understanding of Science*, 9(2), 85-103.
- Ziman, J. 1992. Not knowing, needing to know, and wanting to know. In *When science meets the public*, edited by B. V. Lewenstein, 13-20. Washington, DC: American Association for the Advancement of Science.
- Zucker, L. G. (1986). Production of trust: Institutional sources of economic structure, 1840–1920. *Research in organizational behavior*, 8, 53-111



Invitation to take part in a discussion about your views on communicating climate change information

Dear all,

At this stage of the research we would like to speak with a small number of participants. This will involve one-to-one discussions lasting up to 60 minutes during November/December at a time and location to suit the individual - this can be in a private meeting room in your workplace, at Exeter University or at your home if this is your preference.

These discussions are an opportunity for you to share your experiences, thoughts and opinions on the topic of **communication of climate science**. Whatever your role I would be interested in hearing from you.

We will be treating all interviews in the strictest confidence. Your workplace as an organisation and individuals within it will not have knowledge of who has been interviewed (unless you share this information). Each interview will be recorded for the purposes of analysis, but the recordings and transcripts will only be accessed by the research team and will be destroyed once our reporting is complete. In our reporting of the set of interviews or in any other communication outside of our research team we shall not identify your name with any particular statement - everything you tell us will be anonymised.

On the following page is a small set of questions to help us in identifying participants. If you feel that you would like to take part, please return the completed form back to myself as the PhD researcher, Hebba Haddad, no later than **** DATE SET AT TWO WEEKS AFTER DISPATCH OF THIS LETTER****.

Best wishes,
Hebba Haddad

Please do not hesitate to contact me if you have any questions about this research: email - H.Haddad@exeter.ac.uk ; or telephone 0788-445-***.

Hebba Haddad
Psychology
College of Life and Environmental Sciences
University of Exeter
Exeter EX4 4QG



Dynamics of Communicating Climate Change Information

Thank you for showing an interest to take part in this study. We would like to establish a few background details about you.

Please be assured that all information provided will be kept anonymous and confidential, and no personal details about who is specifically being interviewed will be passed to your employer.

Please complete the questions below and return this document by email to H.Haddad@exeter.ac.uk

1. Your name:
2. Contact telephone number:
3. Contact email address:
4. Gender:
5. Age:
6. How long have you been working in this workplace?
7. What is your job title/role in your workplace:
 - a. If you are a scientist, what area of science do you focus on?
 - b. If you are not a scientist, what area of work do you focus on?
8. On a scale of 1 to 5 (1 = very junior, 5 = very senior), how would you describe your level of seniority?
9. Who would you say are your primary audiences of communication (e.g. public, government, industry, academic, other)?

THANK YOU. I will be in touch soon



Dynamics of climate change communication

Consent form

The interview will be recorded and transcribed. All data will be held securely and not passed to any third party. **Your name will not appear on the transcript.** The research team may use selected quotes from the interview when writing research reports, and will maintain anonymity of all participants.

I understand that the information will be collected and used in analysis []

It may be that we approach you at a later stage of the study

Yes, this would be fine []
No, I would rather not []

I am aware and agree that my interview for the research project 'Dynamics of Communicating Climate Change Information'. This research will form part of the researcher's PhD research.

Name _____

Signature _____

Date _____



Dynamics of Communicating Climate Change Information

Project Aims:

The broad aim of the research conducted within this CASE studentship is to explore the process of communicating climate change information, with a particular focus on issues of trust and the management of scientific uncertainty in that process.

This broad aim will be accomplished by using qualitative and quantitative research methodologies among various actors relevant to the communication process - including the public as the recipients of climate change communication and yourselves as the transmitters of climate change information.

By triangulating the research to explore these issues from different sides of the communication processes, it is hoped that the research will provide a more complete analysis of the barriers and opportunities for communication and provide information/ advice that will connect to the specific concerns of all those involved in this activity (i.e. audiences and communicators alike).

Specific Interview Objectives include:

- i. To get a better understanding of how climate science experts and communicators perceive the process of climate change communication.
- ii. To identify the audiences these experts are seeking to engage with and how they plan their communication activities in relation to different audiences.
- iii. To explore what communicators of climate science and their audiences perceive as effective communication of climate science information.
- iv. To explore the perceived barriers to communicating climate change information effectively.
- v. To explore issues of trust and uncertainty from the perspective of those who are trying to engage audiences with their message and from those who are the audience for these messages.

If you would like to discuss your participation in this research further, or if you would like to receive a summary of the findings from this phase of the research, please feel free to contact me the PhD researcher, Hebba Haddad, at H.Haddad@exeter.ac.uk ; or telephone 0788-445-***

Outline Topic Guide

1. Introduction

- Thanks for agreeing to take part in this discussion, No right or wrong answer – just want your views
- Everything you say is confidential and anonymous – and your employer will not know who will be interviewed
- The recordings will be transcribed, analysed and anonymous quotations may be used in a later write-up
- Please sign this consent form, which includes I may need to approach again at a later date

2. Build-up

- Time spent working at your current workplace
- Tell me a bit about your current job - your role/job here

3. Perceptions of key audiences

- Perceptions of your Audience(s)/Public: *who do you see as the main consumers of climate change information?*
- Beliefs of public's perceptions of risk and uncertainty: *So tell me – how do you think the public see the uncertainty associated with climate science?*
- Trust of your audience(s): *Do you trust your audience?*
- Engagement with the public: *Do you think the public would appreciate scientists/communicators of climate science to engage with the public?*
- Beliefs of public perceptions of organisation/scientists: *How do you think the public might see this workplace?*
- Trust (audience trust of organisation/scientists): *Do you think your audience trusts you?*
- Influence on audience: *Do you think you have much influence on your audiences compared, to say, the media?*

4. Perceptions of science communicators, scientists and science

- Perceptions of scientists/science communicators: *How do you imagine a 'typical' scientist/science communicator to be?*
- Perceptions of science: *What role do you see your science to have?*
- Uncertainty in science: *Do you think uncertainty is inherent in all sciences?*

5. Communication Process(es)

- The process: *So tell me – how does this work: how do you see the process of communicating climate change information?*
- Meaning of effective communication: *How do you know if a communication chain was successful?*
- Balancing the scientists, audience and the media: *do you see there to be demands from different groups when dealing with communicating uncertain science messages?*
- Internal perceptions of external communication: *How do you think others within your workplace see communication process?*

6. Barriers to effective communication of climate science

- Perception of the communication problem: *Do you think there are barriers in communicating climate science – and what are these?*
- Perceived barriers and increase information use: *Do you think there are barriers in people using the climate science information you're communicating?*
- Best practice and training for communicating: *Is there some guide for communicating to different audiences: if so, what?*

7. Wider Issues

- Ideal scenario of communicating climate science: *If you could change or do one thing to improve the communication process – what would this be and why?*
- Future of climate science communication: *In general, how do you see the future of climate science communication?*

8. Finish

- *Is there anything else you think is important or that you would like to add?*
- *Just to remind you everything you've said is completely anonymous and confidential*
- *Many thanks for this discussion. Here are my contact details should you wish to add anything later or want further information on the project*

Language manipulations shown in bold

In this study, we are interested in your impressions of the Hanley Centre. Because you may not have heard of the Hanley Centre and their work, below is a brief description. As you read this text, try and form an impression of the Hanley Centre, who they are and what they do. Then answer the questions that follow. As you answer our questions, keep in mind that there are no right or wrong answers; we just want your opinion.



We are / The Hanley Centre a world-leading group with expertise researching changes in the earth's climate. Changes in the world's climate over time is known as climate change.

We / The Hanley Centre attribute(s) this change to increased amounts of greenhouse gases (carbon dioxide and methane) in the atmosphere, which leads to warming of the planet. Using data available (such as temperature, clouds, sea level) **we / the Hanley Centre** develop(s) climate models to predict how the climate is likely to be in the future. Based on **our / Hanley Centre** research, it is very likely that climate change is caused by human activity, such as burning fossil fuels (e.g. petrol and coal) and changing land use (such as chopping down forests).

Our / Hanley Centre research also shows that the likely impacts of climate change include the earth getting warmer, more flooding, longer periods of drought, more storms and hurricanes, more frequent heat waves, melting of the ice caps and a rise in sea level. **Our / The Hanley Centre's** work suggests that climate change will likely lead to changes in wildlife – for example some species may become extinct, and some plant life may become eroded.

Drawing on world-leading research, **we / the Hanley Centre** also predict that impacts of climate change are likely to have consequences for humans' health, social and economic well-being – for example some diseases can become more widespread, and food and water shortages may become critical in some parts of the world.

Appendix 3.1 Pilot Study

Based on the above text, what do you think about the Hanley Centre summary of climate change? Please indicate how much you agree or disagree with the following statements.

When reading the above information...

	<i>Not at all</i>						<i>Extremely</i>
I felt I understood the information presented to me above	1	2	3	4	5	6	7
I felt I didn't understand this message	1	2	3	4	5	6	7
I found the message easy to understand	1	2	3	4	5	6	7
I found the message engaging	1	2	3	4	5	6	7
I was strongly motivated to take into account the information provided by the Hanley Centre	1	2	3	4	5	6	7
I wanted to know more about the science of climate change	1	2	3	4	5	6	7
I wanted to know more about what to do about climate change	1	2	3	4	5	6	7
I tuned out	1	2	3	4	5	6	7
I felt this message was designed to inform me about climate change	1	2	3	4	5	6	7
I felt this message was deigned to influence my behaviour to reduce the impacts of climate change	1	2	3	4	5	6	7
I was expecting information on what I can personally do about climate change	1	2	3	4	5	6	7
I was not expecting information on what I can personally do about climate change	1	2	3	4	5	6	7

Based on what you read, we asked you to form an impression of the Hanley Centre. Take a moment to think again of the impression you formed. How do you see the source of this message?

	<i>Not at all</i>						<i>Extremely</i>
Competent	1	2	3	4	5	6	7
Warm	1	2	3	4	5	6	7
Moral	1	2	3	4	5	6	7
Distant	1	2	3	4	5	6	7
Honest	1	2	3	4	5	6	7
United	1	2	3	4	5	6	7
Knowledgeable	1	2	3	4	5	6	7
Objective	1	2	3	4	5	6	7
Influential	1	2	3	4	5	6	7
Compassionate	1	2	3	4	5	6	7
Amateurish	1	2	3	4	5	6	7
Confident	1	2	3	4	5	6	7
Corrupt	1	2	3	4	5	6	7
Capable of feeling emotions	1	2	3	4	5	6	7
Efficient	1	2	3	4	5	6	7
Understanding	1	2	3	4	5	6	7
Trustworthy	1	2	3	4	5	6	7
Biased	1	2	3	4	5	6	7

Appendix 3.1 Pilot Study

Sincere	1	2	3	4	5	6	7
Hindering	1	2	3	4	5	6	7
Good-natured	1	2	3	4	5	6	7
Cold	1	2	3	4	5	6	7
Intelligent	1	2	3	4	5	6	7
Inept	1	2	3	4	5	6	7
Deep	1	2	3	4	5	6	7
Skilful	1	2	3	4	5	6	7
Helpful	1	2	3	4	5	6	7
Powerful	1	2	3	4	5	6	7
Immoral	1	2	3	4	5	6	7
Well-intentioned	1	2	3	4	5	6	7
Superficial	1	2	3	4	5	6	7
Useless	1	2	3	4	5	6	7
Clinical	1	2	3	4	5	6	7
Untrustworthy	1	2	3	4	5	6	7
Divided	1	2	3	4	5	6	7
Capable	1	2	3	4	5	6	7
Authoritarian	1	2	3	4	5	6	7
Proud	1	2	3	4	5	6	7
Subjective	1	2	3	4	5	6	7
Friendly	1	2	3	4	5	6	7
Credible	1	2	3	4	5	6	7
Incompetent	1	2	3	4	5	6	7
Dishonest	1	2	3	4	5	6	7
Prestigious	1	2	3	4	5	6	7
Informative	1	2	3	4	5	6	7

Thinking about what you have read, and your more general impressions, how would you describe the current state of research into climate change? Below are a number of statements. Please indicate the extent to which you disagree or agree with each of these.

	<i>Strongly disagree</i>					<i>Strongly agree</i>	
Based on my opinion, I would trust the Hanley Centre as a source of information about climate change	1	2	3	4	5	6	7
I would not trust the Hanley Centre as a source of information about climate change	1	2	3	4	5	6	7
I trust climate scientists as a source of information about climate change	1	2	3	4	5	6	7
I do not trust climate scientists as a source of information about climate change	1	2	3	4	5	6	7
I trust climate science	1	2	3	4	5	6	7
I do not trust climate science	1	2	3	4	5	6	7
I trust climate scientists	1	2	3	4	5	6	7
I do not trust climate scientists	1	2	3	4	5	6	7
I trust scientists	1	2	3	4	5	6	7
I do not trust scientists	1	2	3	4	5	6	7

Appendix 3.1 Pilot Study

I feel at personal risk from the consequences of climate change	1	2	3	4	5	6	7
I feel there is a global risk of the consequences of climate change	1	2	3	4	5	6	7
I think bad consequences of climate change are likely	1	2	3	4	5	6	7
I think it is likely that climate change is happening	1	2	3	4	5	6	7
I think it is unlikely that climate change is happening	1	2	3	4	5	6	7
I think it is likely that climate change is man-made	1	2	3	4	5	6	7
I think it is unlikely that climate change is man-made	1	2	3	4	5	6	7
There is general agreement about the causes and consequences of climate change	1	2	3	4	5	6	7
Experts are united in their position on climate change	1	2	3	4	5	6	7
Experts in this area often disagree with each other	1	2	3	4	5	6	7
Different groups in this field tend to work cooperatively with each other	1	2	3	4	5	6	7
Different groups in this field are in competition with each other	1	2	3	4	5	6	7
There is still considerable uncertainty about the causes and consequences of climate change	1	2	3	4	5	6	7
Where there is uncertainty in climate science, it suggests that the scientists don't know what they are doing	1	2	3	4	5	6	7
Where there is uncertainty in climate science, it suggests that the scientists are following the scientific method	1	2	3	4	5	6	7
Where there is uncertainty in climate science, it suggests that the scientists are protecting themselves in case they are wrong	1	2	3	4	5	6	7
Where there is uncertainty in climate science, it suggests that there is a range of possibilities	1	2	3	4	5	6	7
Uncertainty in climate science is a sign of competence	1	2	3	4	5	6	7

Now we would like to ask you a number of questions about yourself.

1. Are you Male Female
2. How old are you?
3. Would you consider yourself a scientist? Yes No
4. Are you a student? Yes No
5. My degree/background/job is

Thanks very much!

This study is part of a project being conducted in collaboration with the Linford Centre for Climate Research (LCCR). This organisation is interested in how people perceive them and the issue of climate change. In the survey, you will be presented with information about this organisation and their work and then asked for your own impressions.

The survey should take **15 to 20 minutes** to complete. The questions we ask you should not be too hard. Most of the time, you will be able to express your attitudes and beliefs simply by circling a number on a scale that best corresponds to what you personally think.

Your participation in this research is completely voluntary and your responses to the survey will remain anonymous and confidential. The information you provide will be used only for the purposes of research. At no time will we ask you for information that could be used to identify who you are. Where we do ask you for personal information, this will be used only for the purposes of describing the sample of people who completed our survey.

If you have read and understood the above, and you are happy to participate in our research, please turn the page and begin the survey. While you are answering our questions, please remember **there are no 'right' or 'wrong' answers, we are only interested in what you personally think.**

Thanks for agreeing to participate in our research – we really appreciate it!!!

CLIMATE RESEARCH AND THE LINFORD CENTRE

In this study, we are interested in your responses to research findings being produced by the Linford Centre. Because you may not have heard of the Linford Centre and their work, below is a brief description taken from their website. Read the description so that you understand a little bit about the Linford Centre and their work:

Open language condition

Linford Centre

Forecasts Climate Change Research Activities News Educate Create About Us

You are here: [Home](#) > [About Us](#) > [Who we are](#)

Who we are

- **We are** a world-leading group with expertise researching changes in the earth's climate. Changes in the world's climate over time are known as climate change
- **We attribute** this change to increased amounts of greenhouse gases (carbon dioxide and methane) in the atmosphere, which leads to warming of the planet
- **We develop** climate models to predict how the climate is likely to be in the future using the available data (such as temperature, clouds, sea level)

Closed language condition

Linford Centre

Forecasts Climate Change Research Activities News Educate Create About

You are here: [Home](#) > [About](#) > [About the Linford Centre](#)

About the Linford Centre

- **The Linford Centre is** a world-leading group with expertise researching changes in the earth's climate. Changes in the world's climate over time are known as climate change
- **The Linford Centre attributes** this change to increased amounts of greenhouse gases (carbon dioxide and methane) in the atmosphere, which leads to warming of the planet
- **The Linford Centre develops** climate models to predict how the climate is likely to be in the future using the available data (such as temperature, clouds, sea level)

Have you previously heard about the Linford Centre and their work?

- Yes
- No

Based on their web profile, what are your immediate impressions of the Linford centre? For example, what kind of organisation do you think it is? And what kind of people do you think work there? Take a moment to think about the impression you have formed. It might be useful to look again at their web profile. In the space below, please list any impressions you have formed about this organisation based on their web profile and the description it contains.

Now that you've had a moment to think about the Linford Centre and have formed some impression, we would like to ask you a few more specific questions about this. Specifically, please rate the extent to which you think each of the following qualities is reflected in your impression of this organisation. Again, it might be useful to look back at their web profile before you answer:

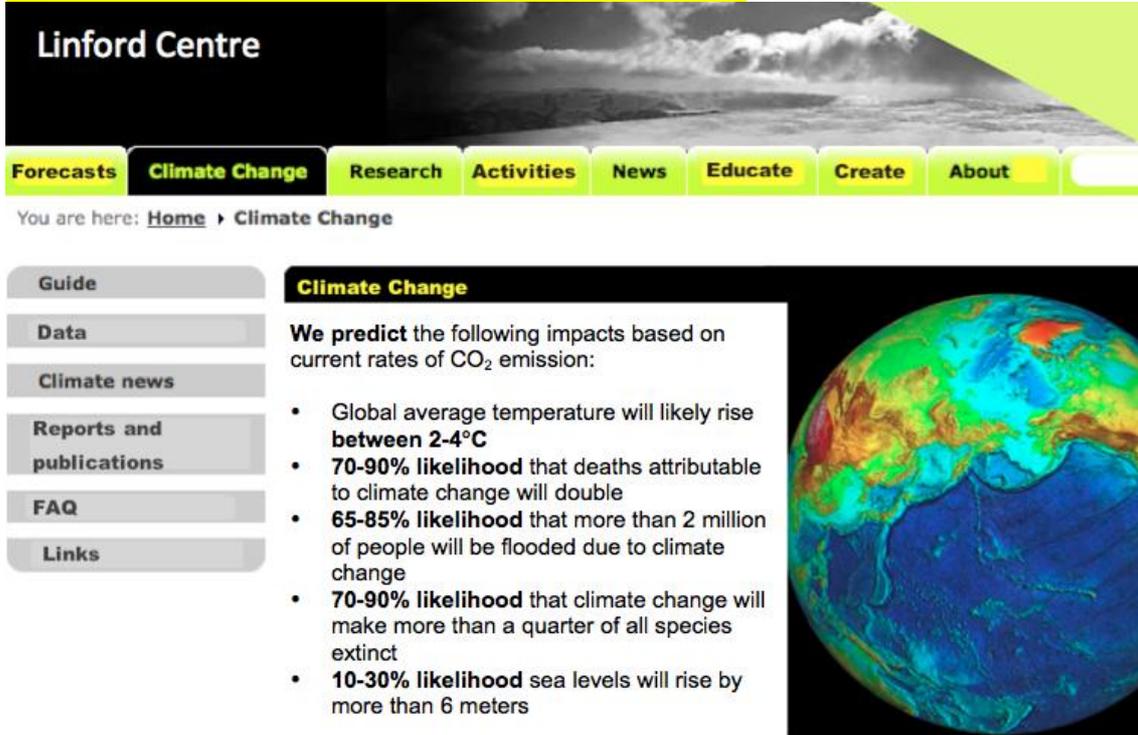
	<i>Not at all</i>						<i>Extremely</i>
	1	2	3	4	5	6	7
Professional	1	2	3	4	5	6	7
Serious	1	2	3	4	5	6	7
Corporate	1	2	3	4	5	6	7
Casual	1	2	3	4	5	6	7
Relaxed	1	2	3	4	5	6	7
Friendly	1	2	3	4	5	6	7
Credible	1	2	3	4	5	6	7
Competent	1	2	3	4	5	6	7
Warm	1	2	3	4	5	6	7
Moral	1	2	3	4	5	6	7
Distant	1	2	3	4	5	6	7
Honest	1	2	3	4	5	6	7
Influential	1	2	3	4	5	6	7
Cold	1	2	3	4	5	6	7
Confident	1	2	3	4	5	6	7
Efficient	1	2	3	4	5	6	7
Trustworthy	1	2	3	4	5	6	7
Sincere	1	2	3	4	5	6	7
Prestigious	1	2	3	4	5	6	7
Helpful	1	2	3	4	5	6	7
Powerful	1	2	3	4	5	6	7
Capable	1	2	3	4	5	6	7

Appendix 3.2 Experiment 1

Incompetent	1	2	3	4	5	6	7
Proud	1	2	3	4	5	6	7

As you already know from their web-profile, the Linford Centre is involved in modelling the possible effects of climate change. Below is a summary of their work, also taken from their website. This summary contains their most recent predictions about climate change and its impacts. Take a moment to read through these predictions and think about what they mean because we will ask you some questions about it later.

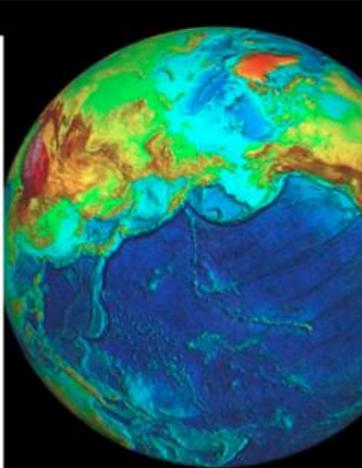
High uncertainty in the Open language condition



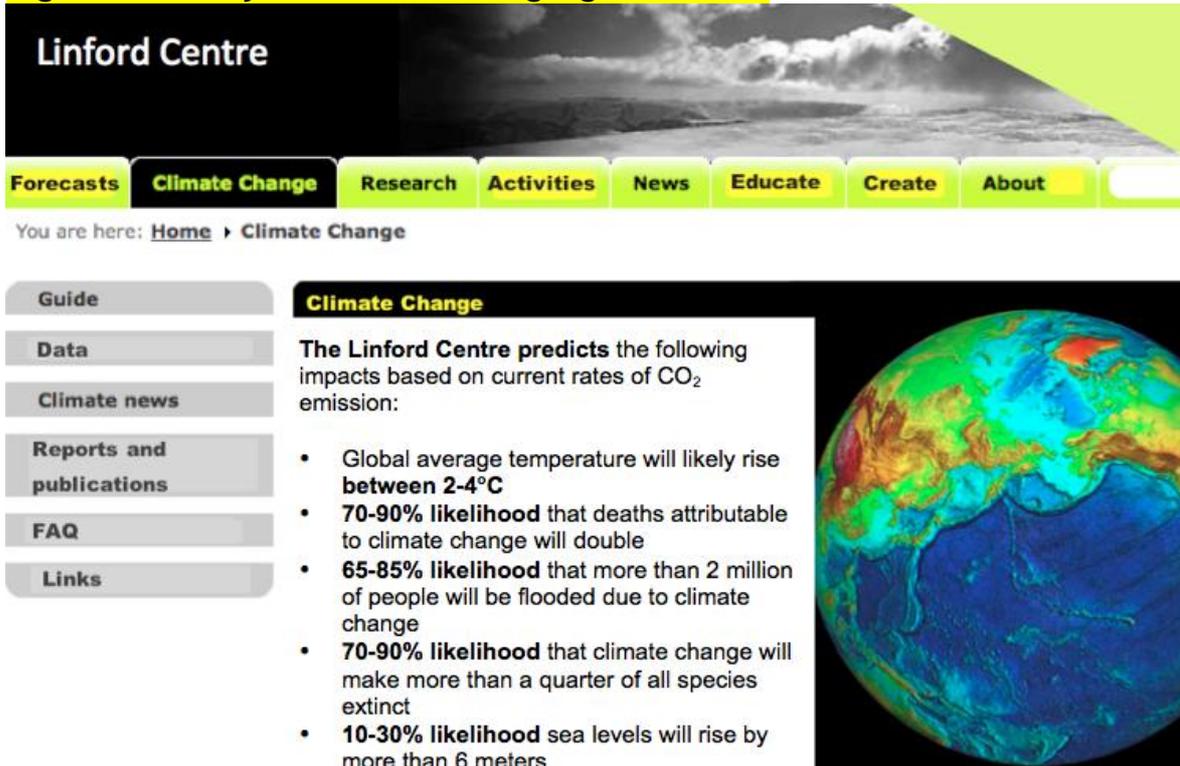
The screenshot shows the Linford Centre website with a navigation menu including 'Forecasts', 'Climate Change', 'Research', 'Activities', 'News', 'Educate', 'Create', and 'About'. The 'Climate Change' section is active, displaying a sidebar with 'Guide', 'Data', 'Climate news', 'Reports and publications', 'FAQ', and 'Links'. The main content area is titled 'Climate Change' and contains the following text and list:

We predict the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise **between 2-4°C**
- **70-90% likelihood** that deaths attributable to climate change will double
- **65-85% likelihood** that more than 2 million of people will be flooded due to climate change
- **70-90% likelihood** that climate change will make more than a quarter of all species extinct
- **10-30% likelihood** sea levels will rise by more than 6 meters



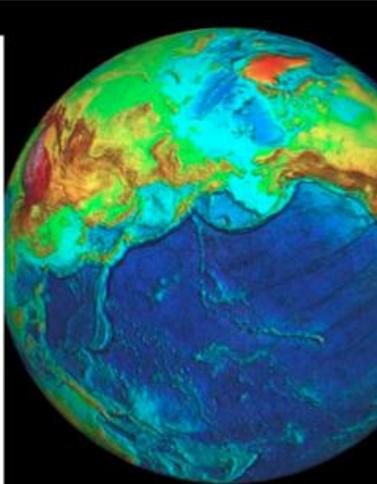
High uncertainty in the Closed language condition



This screenshot is identical to the one above, showing the Linford Centre website with the same navigation and content. The main content area is titled 'Climate Change' and contains the following text and list:

The Linford Centre predicts the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise **between 2-4°C**
- **70-90% likelihood** that deaths attributable to climate change will double
- **65-85% likelihood** that more than 2 million of people will be flooded due to climate change
- **70-90% likelihood** that climate change will make more than a quarter of all species extinct
- **10-30% likelihood** sea levels will rise by more than 6 meters



Low uncertainty in the Open language condition

Linford Centre

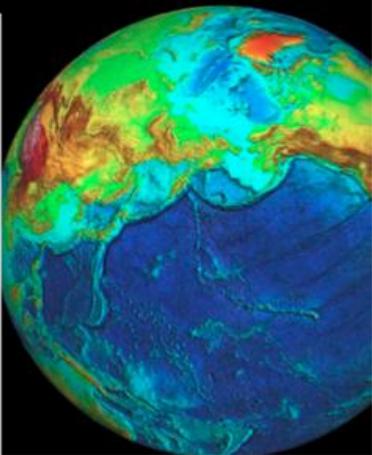
Forecasts **Climate Change** Research Activities News Educate Create About

You are here: [Home](#) > [Climate Change](#)

Climate Change

We predict the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise by **3°C**
- **80% likelihood** that deaths attributable to climate change will double
- **75% likelihood** that more than 2 million of people will be flooded due to climate change
- **80% likelihood** that climate change will make more than a quarter of all species extinct
- **20% likelihood** sea levels will rise by more than 6 meters



Low uncertainty in the Closed language condition

Linford Centre

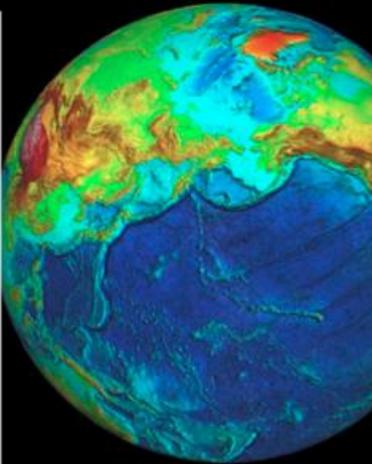
Forecasts **Climate Change** Research Activities News Educate Create About

You are here: [Home](#) > [Climate Change](#)

Climate Change

The Linford Centre predicts the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise by **3°C**
- **80% likelihood** that deaths attributable to climate change will double
- **75% likelihood** that more than 2 million of people will be flooded due to climate change
- **80% likelihood** that climate change will make more than a quarter of all species extinct
- **20% likelihood** sea levels will rise by more than 6 meters



Appendix 3.2 Experiment 1

What is your interpretation of the findings about climate change produced by the Linford Centre? In the space below, please list any thoughts you had while reading the above summary of their research.

Appendix 3.2 Experiment 1

Thinking about all the things you have read, what is your overall impression of this organisation's work? Please indicate the extent to which you disagree or agree with each of the statements below.

	<i>Strongly disagree</i>						<i>Strongly agree</i>
I understand the meaning of the Linford Centre's research	1	2	3	4	5	6	7
I do not understand what this research is supposed to mean	1	2	3	4	5	6	7
I found the summary engaging	1	2	3	4	5	6	7
I was strongly motivated to take into account the information provided by the Linford Centre	1	2	3	4	5	6	7
When reading information about this research, I wanted to know more about the science of climate change	1	2	3	4	5	6	7
I wanted to know more about what to do about climate change	1	2	3	4	5	6	7
I tuned out while reading about this organisation's research	1	2	3	4	5	6	7
I felt this summary was intended to <u>inform</u> me about climate change	1	2	3	4	5	6	7
I felt this summary was intended to <u>influence</u> my behaviour to reduce the impacts of climate change	1	2	3	4	5	6	7
Whilst reading the climate change information, I was expecting information on what I can personally do about climate change	1	2	3	4	5	6	7
I was not expecting information on what I can personally do about climate change	1	2	3	4	5	6	7
Based on their research, the Linford Centre seems to be a trustworthy source of information about climate change	1	2	3	4	5	6	7
Based on what I have read, I would find it hard to trust the Linford Centre as a source of information about climate change	1	2	3	4	5	6	7
I would rather have information on what I can personally do about climate change, than the science behind it	1	2	3	4	5	6	7
I think it is important to know about the science of climate change	1	2	3	4	5	6	7
I would rather scientists kept the science-talk of climate change amongst themselves	1	2	3	4	5	6	7
I'm not interested in understanding the science behind climate change	1	2	3	4	5	6	7

Based on the impressions you have formed, who do you think the information from the Linford Centre is targeted to?

	<i>Not at all</i>						<i>Yes, definitely</i>
The general public	1	2	3	4	5	6	7
Scientists	1	2	3	4	5	6	7
Policymakers	1	2	3	4	5	6	7
Academics	1	2	3	4	5	6	7
Local governments	1	2	3	4	5	6	7
National government	1	2	3	4	5	6	7

Appendix 3.2 Experiment 1

Politicians	1	2	3	4	5	6	7
Businesses	1	2	3	4	5	6	7
Climate scientists	1	2	3	4	5	6	7
Someone like me	1	2	3	4	5	6	7

Thank you for providing your impressions of the Linford Centre and their work. Now we would like to know a little bit more about your attitudes and opinions about the more general issues related to Climate Change. The remainder of this survey is concerned with your more general opinions about these issues.

First we would like to know who you consider trustworthy with the topic of climate change.

<i>When it comes to communicating climate change information, I trust...</i>	<i>Not at all</i>							<i>Very much so</i>
	1	2	3	4	5	6	7	
The media generally	1	2	3	4	5	6	7	
TV and Radio	1	2	3	4	5	6	7	
Broadsheet newspapers (e.g. the Guardian)	1	2	3	4	5	6	7	
Tabloid newspapers (e.g. the Daily Mail)	1	2	3	4	5	6	7	
The Internet in general	1	2	3	4	5	6	7	
Scientists in general	1	2	3	4	5	6	7	
Government scientists (such as the Met Office)	1	2	3	4	5	6	7	
Academic scientists (working in a University)	1	2	3	4	5	6	7	
International scientists (such as the United Nation's Intergovernmental Panel on Climate Change)	1	2	3	4	5	6	7	
Government sources	1	2	3	4	5	6	7	
Politicians	1	2	3	4	5	6	7	
Central Governmental (e.g. the Department for Energy and Climate Change - DECC)	1	2	3	4	5	6	7	
Local governments (e.g. city and local councils)	1	2	3	4	5	6	7	
Non-governmental organisations (e.g. Greenpeace, WWF)	1	2	3	4	5	6	7	
Internet blogs	1	2	3	4	5	6	7	
Real-life interactions (such as with friends/family)	1	2	3	4	5	6	7	
Virtual interaction (social networking Internet sites such as Facebook and Twitter)	1	2	3	4	5	6	7	

Now we would like to know more about how you think and feel about the issue of climate change in your own life. To what extent do you disagree or agree with each of the following statements:

	<i>Strongly disagree</i>							<i>Strongly agree</i>
	1	2	3	4	5	6	7	
In my opinion climate change is happening	1	2	3	4	5	6	7	
In my opinion climate change is man-	1	2	3	4	5	6	7	

Appendix 3.2 Experiment 1

made							
Human beings are responsible for climate change	1	2	3	4	5	6	7
Climate change is a natural process rather than something caused by human activity	1	2	3	4	5	6	7
Climate change is something that I personally believe in	1	2	3	4	5	6	7
	<i>Strongly disagree</i>						<i>Strongly agree</i>
I remain somewhat sceptical about climate change and if it is real	1	2	3	4	5	6	7
I believe there is global risk of the consequences of climate change	1	2	3	4	5	6	7
I think there will be bad consequences of climate change for the planet	1	2	3	4	5	6	7
I believe that the global consequences of climate change will be severe	1	2	3	4	5	6	7
I feel personally at risk from the consequences of climate change	1	2	3	4	5	6	7
I personally worry about climate change and how it will affect me	1	2	3	4	5	6	7
For me, climate change is nothing that I am personally concerned about	1	2	3	4	5	6	7
I do not think that climate change affects my own personal life in any way	1	2	3	4	5	6	7
Most people I know are concerned about climate change	1	2	3	4	5	6	7
Climate change is an issue I talk about often within my social network	1	2	3	4	5	6	7
Most people who are important to me think that it is necessary to act against climate change	1	2	3	4	5	6	7
Climate change is a topic that rarely comes up in the conversations that I have	1	2	3	4	5	6	7
I feel there is something I can personally do to act against climate change	1	2	3	4	5	6	7
I feel it is in my power to tackle climate change	1	2	3	4	5	6	7
I feel there is nothing I can do about climate change	1	2	3	4	5	6	7
I believe my actions have an influence on climate change	1	2	3	4	5	6	7
My actions to reduce the effects of climate change in my community will encourage others to change their actions	1	2	3	4	5	6	7
Generally speaking, I feel well-informed on the issue of climate change	1	2	3	4	5	6	7
I always consider the environmental consequences of my actions	1	2	3	4	5	6	7

Appendix 3.2 Experiment 1

In my own life, I do as much as I can to reduce the impact of climate change	1	2	3	4	5	6	7
There is nothing that I do specifically in response to climate change	1	2	3	4	5	6	7
Things that I already do which are good for the environment (such as walking), I would be doing anyway	1	2	3	4	5	6	7
Things that I do which seem pro-environmental, I do for the environment	1	2	3	4	5	6	7
I go out of my way to behave pro-environmentally	1	2	3	4	5	6	7
	<i>Strongly disagree</i>			<i>Strongly agree</i>			
I am waiting for definitive scientific evidence on climate change before I change my behaviour to respond to climate change	1	2	3	4	5	6	7
I am waiting for government to take the lead on climate change before changing my behaviour for the sake of the environment	1	2	3	4	5	6	7

Is there anything that you already do in your daily life to take action on climate change?

<i>To what extent do you do each of the following for environmental reasons...</i>	<i>No, not all</i>						<i>Yes, very much</i>	
Walk instead of using the car	1	2	3	4	5	6	7	
Cycle instead of using the car	1	2	3	4	5	6	7	
Reduce my household energy use	1	2	3	4	5	6	7	
Recycle	1	2	3	4	5	6	7	
Use a car less	1	2	3	4	5	6	7	
Use public transport instead of the car	1	2	3	4	5	6	7	
Limit unnecessary air travel	1	2	3	4	5	6	7	
Use less water	1	2	3	4	5	6	7	
Reduce, reuse, recycle	1	2	3	4	5	6	7	
Eat less meat	1	2	3	4	5	6	7	

Regardless of what you are already doing, how willing would you be to engage in each of the following behaviours in response to climate change?

<i>To reduce climate change I would be willing to...</i>	<i>Not at all willing</i>						<i>Very willing</i>	
Walk (more) instead of using the car	1	2	3	4	5	6	7	
Cycle (more) instead of using the car	1	2	3	4	5	6	7	
Reduce my household energy use	1	2	3	4	5	6	7	
Recycle (more)	1	2	3	4	5	6	7	
Use a car less	1	2	3	4	5	6	7	

Appendix 3.2 Experiment 1

Use public transport (more) instead of the car	1	2	3	4	5	6	7
Limit unnecessary air travel	1	2	3	4	5	6	7
Use less water	1	2	3	4	5	6	7
Reduce, reuse, recycle	1	2	3	4	5	6	7
Eat less meat	1	2	3	4	5	6	7

What is your general impression of the state of climate science and the scientists who research Climate Change?

	<i>Strongly disagree</i>							<i>Strongly agree</i>	
There is still considerable uncertainty about the causes of climate change	1	2	3	4	5	6	7		
There is general agreement about the causes and consequences of climate change	1	2	3	4	5	6	7		
Experts are united in their position on climate change	1	2	3	4	5	6	7		
Experts in this area often disagree with each other	1	2	3	4	5	6	7		
Different groups in the field of climate change research tend to work cooperatively with each other	1	2	3	4	5	6	7		
Different groups in the field of climate change research are in competition with each other	1	2	3	4	5	6	7		
When it comes to the science of climate change, I would rather have a clear message, rather than one that includes all the uncertainties	1	2	3	4	5	6	7		
When it comes to climate science, I personally find the caveats of scientific uncertainty difficult to understand	1	2	3	4	5	6	7		
I find the caveats of scientific uncertainty unhelpful when understanding the issue of climate change	1	2	3	4	5	6	7		
I think it is important to fully understand all the uncertainties associated with climate science	1	2	3	4	5	6	7		
Climate scientists don't really know for certain what climate change will look like	1	2	3	4	5	6	7		
Where there is uncertainty in climate science, it suggests that the scientists don't know what they are doing	1	2	3	4	5	6	7		
Where there is uncertainty in climate science, it suggest that the scientists are following the scientific method	1	2	3	4	5	6	7		
Scientists use uncertainty in their science as a way of protecting themselves in case they are wrong	1	2	3	4	5	6	7		
Where there is uncertainty in climate science, it simply suggests that there is a range of possibilities	1	2	3	4	5	6	7		
Uncertainty in climate science is a sign of competence	1	2	3	4	5	6	7		
Uncertainty is a normal part of scientific work	1	2	3	4	5	6	7		
I feel that scientists understand the needs of the general public when it comes to climate change	1	2	3	4	5	6	7		
As a member of the public, I feel that scientists trust me to understand their work	1	2	3	4	5	6	7		

Appendix 3.2 Experiment 1

I feel that climate scientists are sometimes too pushy when communicating about climate change	1	2	3	4	5	6	7
I feel that scientists sometimes have a hidden agenda when it comes to climate change	1	2	3	4	5	6	7
	<i>Strongly disagree</i>						<i>Strongly agree</i>
I think that scientists are sometimes biased in their opinions about climate change	1	2	3	4	5	6	7
Scientists should only provide the facts about climate change, and should not tell me how to act in response	1	2	3	4	5	6	7
I would find it helpful if scientists would also tell me how to respond to climate change when providing the climate science	1	2	3	4	5	6	7
If scientists told me what to do in response to climate change, I would lose trust in them	1	2	3	4	5	6	7
I do not expect scientists to tell me what to do to respond to climate change	1	2	3	4	5	6	7
It is the responsibility of scientists to advise me on what do to about climate change as well as the science behind it	1	2	3	4	5	6	7
Scientists' primary role should be to inform policy on climate change	1	2	3	4	5	6	7
It is up to governments, not scientists, to tell society what to do in response to climate change	1	2	3	4	5	6	7
When policies are based on science, I think it is important for the public to understand the science behind it	1	2	3	4	5	6	7
I can accept a policy which is based on science, without fully understanding the science behind it	1	2	3	4	5	6	7
In general, I am fearful of scientists	1	2	3	4	5	6	7
In general, I trust scientists	1	2	3	4	5	6	7
I think that scientists often sit in ivory towers, without really understanding the real world	1	2	3	4	5	6	7
Scientists are primarily interested in conveying the truth about what they know	1	2	3	4	5	6	7
Scientists are not really interested in engaging with the public	1	2	3	4	5	6	7
I don't feel I need to know the science of climate change	1	2	3	4	5	6	7
I would like climate scientists to be more definite with their information	1	2	3	4	5	6	7
Generally I am interested in science	1	2	3	4	5	6	7
When people 'talk science' it often bores me	1	2	3	4	5	6	7
If I don't understand the climate science it is my fault	1	2	3	4	5	6	7
If I don't understand the climate science it means that it has not been communicated very well	1	2	3	4	5	6	7

Finally, we need to know a little bit about you....

1. Are you Male Female
2. How old are you?
3. How would you rate you level of previous scientific training?
 - a. I have had no science training at all
 - b. I have had some scientific training through my previous studies
 - c. I have had quite a lot of scientific training through my previous studies
 - d. Most of my previous studies have been in the area of science. As such I have had a lot of training
4. Do you own or have access to a car? Yes No
5. Do you live in:
 - a. Catered halls of residence
 - b. Self-catered halls of residence
 - c. Private shared accommodation
 - d. Other. *Please specify*.....
6. Please use the below box for any comments you may have...

***Thanks very much! That's the end of our survey.
If you are interested in learning more about climate change, please see the next
page.
If not, please return your survey to the experimenter***

This study is part of a project being conducted in collaboration with the Linford Centre for Climate Research (LCCR). This organisation is interested in how people perceive them and the issue of climate change. In the survey, you will be presented with information about this organisation and their work and then asked for your own impressions.

The survey should take no more than **10 minutes** to complete. The questions we ask you should not be too hard. Most of the time, you will be able to express your attitudes and beliefs simply by circling a number on a scale that best corresponds to what you personally think.

Your participation in this research is completely voluntary and your responses to the survey will remain anonymous and confidential. The information you provide will be used only for the purposes of research. At no time will we ask you for information that could be used to identify who you are. Where we do ask you for personal information, this will be used only for the purposes of describing the sample of people who completed our survey.

If you have read and understood the above, and you are happy to participate in our research, please turn the page and begin the survey. While you are answering our questions, please remember **there are no 'right' or 'wrong' answers, we are only interested in what you personally think.**

Thanks for agreeing to participate in our research – we really appreciate it !!!

CLIMATE RESEARCH AND THE LINFORD CENTRE

In this study, we are interested in your responses to research findings being produced by the Linford Centre. Because you may not have heard of the Linford Centre and their work, below is a brief description taken from their website. Read the description so that you understand a little bit about the Linford Centre and their work:

Here is some information about the organisation (please read):

Open language condition

Linford Centre

Welcome | Climate Change | Our research | Our activities | Learn with us | Our services | **About Us**

You are here: Welcome > About us > Who we are

Who we are

- **We are** a world-leading group with expertise researching changes in the earth's climate. Changes in the world's climate over time are known as climate change
- **We attribute** this change to increased amounts of greenhouse gases (carbon dioxide and methane) in the atmosphere, which leads to warming of the planet
- **We develop** climate models to predict how the climate is likely to be in the future using the available data (such as temperature, clouds, sea level)

Closed language condition

Linford Centre

Home | Climate Change | Research | Activities | Learn about climate science | Services | **About**

You are here: Home > About

About

- **The Linford Centre is** a world-leading group with expertise researching changes in the earth's climate. Changes in the world's climate over time are known as climate change
- **The Linford Centre attributes** this change to increased amounts of greenhouse gases (carbon dioxide and methane) in the atmosphere, which leads to warming of the planet
- **The Linford Centre develops** climate models to predict how the climate is likely to be in the future using the available data (such as temperature, clouds, sea level)

Have you previously heard about the Linford Centre and their work?

- d. Yes
- e. No
- f. Unsure

Here is some information about their work (please read):

High uncertainty in the Open language condition

Linford Centre

Welcome **Climate Change** Our research Our activities Learn with us Our services About us

You are here: Welcome ▶ Climate Change

▶ Climate Change

Our data
Our models
Our research reports
Policy relevant science
Our academic publications
Ask us anything
Links

Climate Change

We predict that the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise **between 2-4°C**
- **70-90% likelihood** that deaths attributable to climate change will double
- **65-85% likelihood** that more than 2 million of people will be flooded due to climate change
- **70-90% likelihood** that climate change will make more than a quarter of all species extinct
- **10-30% likelihood** sea levels will rise by more than 6 metres

Low uncertainty in the Open language condition

Linford Centre

Welcome **Climate Change** Our research Our activities Learn with us Our services About us

You are here: Welcome ▶ Climate Change

▶ Climate Change

Our data
Our models
Our research reports
Policy relevant science
Our academic publications
Ask us anything
Links

Climate Change

We predict that impacts based on current rates of CO₂ emission include:

- Global average temperature will likely rise **3°C**
- **80% likelihood** that deaths attributable to climate change will double
- **75% likelihood** that more than 2 million of people will be flooded due to climate change
- **80% likelihood** that climate change will make more than a quarter of all species extinct
- **20% likelihood** sea levels will rise by more than 6 metres

High uncertainty in the Closed language condition

Linford Centre

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You are here: Home ▶ Climate Change

▶ Climate Change

Linford Centre data
Linford Centre Models
Linford research reports
Policy relevant science
Academic publications
FAQ
Links

Climate Change

It is predicted that the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise **between 2-4°C**
- **70-90% likelihood** that deaths attributable to climate change will double
- **65-85% likelihood** that more than 2 million of people will be flooded due to climate change
- **70-90% likelihood** that climate change will make more than a quarter of all species extinct
- **10-30% likelihood** sea levels will rise by more than 6 metres

Low uncertainty in the Closed language condition

Linford Centre

Home **Climate Change** Research Activities Learn about climate science Services About

You are here: Home ▶ Climate Change

▶ Climate Change

Linford Centre data
Linford Centre Models
Linford research reports
Policy relevant science
Academic publications
FAQ
Links

Climate Change

It is predicted that impacts based on current rates of CO₂ emission include:

- Global average temperature will likely rise **3°C**
- **80% likelihood** that deaths attributable to climate change will double
- **75% likelihood** that more than 2 million of people will be flooded due to climate change
- **80% likelihood** that climate change will make more than a quarter of all species extinct
- **20% likelihood** sea levels will rise by more than 6 metres

Based on their web profile, what are your immediate impressions of the Linford centre? For example, what kind of organisation do you think it is? And what kind of people do you think work there? Take a moment to think about the impression you have formed. It might be useful to look again at their web profile. In the space below, please list any impressions you have formed about this organisation based on their web profile and the description it contains.

Take a moment to think again of the impression you formed. To what extent are each of the following adjectives part of the impression of the Linford Centre? In my impression, the Linford Centre is...

	<i>Not at all</i>						<i>Extremely</i>
Competent	1	2	3	4	5	6	7
Moral	1	2	3	4	5	6	7
Warm	1	2	3	4	5	6	7
Professional	1	2	3	4	5	6	7
Casual	1	2	3	4	5	6	7
Sincere	1	2	3	4	5	6	7
Capable	1	2	3	4	5	6	7
Honest	1	2	3	4	5	6	7
Cold	1	2	3	4	5	6	7
Trustworthy	1	2	3	4	5	6	7
Friendly	1	2	3	4	5	6	7
Distant	1	2	3	4	5	6	7
Immoral	1	2	3	4	5	6	7
Incompetent	1	2	3	4	5	6	7
Efficient	1	2	3	4	5	6	7

Appendix 3.3 Experiment 2

Thinking about all the things you have read, what is your overall impression of this organisation's work? Please indicate the extent to which you disagree or agree with each of the statements below.

	<i>Strongly disagree</i>						<i>Strongly agree</i>
I found the summary description of the Linford Centre engaging	1	2	3	4	5	6	7
I tuned out while reading about this organisation's research	1	2	3	4	5	6	7
When reading information about this organisation's research, I wanted to know more about the <u>science</u> of climate change	1	2	3	4	5	6	7
Based on their web profile, I was strongly motivated to take into account the information provided by the Linford Centre	1	2	3	4	5	6	7
After read the webpages, I wanted to know more about what to do about climate change	1	2	3	4	5	6	7
I understand the meaning of the Linford Centre's research	1	2	3	4	5	6	7
I do not understand what this research is supposed to mean	1	2	3	4	5	6	7
I felt this organisation's summary was intended to <u>inform</u> me about climate change	1	2	3	4	5	6	7
I felt this summary was intended to <u>influence</u> my behaviour to reduce the impacts of climate change	1	2	3	4	5	6	7
Based on their research, the Linford Centre seems to be a trustworthy source of information about climate change	1	2	3	4	5	6	7
Based on what I have read, I would find it hard to trust the Linford Centre as a source of information about climate change	1	2	3	4	5	6	7

Now we would like to know more about how you think and feel about the issue of climate change in your own life. To what extent do you disagree or agree with each of the following statements:

	<i>Strongly disagree</i>						<i>Strongly agree</i>
In my opinion climate change is happening	1	2	3	4	5	6	7
In my opinion climate change is man-made	1	2	3	4	5	6	7
Human beings are responsible for climate change	1	2	3	4	5	6	7
Climate change is a natural process rather than something caused by human activity	1	2	3	4	5	6	7
Climate change is something that I personally believe in	1	2	3	4	5	6	7
I remain somewhat sceptical about climate change and if it is real	1	2	3	4	5	6	7
I believe there is global risk of the consequences of climate change	1	2	3	4	5	6	7
I think there will be bad consequences of climate change for the planet	1	2	3	4	5	6	7
I believe that the global consequences of climate change will be severe	1	2	3	4	5	6	7
I feel personally at risk from the consequences of climate change	1	2	3	4	5	6	7
I personally worry about climate change and how it will affect me	1	2	3	4	5	6	7
For me, climate change is nothing that I am personally concerned about	1	2	3	4	5	6	7

Regardless of what you are already doing, how willing would you be to engage in each of the following behaviours in response to climate change?

<i>To reduce the impact of climate change I would be willing to...</i>	<i>Not at all willing</i>						<i>Very willing</i>
Walk (more) instead of using the car	1	2	3	4	5	6	7
Cycle (more) instead of using the car	1	2	3	4	5	6	7
Reduce my household energy use	1	2	3	4	5	6	7
Recycle (more)	1	2	3	4	5	6	7
Use a car less	1	2	3	4	5	6	7
Use public transport (more) instead of the car	1	2	3	4	5	6	7
Limit unnecessary air travel	1	2	3	4	5	6	7
Use less water	1	2	3	4	5	6	7

Reduce, reuse, recycle	1	2	3	4	5	6	7
Eat less meat	1	2	3	4	5	6	7

Finally, we need to know a little bit about you....

1. Are you Male Female
2. How old are you?
3. How would you rate you level of previous scientific training?
 - e. I have had no science training at all
 - f. I have had some scientific training through my previous studies
 - g. I have had quite a lot of scientific training through my previous studies
 - h. Most of my previous studies have been in the area of science. As such I have had a lot of training
4. What is your course of study?
5. What year of your course are you in?
6. Do you own or have access to a car? Yes No
7. Do you live in:
 - e. Catered halls of residence
 - f. Self-catered halls of residence
 - g. Private shared accommodation
 - h. Other. *Please specify*.....
8. Please use the below box for any comments you may have...

***That's the end of our survey
Thanks very much!***

This study is part of a project being conducted in collaboration with the Linford Centre for Climate Research (LCCR). This organisation is interested in how people perceive them and the issue of climate change. In the survey, you will be presented with information about this organisation and their work and then asked for your own impressions.

The survey should take no more than **15-20 minutes** to complete. The questions we ask you should not be too hard. Most of the time, you will be able to express your attitudes and beliefs simply by circling a number on a scale that best corresponds to what you personally think.

Your participation in this research is completely voluntary and your responses to the survey will remain anonymous and confidential. The information you provide will be used only for the purposes of research. At no time will we ask you for information that could be used to identify who you are. Where we do ask you for personal information, this will be used only for the purposes of describing the sample of people who completed our survey.

If you have read and understood the above, and you are happy to participate in our research, please turn the page and begin the survey. While you are answering our questions, please remember **there are no 'right' or 'wrong' answers, we are only interested in what you personally think.**

As a token of our appreciation for participating in this survey, we would like to give you the chance to be entered into a prize draw for Amazon vouchers. For this you would need to enter your contact details below, but this information will in **no way** be kept and related to your responses.

Thanks for agreeing to participate in our research - we really appreciate it !!!

CLIMATE RESEARCH AND THE LINFORD CENTRE

In this study, we are interested in your responses to research findings being produced by the Linford Centre. Because you may not have heard of the Linford Centre and their work, below is a brief description taken from their website. Read the description so that you understand a little bit about the Linford Centre and their work:

Here is some information about the organisation. Please read this carefully because we will ask you some questions later about your impressions of this organisation:

Open language condition

Linford Centre

Welcome Climate Change Our research Our activities Learn with us Our services **About Us**

You are here: Welcome > About us > Who we are

> Who we are

Who we are

- Our history
- How are we doing?
- Our society
- Our obligations
- Work with us
- Our board
- Let us help you

- **We are** a world-leading group with expertise researching changes in the earth's climate. Changes in the world's climate over time are known as climate change
- **We attribute** this change to increased amounts of greenhouse gases (carbon dioxide and methane) in the atmosphere, which leads to warming of the planet
- **We develop** climate models to predict how the climate is likely to be in the future using the available data (such as temperature, clouds, sea level)

Closed language condition

Linford Centre

Home Climate Change Research Activities Learn about climate science Services **About**

You are here: Home > About

> About

About

- Linford Centre data
- How the Linford Centre operates
- Municipal society
- Corporate obligations
- Work for the Linford Centre
- Executive board
- Help

- **The Linford Centre is** a world-leading group with expertise researching changes in the earth's climate. Changes in the world's climate over time are known as climate change
- **The Linford Centre attributes** this change to increased amounts of greenhouse gases (carbon dioxide and methane) in the atmosphere, which leads to warming of the planet
- **The Linford Centre develops** climate models to predict how the climate is likely to be in the future using the available data (such as temperature, clouds, sea level)

Have you previously heard about the Linford Centre and their work?

- g. Yes
- h. No
- i. Unsure

Based on their web profile, what are your immediate impressions of the Linford centre? For example, what kind of organisation do you think it is? And what kind of people do you think work there? Take a moment to think about the impression you have formed. It might be useful to look again at their web profile. In the space below, please list any impressions you have formed about this organisation based on their web profile and the description it contains.

Take a moment to think again of the impression you formed. To what extent are each of the following adjectives part of the impression of the Linford Centre? In my impression, the Linford Centre seems...

	<i>Not at all</i>						<i>Extremely</i>
	1	2	3	4	5	6	7
Competent	1	2	3	4	5	6	7
Moral	1	2	3	4	5	6	7
Truthful	1	2	3	4	5	6	7
Professional	1	2	3	4	5	6	7
Dishonest	1	2	3	4	5	6	7
Sincere	1	2	3	4	5	6	7
Capable	1	2	3	4	5	6	7

Here is some information about the work of the Linford Centre. Again, please read this carefully because we will later ask for your impressions of this work.

High uncertainty in the Open language condition

Linford Centre

Welcome **Climate Change** Our research Our activities Learn with us Our services About us

You are here: Welcome > Climate Change

Climate Change

- Our data
- Our models
- Our research reports
- Policy relevant science
- What you can do about Climate Change
- Ask us anything
- Links

Climate Change

We predict that the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise **between 2-4°C**
- **70-90% likelihood** that deaths attributable to climate change will double
- **65-85% likelihood** that more than 2 million of people will be flooded due to climate change
- **70-90% likelihood** that climate change will make more than a quarter of all species extinct
- **10-30% likelihood** sea levels will rise by more than 6 metres

Low uncertainty in the Open language condition

Linford Centre

Welcome **Climate Change** Our research Our activities Learn with us Our services About us

You are here: Welcome > Climate Change

Climate Change

- Our data
- Our models
- Our research reports
- Policy relevant science
- What you can do about Climate Change
- Ask us anything
- Links

Climate Change

We predict that impacts based on current rates of CO₂ emission include:

- Global average temperature will likely rise **3°C**
- **80% likelihood** that deaths attributable to climate change will double
- **75% likelihood** that more than 2 million of people will be flooded due to climate change
- **80% likelihood** that climate change will make more than a quarter of all species extinct
- **20% likelihood** sea levels will rise by more than 6 metres

High uncertainty in the Closed language condition

Linford Centre

Home **Climate Change** Research Activities Learn about climate science Services About

You are here: Home > Climate Change

Climate Change

Linford Centre data

Linford Centre Models

Linford research reports

Policy relevant science

Advice on climate change

FAQ

Links

Climate Change

It is predicted that the following impacts based on current rates of CO₂ emission:

- Global average temperature will likely rise **between 2-4°C**
- 70-90% likelihood** that deaths attributable to climate change will double
- 65-85% likelihood** that more than 2 million of people will be flooded due to climate change
- 70-90% likelihood** that climate change will make more than a quarter of all species extinct
- 10-30% likelihood** sea levels will rise by more than 6 metres

Low uncertainty in the Closed language condition

Linford Centre

Home **Climate Change** Research Activities Learn about climate science Services About

You are here: Home > Climate Change

Climate Change

Linford Centre data

Linford Centre Models

Linford research reports

Policy relevant science

Advice on Climate Change

FAQ

Links

Climate Change

It is predicted that impacts based on current rates of CO₂ emission include:

- Global average temperature will likely rise **3°C**
- 80% likelihood** that deaths attributable to climate change will double
- 75% likelihood** that more than 2 million of people will be flooded due to climate change
- 80% likelihood** that climate change will make more than a quarter of all species extinct
- 20% likelihood** sea levels will rise by more than 6 metres

How certain do you think the scientific community are about the impacts of climate change?

Low certainty							High certainty	
1	2	3	4	5	6	7		

Appendix 3.4 Experiment 3

Thinking about all the things you have read, what is your overall impression of this organisation's work? Please indicate the extent to which you disagree or agree with each of the statements below.

	<i>Strongly disagree</i>						<i>Strongly agree</i>
I found the summary description of the Linford Centre engaging	1	2	3	4	5	6	7
I tuned out while reading about this organisation's research	1	2	3	4	5	6	7
When reading information about this organisation's research, I wanted to know more about the <u>science</u> of climate change	1	2	3	4	5	6	7
Based on their web profile, I was strongly motivated to take into account the information provided by the Linford Centre	1	2	3	4	5	6	7
After read the webpages, I wanted to know more about what to do about climate change	1	2	3	4	5	6	7
I understand the meaning of the Linford Centre's research	1	2	3	4	5	6	7
I do not understand what this research is supposed to mean	1	2	3	4	5	6	7
I felt this organisation's summary was intended to <u>inform</u> me about climate change	1	2	3	4	5	6	7
I felt this summary was intended to <u>influence</u> my behaviour to reduce the impacts of climate change	1	2	3	4	5	6	7
Based on their research, the Linford Centre seems to be a trustworthy source of information about climate change	1	2	3	4	5	6	7
Based on what I have read, I would find it hard to trust the Linford Centre as a source of information about climate change	1	2	3	4	5	6	7

The Linford Centre is committed to providing people with advice on how people can act as a response to climate change. Below is a screenshot of information the Linford Centre provides on behaviours people can do in response to climate change. Please read.

Advice present in the Open language condition

The screenshot shows the Linford Centre website navigation menu with 'Climate Change' selected. The breadcrumb trail reads: 'You are here: Welcome > Climate Change > What you can do about Climate Change'. The left sidebar includes links for 'Our data', 'Our models', 'Our research reports', 'Policy relevant science', 'What you can do about Climate Change', 'Ask us anything', and 'Links'. The main content area is titled 'What you can do about Climate Change' and contains the following text:

Based on our research, here is a list of simple **things you can do** to help avoid dangerous climate change:

- Turn off unused appliances
- Cycle more
- Eat less meat
- Fly less
- Reduce, reuse, recycle
- Drive less
- Use public transport more
- Reduce water use

Advice absent in the Open language condition

The screenshot shows the Linford Centre website navigation menu with 'Climate Change' selected. The breadcrumb trail reads: 'You are here: Welcome > Climate Change > External websites'. The left sidebar includes links for 'Our data', 'Our models', 'Our research reports', 'Policy relevant science', 'External websites', 'Ask us anything', and 'Links'. The main content area is titled 'External websites' and contains the following text:

We do not believe we should provide advice on how to respond to climate change.

Below is a list of **organisations and web links** you can go to for information on how you can help avoid dangerous climate change:

Department for Climate Change website
The UK's Government advice based on policy-relevant science

National Council for Climate Change
This is an independent advisory group that provides information to companies, Government Departments and individuals on what simple things can be done

AVOID website
This is a collective of academic and scientific institutes examining the most effective behavioural changes we can make as individuals

We are not responsible for the content of external sites.

Advice present in the Closed language condition

The screenshot shows the Linford Centre website with a navigation menu. The 'Climate Change' menu item is highlighted. The breadcrumb trail reads 'Home > Climate Change > Advice on Climate Change'. The left sidebar contains a list of links, with 'Advice on Climate Change' selected. The main content area features a heading 'Advice on Climate Change' and a paragraph stating the center's commitment to providing advice. Below this, a list of simple actions to avoid dangerous climate change is provided, including turning off appliances, cycling, eating less meat, flying less, recycling, driving less, using public transport, and reducing water use.

Advice absent in the Closed language condition

The screenshot shows the Linford Centre website with a navigation menu. The 'Climate Change' menu item is highlighted. The breadcrumb trail reads 'Home > Climate Change > External websites'. The left sidebar contains a list of links, with 'External websites' selected. The main content area features a heading 'External websites' and a paragraph stating the center does not provide advice. Below this, a list of external websites is provided, including the Department for Climate Change website, the National Council for Climate Change, and the AVOID website. Each website is described with its purpose and the type of information it provides.

The Linford Centre is not responsible for the content of external sites.

Take a moment to think again of the impression you formed. To what extent are each of the following adjectives part of the impression of the Linford Centre? In my impression, the Linford Centre is...

	<i>Not at all</i>						<i>Extremely</i>
	1	2	3	4	5	6	7
Honest	1	2	3	4	5	6	7
Trustworthy	1	2	3	4	5	6	7
Able	1	2	3	4	5	6	7
Skilled	1	2	3	4	5	6	7
Immoral	1	2	3	4	5	6	7
Incompetent	1	2	3	4	5	6	7
Efficient	1	2	3	4	5	6	7

In this survey, we are also interested in what you think you can do in response to the topic of climate change. Below are some questions regarding the extent to how you feel you personally can do something in response to climate change. Please indicate the extent to which you disagree or agree with each of the following statements.

	<i>Strongly disagree</i>						<i>Strongly agree</i>
	1	2	3	4	5	6	7
I feel there is something I can personally do to act against climate change	1	2	3	4	5	6	7
I feel it is in my power to tackle climate change	1	2	3	4	5	6	7
I feel there is nothing I can do about climate change	1	2	3	4	5	6	7
I believe my actions have an influence on climate change	1	2	3	4	5	6	7

Appendix 3.4 Experiment 3

Regardless of what you are already doing, how willing would you be to engage in each of the following behaviours in response to climate change?

<i>To reduce the impact of climate change I would be willing to...</i>	<i>Not at all willing</i>						<i>Very willing</i>
Walk (more) instead of using the car	1	2	3	4	5	6	7
Cycle (more) instead of using the car	1	2	3	4	5	6	7
Reduce my household energy use	1	2	3	4	5	6	7
Recycle (more)	1	2	3	4	5	6	7
Use a car less	1	2	3	4	5	6	7
Use public transport (more) instead of the car	1	2	3	4	5	6	7
Limit unnecessary air travel	1	2	3	4	5	6	7
Use less water	1	2	3	4	5	6	7
Reduce, reuse, recycle	1	2	3	4	5	6	7
Eat less meat	1	2	3	4	5	6	7

Now we would like to know more about how you think and feel about the issue of climate change in your own life. To what extent do you disagree or agree with each of the following statements:

	<i>Strongly disagree</i>						<i>Strongly agree</i>
In my opinion climate change is happening	1	2	3	4	5	6	7
In my opinion climate change is man-made	1	2	3	4	5	6	7
Human beings are responsible for climate change	1	2	3	4	5	6	7
Climate change is a natural process rather than something caused by human activity	1	2	3	4	5	6	7
Climate change is something that I personally believe in	1	2	3	4	5	6	7
I remain somewhat sceptical about climate change and if it is real	1	2	3	4	5	6	7
I believe there is global risk of the consequences of climate change	1	2	3	4	5	6	7
I think there will be bad consequences of climate change for the planet	1	2	3	4	5	6	7
I believe that the global consequences of climate change will be severe	1	2	3	4	5	6	7

Appendix 3.4 Experiment 3

I feel personally at risk from the consequences of climate change	1	2	3	4	5	6	7
I personally worry about climate change and how it will affect me	1	2	3	4	5	6	7
For me, climate change is something that I am <u>not</u> personally concerned about	1	2	3	4	5	6	7

Finally, we need to know a little bit about you....

1. Are you Male Female
2. How old are you?
3. Do you own or have access to a car? Yes No
4. How would you rate you level of previous scientific training?
 - i. I have had no science training at all
 - j. I have had some scientific training through my previous studies
 - k. I have had quite a lot of scientific training through my previous studies
 - l. Most of my previous studies have been in the area of science. As such I have had a lot of training
 - m. I work professionally as a scientist
5. Are you a student? Yes No (*Go to question 6*)
 - i) What is your course of study?
 - ii) What year of your course are you in?
 - iii) Do you live in:
 - i. Catered halls of residence
 - j. Self-catered halls of residence
 - k. Private shared accommodation
 - l. Other. *Please specify*.....

Go to question 8
6. What is the highest level of education you have completed/finished?
 - a. O-levels/ GCSE-grade
 - b. 2. A-level or equivalent
 - c. 3. Higher National Diploma or equivalent
 - d. 4. Degree or equivalent
 - e. 5. Post-graduate qualification
 - f. 6. Other (please specify)
7. What is the monthly net income of your household (after tax, national insurance and other statutory deductions)? If you are sharing a house, just answer for yourself.
 - a. Less than £1,000 per calendar month
 - b. Between £1,000 and £1,499 per calendar month
 - c. Between £1,500 and £1,999 per calendar month
 - d. Between £2,000 and £2,499 per calendar month
 - e. Between £2,500 and £2,999 per calendar month
 - f. Between £3,000 and £3,499 per calendar month
 - g. £3,500 per calendar month or more

8. That's the end of our questions! But if you think that there is something we have missed or if there is something else you would like to say about the issues in this survey, please give your comments here:

Thanks very much!

PLEASE CLICK [HERE](#) TO RECEIVE YOUR MAXIMILES POINTS



Debriefing information

Thank you so much for completing this questionnaire and taking part in this PhD research - I really appreciate it!

Now that you've kindly completed my questionnaire, I would like to tell you a bit more about my PhD project.

Though the Linford Centre, I am working in collaboration with a science organisation (Met Office Hadley Centre) looking at different communication styles and levels of scientific uncertainty.

What we have found so far is that scientists and science communicators have different styles when communicating with the public. Scientists prefer to communicate with focus on the technical and informational aspects. Whereas communicators view the language used to communicate as being a central feature, rather than simply the informational content. The experimental studies conducted so far in this PhD research have shown there to be different effects of language style when communicating climate change information. Using an open, warm tone of communication, respondents view the communicator as being more trustworthy than a cold and distant communication style. The higher the level of uncertainty, the less people believe that climate change is happening. These negative effects of uncertainty can be buffered by the language used i.e., conveying communicator trustworthiness by using a more open tone.

This current questionnaire has taken the previous work of language and uncertainty, and adds a further dimension, what the effect of provision of advice on what to do about climate change has on people's intentions to environmentally friendly behavioural intentions. As I am currently collecting data for this, I cannot report these findings yet.

If you would like to hear of the results of this particular study or further information of this PhD research more generally, please feel free to get in touch with myself, Hebba, via email - H.Haddad@exeter.ac.uk

Thank you again!
Hebba

Met Office Public Perceptions Survey

In this survey we are interested in your perceptions of the Met Office.

The Met Office (an abbreviation for Meteorological Office) is the United Kingdom's national weather service. The Headquarters of the Met Office are located in Exeter, Devon.

Regardless of your level of knowledge of the Met Office and their work, we would like you to think about them - that is, your **impressions** of the Met Office as an organisation.

Because we are interested in your impressions of the Met Office, please be aware that **there are no right or wrong answers to our questions**. We are genuinely interested in what you think, even if you have never thought about this topic before. When answering our questions, just try to be as open and honest as you can and tell us whatever you think is the right answer for you.

All responses to this survey will remain **anonymous and confidential**. Your answers will only be used for the purposes of research, and any findings will be reported in summary form, so could not be traced back to you personally.

The survey should take about 10 to 15 minutes to complete. As a token of our appreciation for participating in this survey, we would like to give you the chance to be entered into a **prize draw for a chance to win one of 3 Amazon vouchers worth £20**. For this you would need to enter your contact details following completion of this survey. This information will be stored separately from your responses to the survey and will only be used for the purposes of administering prizes.

If you have read and understood the above, and you are happy to take part in this research, please tick the following box:

<input type="checkbox"/>	I have read the above and consent to taking part in this research
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Now you are ready to begin. Please click the “Next” button below.

Appendix 4.1 Met Office public perceptions survey

First, how familiar do you think you are with the Met Office as an organisation and the work that they do? On the scale below, please tell us how familiar you think you are with the Met Office:

<i>Not at all familiar</i>	1	2	3	4	5	6	7	<i>Very familiar</i>
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What kind of work do you associate with the Met Office? That is, as an organisation what do you think the Met office is concerned with, and what kind of things do you think people who work at the Met Office do? In the space below, please describe to us any areas of work or interest you associate with the Met Office:

Now that you've had a chance to think a little bit about who the Met Office are and what they do, can you tell us a little bit more about your impressions of this organisation? Below is a list of words that are sometimes used to describe organisations. For each of these words, can you tell us how much you associate that quality with the Met Office using the scale provided below:

	<i>Not at all part of my impression</i>						<i>Very much part of my impression</i>
Competent	1	2	3	4	5	6	7
Skilled	1	2	3	4	5	6	7
Incompetent	1	2	3	4	5	6	7
Able	1	2	3	4	5	6	7
Efficient	1	2	3	4	5	6	7
Professional	1	2	3	4	5	6	7

Can you tell us a little bit more about what you were thinking of when you answered the questions above? When you rated the Met Office on the adjectives above, was there something you were thinking about that might explain the impression that you have? In the space below, please tell us what you were thinking about when you answered the above questions about your impressions of the Met Office.

Appendix 4.1 Met Office public perceptions survey

We have a few more questions about your impressions of the Met Office. Below is another list of words that might be used to describe organisations. Again, for each of these words, can you tell us how much you associate that quality with the Met office using the scale provided below:

	<i>Not at all part of my impression</i>						<i>Very much part of my impression</i>
	1	2	3	4	5	6	7
Trustworthy	1	2	3	4	5	6	7
Honest	1	2	3	4	5	6	7
Moral	1	2	3	4	5	6	7
Dishonest	1	2	3	4	5	6	7
Sincere	1	2	3	4	5	6	7
Dishonest	1	2	3	4	5	6	7

Again, can you tell us a bit more about what you were thinking of when you answered the questions above? When you rated the Met Office on these dimensions, was there something you were thinking about that might explain the impression that you have? In the space below, please tell us what you were thinking about when you answered the above questions about your impressions of the Met Office.

Appendix 4.1 Met Office public perceptions survey

Thank you for answering our questions about the Met Office. As you are probably aware, one of the areas the Met Office works in is Climate Change. That is, Met Office scientists are involved in research into the nature and possible impacts of climate change. Given this, we would also like to know what you think about this area of research and **your own opinions more generally** about the science of Climate Change and those who work in the area.

In other words, **what do you think scientists' positions on climate change are**, and how much agreement do you think there is in the scientific community? Below is a list of statements. Please indicate the extent to which you disagree or agree with each of these statements using the scale provided.

	<i>Strongly disagree</i>			<i>Strongly agree</i>			
Scientists generally agree about the causes and consequences of climate change	1	2	3	4	5	6	7
Among scientists, there is disagreement about the causes and consequences of climate change	1	2	3	4	5	6	7
In the science, there is still uncertainty about how much climate change is really happening	1	2	3	4	5	6	7
In the science, there is still uncertainty about the effects climate change might have.	1	2	3	4	5	6	7
All things considered, the scientific community are very certain about the nature and extent of climate change	1	2	3	4	5	6	7

Now we would like to know **what you personally think about the topic of Climate Change** more broadly. Below are a few more statements - this time about **your own thoughts and feelings** about climate change. Again, for each statement please indicate how much you disagree or agree using the scale provided.

	<i>Strongly disagree</i>			<i>Strongly agree</i>			
In my opinion climate change is happening	1	2	3	4	5	6	7
In my opinion climate change is man-made	1	2	3	4	5	6	7
Human beings are responsible for climate change	1	2	3	4	5	6	7
Climate change is a natural process rather than something caused by human activity	1	2	3	4	5	6	7
Climate change is something that I personally believe in	1	2	3	4	5	6	7

Appendix 4.1 Met Office public perceptions survey

I remain somewhat sceptical about climate change and if it is real	1	2	3	4	5	6	7
I believe there is global risk of the consequences of climate change	1	2	3	4	5	6	7
I think there will be bad consequences of climate change for the planet	1	2	3	4	5	6	7
I believe that the global consequences of climate change will be severe	1	2	3	4	5	6	7
I feel personally at risk from the consequences of climate change	1	2	3	4	5	6	7
I personally worry about climate change and how it will affect me	1	2	3	4	5	6	7
For me, climate change is something that I am <u>not</u> personally concerned about	1	2	3	4	5	6	7

Now think about **your own behaviour in relation to climate change**. How **willing** are you to change your own behaviour in response to this issue? Below is a list of behaviours that some people think are useful for reducing climate change. How willing are you to engage in each of these behaviours?

<i>To reduce the impact of climate change I would be willing to...</i>	<i>Not at all willing</i>						<i>Very willing</i>
Walk (more) instead of using the car	1	2	3	4	5	6	7
Cycle (more) instead of using the car	1	2	3	4	5	6	7
Reduce my household energy use	1	2	3	4	5	6	7
Recycle (more)	1	2	3	4	5	6	7
Use a car less	1	2	3	4	5	6	7
Use public transport (more) instead of the car	1	2	3	4	5	6	7
Limit unnecessary air travel	1	2	3	4	5	6	7
Use less water	1	2	3	4	5	6	7
Reduce, reuse, recycle	1	2	3	4	5	6	7
Eat less meat	1	2	3	4	5	6	7

Finally, we need to know a little bit about you....

1. Are you Male Female
2. How old are you?
3. Do you own or have access to a car? Yes No
4. How would you rate you level of previous scientific training?
 - n. I have had no science training at all
 - o. I have had some scientific training through my previous studies
 - p. I have had quite a lot of scientific training through my previous studies
 - q. Most of my previous studies have been in the area of science. As such I have had a lot of training
 - r. I work professionally as a scientist
5. What is the highest level of education you have completed/finished?
 - g. O-levels/ GCSE-grade
 - h. 2. A-level or equivalent
 - i. 3. Higher National Diploma or equivalent
 - j. 4. Degree or equivalent
 - k. 5. Post-graduate qualification
 - l. 6. Other (please specify)
6. What is the monthly net income of your household (after tax, national insurance and other statutory deductions)? If you are in a house share situation with housemates, just answer for yourself.
 - h. Less than £1,000 per calendar month
 - i. Between £1,000 and £1,499 per calendar month
 - j. Between £1,500 and £1,999 per calendar month
 - k. Between £2,000 and £2,499 per calendar month
 - l. Between £2,500 and £2,999 per calendar month
 - m. Between £3,000 and £3,499 per calendar month
 - n. £3,500 per calendar month or more
7. That's the end of our questions! But if you think that there is something we have missed or if there is something else you would like to say about the issues in this survey, please give your comments here:

Thanks very much!

PLEASE CLICK [HERE](#) TO RECEIVE YOUR MAXIMILES POINTS



Debriefing information

Thank you so much for completing this questionnaire and taking part in this PhD research - I really appreciate it!

Now that you've kindly completed my survey, I would like to tell you a bit more about the research this is part of. This survey is part of a larger PhD project being conducted in collaboration with the Met Office Hadley Centre. In this project we are examining how various people think about climate change, the processes involved in communicating climate change and the various factors that affect this communication.

With respect to the latter, we have been particularly focussing on how uncertainty affects climate change communication, and how perceptions of communicators can affect this. One thing we have found so far is that although uncertainty (e.g., about climate change predictions) can disrupt effective communication about climate change, perceptions of communicator trustworthiness can help to overcome this. Said simply, if the source of communication is perceived to be trustworthy, people can be willing to listen to and act on messages even if these contain high degrees of uncertainty.

Because our past research shows that perceptions of trustworthiness are important for effective communication, the survey you just completed was interested in exploring where these perceptions come from. For that reason, we asked you **how** you perceived the Met Office as an organisation involved in climate change communication and we also asked you to reflect on **why** you see the Met Office the way you do. We also asked you about your own personal beliefs and actions in response to climate change so that we can explore how perceptions of trustworthiness relate to these things.

If you would like to hear of the results of this particular study when complete or further information of this PhD research more generally, please feel free to get in touch with myself, Hebba, via email - H.Haddad@exeter.ac.uk

Thank you again!
Hebba