Chapter 10
Evaluating Arguments About Climate Change

Adam Corner

Introduction – Communicating Climate Change

Anthropogenic climate change – the impact of human activity on the climate – has become a global political priority. Delegations from 192 countries and more than 60 Heads of State gathered for the United Nations Conference of Parties in Copenhagen in December 2009, and individual nations have now begun the formidable task of decarbonising their economies. In the United Kingdom, for example, the government has set a target of an 80% reduction in levels of greenhouse gases by 2050 (HM Government, 2008) and published a plan that sets out some of the major structural changes that will be required to achieve this goal.

Despite these major and significant developments in national and international policy, a considerable amount of uncertainty remains in public attitudes about the reality and seriousness of climate change. In fact, a range of public opinion polling data suggests that scepticism about anthropogenic climate change has recently *increased* (e.g., BBC, 2010; Pew Research Centre, 2009). The increase in uncertainty about climate change has been most marked in the United States, where a significant proportion of the public do not accept that climate change is caused by human activity (Pew Research Centre, 2009). There is also evidence that an increasing number of people believe that claims about human impacts on the climate have been exaggerated (Dunlap & McCright, 2008; Whitmarsh, 2011). It is sobering to contrast these data on public opinion with a survey of active and publishing climate scientists. Among this group, Doran and Zimmerman (2009) found that 97% agreed that human activity was contributing to climate change.

Despite the fact that climate is a statistical phenomenon – the pattern of weather over a particular time period or geographical location – the communication of

A. Corner (✉)
School of Psychology, Cardiff University, Cardiff, Wales CF10 3AT, UK
e-mail: corneraj@cardiff.ac.uk

M.S. Khine (ed.), *Perspectives on Scientific Argumentation*,
DOI 10.1007/978-94-007-2470-9_10,

climate change is not usually achieved using probabilistic data or numerical risk information. Rather, *arguments* are constructed and transmitted, from scientists to politicians, from politicians to the media and from all of these groups to the general public. One such group is the Intergovernmental Panel on Climate Change (IPCC) – the body of independent scientists charged with providing periodic assessments of climate science. In their most recent assessment report, they stated that:

> Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. . .(these are) expected to have mostly adverse effects on natural and human systems. (Pachauri & Reisinger, 2007)

The statement seems clear and unequivocal – yet, a considerable number of people are not persuaded of its truth. Why is it that a significant proportion of international public opinion has not been convinced by arguments about anthropogenic climate change?

There is growing interest in answering this question, in developing more effective ways of communicating about climate change and in engaging the public more successfully (e.g., American Psychological Association, 2009; Spence, Pidgeon, & Uzzell, 2009). While there are some well-documented small-scale projects that have successfully communicated climate change messages to the general public (e.g., McKenzie-Mohr & Smith, 1999; WRAP, 2008), for the most part the story of climate change communication is one of failure. While general awareness about climate change is growing, there is little evidence that behavioural engagement has shifted significantly over the past few years (Upham, Whitmarsh, Poortinga, Purdam, Darnton, McLachlan & Devine-Wright, 2009).

A recent example of an emphatically unsuccessful climate change communication campaign was the 'Bedtime Story' advertisement commissioned by the British government's Department for Energy and Climate Change in 2009. The advert was designed to communicate the seriousness and urgency of climate change by depicting a young child being read a bedtime story about climate change. As a narrative about the destructive future effects of climate change unfolds, scary music plays in the background and vivid graphical representations of 'evil carbon' cause floods to rise around the house of the child. The advert ends with the message that it is up to the viewer how the 'story' of climate change ends – that it is not too late to avert the negative consequences of unmitigated climate change. The advert was intended to make climate change more personally relevant to British viewers (by depicting an 'average' neighbourhood becoming flooded). However, following a number of complaints from viewers that the advert was unnecessarily scary and several critical analyses from climate change communication experts, the advert was abandoned.

Why is it that the process of communicating climate change to the public is not straightforward? In this chapter, I will outline some possible answers to this question. With reference to analyses of popular climate change media narratives and empirical data on climate change argument evaluation, I will examine the way that people evaluate arguments, evidence and messages about climate change.

How do People Evaluate Arguments About Climate Change?

Knowledge About Climate Change

Is it the case that people simply do not know or understand enough about climate change? Would educating or teaching members of the public more about climate change make them more likely to accept arguments about the human impact on the climate?

Until fairly recently, it was often assumed by scholars and science communicators that if a particular scientific or technological development was unpopular among the general public, that the public must have a 'deficit' of knowledge that needed addressing through information provision. Increasingly, however, this view has been challenged, as studies have consistently shown that people's perception of science and technology is not straightforwardly attributable to their level of knowledge about it (e.g.,Kahan, Braman, Slovic, Gastil, & Cohen, 2009; Malka, Krosnick, & Langer, 2009). Rather, disagreement over scientific and technological developments may be due to divergent values, distrust in risk communicators or differing attitudes towards risk management and regulatory systems. Furthermore, assuming a 'deficit' of knowledge is not conducive to establishing a genuinely participatory interaction between science communicators and the broader public (Irwin & Wynne, 1996). It is now widely recognised that differences in opinion between science and industry and members of the public cannot simply be put down to a lack of knowledge or awareness. Correspondingly, behavioural research has found that information alone is insufficient to promote pro-environmental behaviour. Even if informational campaigns are successful in influencing attitudes, there is often a significant gap between people's attitudes and their behaviour (Maio, Verplanken, Manstead, Stroebe, Abraham, Sheeran, & Connor, 2007).

Adams (1999) examined how college students, scientists and policy analysts evaluated 'questionable' scientific claims about climate change. Participants were interviewed as they evaluated the claims made in a particular article, were asked whether they agreed with the article, what they thought of the article and how reliable they thought it was. The qualitative responses they gave indicated that despite being the least knowledgeable of the three groups about climate change, the college students seemed able to apply a 'generic' evaluative criteria to the reports, asking questions about the source's validity and the degree to which it was appropriate to generalise or extrapolate given the available evidence. The results of this study suggest that being knowledgeable about climate change is not a prerequisite for evaluating the merit of climate change arguments.

However, while the relationship between lay knowledge and attitudes towards climate change is not straightforward, there is some evidence to suggest that people who demonstrate a greater understanding of climate change are more likely to support arguments about government action to reduce greenhouse gases (Bord, O'Connor, & Fischer, 2000) and that learning about climate change through structured educational programmes promotes a heightened sense of agency around climate change – that is, an increased acceptance of the human impact on climate

and the ability of human behaviour to mitigate it (Hogg & Shah, 2010). A comprehensive review of the role of psychology in addressing climate change by the American Psychological Association (APA, 2009) suggested that a lack of knowledge about appropriate behavioural responses to climate change (and their impact – Stern, 2000) was a major barrier to public engagement with climate change.

In addition, as Weber (2010) has argued, even a good technical understanding of the causes and effects of climate change cannot prevent experiential learning from personal experience of everyday weather from interfering. Climate is a statistical phenomenon, comprised of patterns of weather over a period of time for a particular region. Confusingly, however, weather is not necessarily a good guide to climate – while an increase in greenhouse gases is expected to increase the frequency and severity of extreme weather events, no single weather event can be unambiguously attributed to 'climate change'. This means that climate change is perceptually vague, abstract and difficult to visualise, while most people's experience of weather is concrete and visceral. Where there is a conflict between the weather (e.g., a particularly cold winter) and climatic predictions (e.g., warming over a 50-year period), the fast and automatic associative processes that drive learning from personal experience are likely to trump the cognitive effort required for learning from statistical descriptions or written reports (Weber, 2010).

In an attempt to make climate change more tangible and more relevant to people's lives, the American think-tank EcoAmerica played people recordings of actors delivering speeches about climate change (Western Strategies & Lake Research Partners, 2009). The version that people were most positive towards talked about 'air pollution' rather than 'climate change' – because pollution is something visible that they could relate to, with strong connotations of dirtiness and poor health. Research comparing the climate change attitudes of flood victims and ordinary citizens has also identified a positive association between air pollution and concern about climate change (Whitmarsh, 2008). While flood victims were no more likely than other people to be concerned about climate change (perhaps, because they did not associate their personal experience with the global phenomenon of climate change), people who reported direct experience of air pollution affecting their health were more concerned about climate change (see also Spence, Poortinga, Butler, and Pidgeon, 2011, for a more recent discussion of the links between flooding experience and attitudes towards climate change). Weber (2010) has suggested that the concretisation of future climate-related events may hold promise as a method of increasing awareness and concern about climate change. One reason that arguments about climate change so often seem to fail is that they are arguments about abstract concepts, intangible effects and psychologically distant consequences.

The link between knowledge and attitudes towards climate change is complex and learning about climate change – either through structured educational programmes or by using techniques to overcome the challenges that climate change poses to our perceptual and cognitive systems – is one determinant of how climate change messages will impact on members of the public. But what does it mean to say that someone is 'engaged' by climate change? Lorenzoni, Nicholson-Cole and Whitmarsh (2007) presented an analysis of what they considered constituted

'engagement' with climate change. They identified engagement as an individual's state, comprised of cognitive, affective and behavioural elements, suggesting that

> (I)t is not enough for people to know about climate change in order to be fully engaged; they also need to care about it, be motivated and be able to take action. (Lorenzoni et al., 2007, p. 445)

Lorenzoni et al. (2007) asked members of the public about their perceptions of and responses to climate change and identified two broad classes of barriers that people perceived to engaging with climate change – individual and social. Individual barriers included a lack of knowledge about where to find relevant information – but also a perceived *overload* in the amount of information available; confusion about conflicting scientific evidence and a lack of trust in the sources delivering messages about climate change (e.g., politicians/environmental campaigners/the media). Social barriers included a lack of perceived political action on climate change, social norms and expectations to live (or aspire to) high consuming lifestyles, and concern about 'free riders' who might avoid taking action on climate change (leaving an unfair burden on those willing to change).

This research makes clear that it is not simply a lack of knowledge about climate change that acts as a barrier to the communication of arguments about climate change. In the next section, I will present a more detailed analysis of one of these barriers – uncertainty – and describe some forthcoming research (Corner, Whitmarsh, & Xenias, in press) that sheds light on how uncertainty impacts on the evaluation of arguments about climate change.

Uncertainty

Despite the overwhelming body of evidence showing that human activity is altering the global climate, debates about climate change are characterised by an enormous amount of *uncertainty* (Hulme, 2009; Zehr, 2000). Uncertainty is a multi-facetted and complex phenomenon, which is present in almost every debate about science and society (Friedman, Dunwoody, & Rogers, 1999). Some of the uncertainty about climate change stems from the science itself: important questions about the extent and impact of climatic changes remain unanswered. Many of the predicted effects of climate change are quantifiable but uncertain, and are only accurately expressed as probability distributions or ranges (see, e.g., UK Climate Impact Programme, 2009). As in economic forecasts, medical diagnoses and policy making, uncertainty is a fundamental feature of climate science. Yet, more uncertainty arises from policy debates about what constitutes 'dangerous' climate change (Lorenzoni, Pidgeon, & O'Connor, 2005; Oppenheimer, 2005) and which mitigation and adaptation measures will be required to prevent it. However, among ordinary members of the public, a substantial amount of uncertainty remains about the reality or seriousness of human-caused climate change.

While the everyday meaning of uncertainty is negative, as it is commonly equated with ignorance (Shome & Marx, 2009), uncertainty is not an enemy of science that

must be conquered. Rather, it is a stimulus that drives science forward. Pollack (2005) has suggested that there is a tendency for the media and non-scientists in general to infer from the fact that scientists do not know *everything* about a topic, that they do not know *anything* about it. This means that uncertainty can be problematic when people seek to evaluate arguments, evidence and media reports on climate change.

Some concerted attempts have been made at quantifying and communicating the uncertainties around climate science. In their most recent assessment report, the IPCC used specific terms to indicate the confidence with which particular conclusions were held (Pachauri & Reisinger, 2007). The term 'very likely' was used, for example, to indicate 90% confidence in a statement. By using numerically defined terms – Bayesian expressions of belief in a hypothesis based on scientific evidence – the IPCC hoped to quantify uncertainty in a meaningful way. However, the way that people interpret evidence about climate change is impacted by well-documented biases that influence judgments about numerical and non-numerical risk information (Pidgeon, Kasperson, & Slovic, 2003; Weber, 2006; Weber, 2010) and several studies have shown that the average person's interpretation of the verbal labels used by the IPCC does not match their intended meaning.

Budescu, Broomwell and Por (2009) found that there were significant discrepancies between the meaning intended by the IPCC in their risk statements and the numerical values that people assigned to them – even when people were provided with the numerical definitions of the verbal terms. Patt and Schrag (2003) proposed that the use of specific language to describe probability ranges in climate change risks – the strategy employed by the IPCC – tended to result in miscommunication. In a study designed to examine the relationship between the severity of an environmental risk and the numerical probability people assigned to a verbal description of it, Harris and Corner (2011) found that severe events such as volcanoes elicited higher probability judgments than more neutral events (even when the language used to describe the likelihood of these events occurring was held constant), suggesting that more severe outcomes are easier to 'simulate' in the imagination (Risen & Gilovich, 2007).

The communication of risk and uncertainty is a major challenge for the IPCC. However, the overwhelming majority of risk information that people receive about climate change comes not through formal IPCC reports (which are designed for policy makers), but through arguments summarising risk information presented by the media. Norris, Phillips, and Korpan (2003) studied university students' evaluations of brief scientific stories, found evidence that they overestimated the certainty with which they could make conclusions based on the data reported in the report and seemed to display an inflated view of how well they could understand the report.

Several analyses of media coverage of climate change have concluded that a discourse of uncertainty is unsuited to the typically adversarial style of English language journalism (e.g., Boykoff, 2007). Radio, television and newspaper reports have been criticised for interpreting too simplistically the notion of providing a 'balanced' set of views, which can lead to competing points of view on a scientific issue being presented as equal when in fact they are not (Zehr, 2000). While

there is evidence that this is changing (in the United Kingdom at least – Boykoff, 2007), Butler and Pidgeon (2009) have shown that people view the media as offering a range of viewpoints on climate change, creating the impression that the causes of climate change are more controversial than they in fact are. Corbett and Durfee (2004) have emphasised that the word 'uncertainty' need not be present in an article in order for the science to be portrayed as uncertain – all that is necessary is that 'duelling experts' are presented without any sense of how the weight of evidence is distributed.

Difficulties in interpreting scientific uncertainty can be overcome through a more structured process of evaluation. Ratcliffe (1999) studied the ability of 11–14-year-old pupils, 16–18-year-old college students and university graduates to evaluate the content of short articles taken from the *New Scientist* magazine. Participants were required to note any areas about which they felt uncertainty and to make a list of questions they would like to ask about the article. The graduates showed more advanced evaluative skills than the students and the students more advanced skills than the pupils (as measured by the taxonomy developed in Korpan, Bisanz, Bisanz, & Henderson, 1997); however, all age groups demonstrated relevant evaluation of the claim to some extent, acknowledging the role of uncertainty and recognising that the reports also contained established facts. Corbett and Dufree (2004) have argued that providing more 'context' for claims about climate change (i.e., general information about climatic trends alongside specific claims about individual phenomena) is an effective way of reducing the unintended communication of uncertainty.

However, while presentational devices may mitigate unintended uncertainty to some extent, uncertainty about climate change is often attributable to more deep-rooted and psychological differences. Studies in the United States that have suggested that scepticism about climate change is increasing (Pew Research Centre, 2009) have also demonstrated that public opinion about climate change in the United States is dividing along ideological lines. Supporters of the Republican Party are far more likely to express scepticism about anthropogenic climate change than the Democrats. In the United Kingdom, Whitmarsh (2011) found that between 2003 and 2008 public uncertainty about climate change remained constant in most respects. However, the belief that claims about climate change has been exaggerated almost doubled over that period from 15 to 29%. In addition, beliefs about climate change were strongly influenced by stated political affiliation, with conservative voters the most sceptical about the human causes of climate change.

A growing body of research by Dan Kahan and his colleagues at the Yale Centre for Cultural Cognition suggests that there may be an even more important factor than an individual's political preferences for predicting their attitude towards scientific risks such as climate change. Drawing on the long-standing anthropological work of Douglas and Wildavsky (1982), Kahan and his colleagues have demonstrated that people with opposing 'cultural worldviews' tend to polarise in their perception of the risks posed by climate change, as well as other areas of science and technology (Kahan et al., 2009). According to Kahan et al., people's cultural worldviews (their

beliefs about the relationship between nature and society and their attitudes towards risk and regulation) lead them to assimilate and integrate new information about science and technology in a biased way, such that following exposure to 'balanced' information about climate change, people's attitudes divide along cultural lines.

In fact, there is a long history of research in social psychology (Lord, Ross, & Lepper, 1979; Miller, McHoskey, Bane, & Dowd, 1993; Munro & Ditto, 1997) demonstrating that people with opposing views on controversial topics sometimes polarise when they receive new information. For example, when presented with balanced/mixed evidence for and against a hypothesis (e.g., the desirability of capital punishment), pro-capital punishment people become *more* convinced of their beliefs, while anti-capital punishment people become *more* convinced of theirs (Lord et al., 1979). Despite viewing the very same evidence, people report that their beliefs move in different directions.

Corner, Whitmarsh, and Xenias (in press) conducted an experiment with undergraduate students at Cardiff University to establish whether individuals who expressed different attitudes about climate change would evaluate uncertain evidence about climate change differentially. Drawing on the typology of uncertainty presented in Tannert, Elvers, and Jandrig (2007; see also Patt (2007), for a distinction between model-based and conflict-based uncertainty), Corner et al. presented participants with two newspaper 'editorials' that offered opposing arguments about climate change (the editorials were constructed for the purpose of the study). In one condition of the experiment, the two opposing articles focussed on climate science (one headline read 'We are as certain about climate change as we are about anything', while the other read 'If we can't predict the weather, how can we predict the climate?') and was designed to generate data-based or *epistemological* uncertainty. In the other condition, the two opposing articles focussed on *moral* uncertainty – one headline read 'US politicians are committing treason against the planet', while the other read 'Why are environmentalists exaggerating claims about climate change?'

Corner et al. asked participants to indicate how convincing and how reliable they found the two editorials to be, and reported that participants' evaluations of the editorials depended on their prior attitudes towards climate change – in particular, the extent to which they perceived climate change to be uncertain. For people who expressed lower levels of uncertainty about climate change, the pro-climate change editorials were rated as both more convincing and more reliable than the anti-climate change editorials. However, the opposite pattern was observed for individuals who expressed higher levels of uncertainty about climate change. These findings suggest that when presented with arguments about climate change, prior beliefs and attitudes towards climate change are likely to play an important role in how compelling these arguments will be. Arguments that seem compelling to those who are already persuaded of the reality or importance of climate change may not be as effective for people who are uncertain about climate change in the first place. Despite the fact that uncertainty is an inescapable part of any complex scientific topic, perceived uncertainty may play a critical role in determining the extent to which people accept arguments about climate change.

An irony of the debate about the uncertainty associated with predictions about climate change is that climate models sketch out possible, rather than inevitable futures. One crucial uncertainty that cannot be captured in any climate model is the extent to which action is taken to cut the emissions of greenhouse gases – something directly contingent on the public acceptance of arguments about climate change. The IPCC was initiated as a body that could assess the predictions made by climate models in order to give policy makers and the public some idea of what lies ahead. Climate models, replete with their inherent uncertainties about impacts and effects, provide policy makers with a critical opportunity to change course.

Preventing the negative consequences of climate change is of course central to the growing level of interest in how to better communicate about climate change. In the next section, I present quantitative data from an experiment with college students in South Wales that examined the way in which *consequentialist* arguments about climate change were evaluated.

The Consequences of Climate Change

Many scientific arguments about climate change are based on the *consequences* that our current actions will have for future generations. A dissuasive consequentialist argument (or deterrent) warns against a particular course of action on the grounds that it will lead to an undesirable outcome or consequence (Bonnefon & Hilton, 2004). We may be warned, for example, that if the global climate continues to increase in temperature, glacial ice will melt at an accelerated rate, sea levels will rise and low lying homes will be flooded. This is certainly a negative consequence, but avoiding it might require personal sacrifices that many consider unacceptable. For example, the aviation industry is one of the fastest growing sources of carbon dioxide emissions in the world (Bows, Upham, & Anderson, 2005). It may be the case that the use of aeroplanes will be curbed or restricted in some way in the future, although this is a sacrifice that few are currently willing to make as a method of reducing carbon dioxide emissions (Defra, 2008). Presumably, this is because people find the prospect of international travel less appealing if large distances cannot be covered quickly using an aeroplane. The negativity of the outcome (i.e., the adverse effects of climate change) must be balanced against the personal cost involved in avoiding it.

In 2007, 64 students aged 16–18 from three schools in South Wales took part in an experiment where they were required to evaluate the strength of consequentialist arguments. The experiment was part of a project called 'Evaluating Scientific Arguments', which was an initiative designed to engage young people in a scientific activity. The experiment followed the design of the 'Consequentialist Arguments Task' reported in Corner and Hahn (2009) and was designed to replicate the results of this study with a different sample. Two features of the consequentialist arguments were varied – the negativity of the outcome and the sacrifice required to avoid the outcome in the experiment – creating four experimental conditions:

1. Very negative outcome/small sacrifice required
2. Less negative outcome/small sacrifice required
3. Very negative outcome/big sacrifice required
4. Less negative outcome/big sacrifice required

Participants were required to evaluate one consequentialist argument about a scientific topic (flooding caused by climate change) and one consequentialist argument about a non-scientific topic (sleeping through an alarm clock). Each individual participant contributed data to two (randomly selected) conditions of the experiment – one for each argument topic. Participants were asked to indicate how convincing they found the arguments, on a scale from 0 (very unconvincing) to 10 (very convincing).

The four variations of the climate change argument were as follows:

1. "If global warming continues at the current rate, it will cause the sea levels to rise and 10,000 people in Britain will lose their homes within 5 years. To prevent this, we must switch all the light bulbs in our houses to energy efficient ones." (Very negative outcome/small sacrifice)
2. "If global warming continues at the current rate, it will cause the sea levels to rise and 1,000 people in Bangladesh will lose their homes in 50 years time. To prevent this, we must all never use an aeroplane to go on holiday ever again." (Less negative outcome/big sacrifice)
3. "If global warming continues at the current rate, it will cause the sea levels to rise and 10,000 people in Britain will lose their homes within 5 years. To prevent this, we must all never use an aeroplane to go on holiday ever again." (Very negative outcome/big sacrifice)
4. "If global warming continues at the current rate, it will cause the sea levels to rise and 1,000 people in Bangladesh will lose their homes in 50 years time. To prevent this, we must switch all the light bulbs in our houses to energy efficient ones." (Less negative outcome/small sacrifice)[1]

The non-scientific argument followed a similar format, but involved walking a short or long distance (level of sacrifice) in order to buy batteries for an alarm clock

[1] That the experiment contrasted the prospect of people in Bangladesh losing their homes with people in the United Kingdom losing their homes does not indicate that the housing security of British citizens is of greater value than that of Bangladeshi citizens. Rather, it was an attempt to render the negative outcome not only *more negative* (in the sense that 10,000, rather than 1,000 people's homes were at risk and in 5, rather than 50 years time), but also *more relevant* (based on the assumption that a typical 16–18-year-old British citizen has more empathy with the security of houses in their own country within the next 5 years than the security of houses in a foreign country within the next 50 years). Bangladesh was selected as a comparison country simply because as a geographically low-lying nation, it faces very real threats from rising sea levels attributable to human-caused climate change.

that was necessary to wake up in time for an important exam or an ordinary 'non-work' day (negativity of outcome).

Corner and Hahn (2009) used the framework of Bayesian decision theory to make predictions about the strength of consequentialist arguments (Edwards, 1961; Keeney & Raiffa, 1976; Savage, 1954). Applying decision theory to consequentialist arguments, the more (subjective) negative utility there is associated with a consequence, the stronger that consequentialist argument should be (Corner, Hahn, & Oaksford, 2006; Hahn & Oaksford, 2006, 2007). As the perceived negativity of the outcome and the level of sacrifice required to avoid it both contribute to the subjective utility of a consequentialist argument, Corner and Hahn (2009) predicted and found that both these factors influenced the strength of scientific and non-scientific consequentialist arguments. Arguments containing more negative outcomes were rated as significantly stronger than arguments containing less negative outcomes, while arguments requiring a smaller sacrifice were rated as significantly stronger than arguments requiring a bigger sacrifice. Figure 10.1 displays the ratings of argument strength obtained from participants in each condition of the current experiment.

An analysis of variance (ANOVA) was conducted with outcome negativity (very negative vs. less negative), level of sacrifice (big sacrifice vs. small sacrifice) and topic (scientific vs. non-scientific) as independent variables. Only level of sacrifice had a significant effect on baseline ratings of argument strength (F (1, 124) = 18.83, $p < 0.001$), meaning that neither the negativity of the outcome nor the topic of the argument had a statistically significant effect on participants' ratings of argument strength.

The results suggest that participants were highly sensitive to the level of sacrifice in the arguments. Where a high level of sacrifice was required, people assigned a

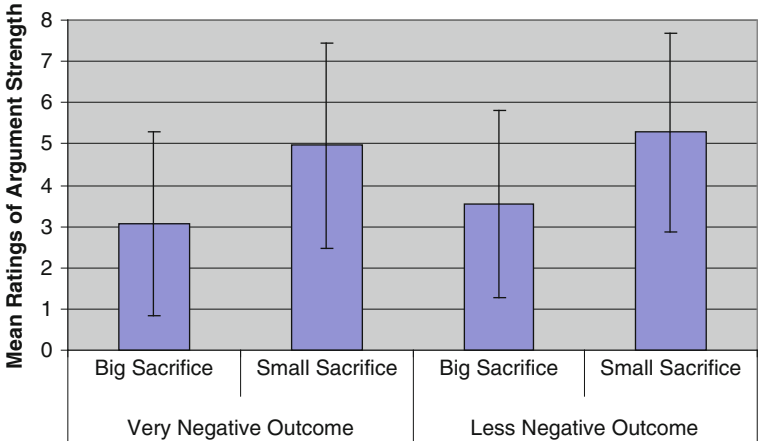

Fig. 10.1 Mean baseline ratings of argument strength (scientific and non-scientific topics combined). Error bars represent one standard deviation

significantly lower rating of strength to the argument.[2] Could this be part of the reason that many people remain unconvinced by the evidence for climate change?

Research on the use of fear appeals in persuasive communication suggests that there is a danger of inducing defensive reactions if the severity of the message is too high (de Vries, Ruiter, & Leegwater, 2002), and that simply increasing severity does not necessarily add to the persuasive impact of a message (Hoog, Stroebe, & de Wit, 2005). This kind of defensive reaction is all the more likely where the behaviour targeted is highly valued, pleasurable or central to one's identity – as in the case of many energy-intensive activities (Randall, 2009). Most people in the United Kingdom do not feel personally threatened by climate change (Lorenzoni et al., 2007; O'Neill & Nicholson-Cole, 2009) which means that doomsday scenarios and apocalyptic language are unlikely to be effective communication strategies. Research also suggests that if climate change risks are perceived as temporally or geographically distant, then they are likely to be psychologically discounted (APA, 2009; Spence et al., 2011; Uzzell, 2000).

The results of this experiment suggest that there is an additional factor to consider in constructing arguments about climate change that contain negative consequences – that the convincingness of these arguments will be partly dependent on the *sacrifice* that is required to avoid the negative outcome. Promoting environmental behaviour may be more effectively achieved by emphasising the positive effects of pro-environmental behaviours (e.g., the health benefits of cycling rather than using a car), although constructing an artificially positive 'spin' on messages that ultimately require a certain level of sacrifice may be problematic in the longer term (Randall, 2009). For example, while the prospect of saving money may motivate energy saving behaviours in the home, Thogersen and Crompton (2009) have argued that it does not trigger critical psychological mechanisms that make the performance of *other* pro-environmental behaviours more likely. In general, people like to avoid feeling hypocritical and will take steps to avoid any *dissonance* between their actions (Cooper & Fazio, 1984; Festinger, 1957). However, people saving energy for financial reasons will feel no obligation to save energy when these reasons are

[2] An additional difference between changing light bulbs and refraining from using aeroplanes (other than the magnitude of the sacrifice) is that they may impact on the prevention of the outcome in different ways. If people *were* to stop using aeroplanes, this would reduce greenhouse gas emissions more than swapping over to energy efficient light bulbs. This difference in the *efficacy* of the sacrifice is not present in the non-scientific argument – walking 2 minutes to the shop is no less effective as a method of buying batteries than walking 3 miles; it is simply more of a sacrifice. However, there are two indications that this potentially confounding effect does not seem to have influenced the outcome of the experiment. Firstly, if participants in the experiment were paying attention to this difference in efficacy, the arguments containing big sacrifices should have been rated as *more* compelling than the arguments containing small sacrifices. However, this was not the case. Secondly, no differences were observed in the impact of the level of sacrifice variable between the scientific and non-scientific arguments. It would seem, therefore, that participants treated the arguments as representing greater and lesser sacrifices, rather than more or less effective methods of avoiding the negative outcome.

absent – they might switch off appliances at home (where they pay the bills), for example, but leave them on at work (where they do not).

The picture that is starting to be built up around the efficacy of employing different types of arguments to communicate climate change is complex. However, the results of this experiment suggest that there is a compromise to be struck between being honest about the negativity of the predicted effects of climate change and avoiding disengaging people through ill-considered fear appeals. Supporting the findings reported in Corner & Hahn (2009), paying attention to the perceived sacrifice contained in an argument about the consequences of climate change is an important determinant of its strength.

Of course, consequentialist arguments about the behaviour required to avoid a particular outcome are about far more than just climate change science – they are normative statements about behaviour and policy. In the next section, I use a recent controversy over climate change communication to illustrate why the indeterminate lines between climate science, climate change communication and climate change advocacy may act as a barrier to communicating arguments about climate science itself.

Trust in the Communicators of Climate Change Arguments

Until fairly recently, science was typically viewed as value free and apolitical – a lack of trust in science and scientists was not something of concern. This view was challenged by some high profile scientific controversies (such as the debate over agricultural biotechnology – Walls, Rogers-Hayden, Mohr, & O'Riordan, 2005) and social scientists who highlighted the role of social and cultural influences in science (e.g., Irwin & Wynne, 1996; Collins & Evans, 2007). The picture of science that emerged was one that stressed the importance of the scientific community as the location and source of legitimation of scientific norms, judgements and knowledge – but not one that viewed science as *value free*.

Climate change provides perhaps the most compelling example of the ways in which political interests, personal involvement or corporate allegiances can colour the interpretation of scientific evidence. In October 2007, the IPCC and the American politician Al Gore won the Nobel Peace Prize. The IPCC was recognised for

> Efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change. (www.ipcc.ch)

Al Gore was recognised for his film, *An Inconvenient Truth*, which attempts to translate the science of the IPCC and make it accessible to the widest possible audience. As a piece of science communication, it is a tour de force – the content of the film is dominated by scientific evidence, graphs and statistics. Evidence of the uncontroversial nature of the film and its message can be found in the British Government's decision to send the film to every secondary school in the United

Kingdom, as an educational tool for teaching about the effects of climate change. However, some of the arguments in the film are also clearly political: urgent action is required if the worst predicted effects of human-caused climate change are to be avoided.

In the same week as Gore received his Nobel Peace Prize, a British High Court judge ruled that there were nine errors in *An Inconvenient Truth* and that the film should be accompanied by guidance for schools, pointing these errors out. Although the judge was careful to emphasise that the film's main arguments were based on uncontroversial scientific data, the effect of the ruling was to create some doubt about the reliability of the evidence presented in the film.

Viewers of the film may have had their reservations moderated by the knowledge that Stewart Dimmock, the claimant who brought the case against the government, was funded by a Scottish quarrying magnate who has a track record of lobbying against environmentalist groups. However, the example highlights many of the issues associated with the public evaluation of arguments about climate change. To the extent that science was being debated, the participants were not scientists but a politician, a lobbyist, lawyers and a judge, while the public learnt about the debate indirectly through its reporting in the news and other media. The lines between the science of climate change, the communication of climate change science and normative policy or behavioural recommendations based on climate science are indeterminate and blurry.

In *Why We Disagree About Climate Change*, Hulme (2009) proposed that while 'climate change' has a physical meaning – literally the changes in patterns of weather over a period of time – it also has a *social* meaning and many competing and overlapping narratives have developed around the *idea* of climate change. According to Hulme, people use climate change to tell stories about human progress and disagree about how to respond to climate change because it (socially) means very different things to different people. Thus, when evaluating arguments about seemingly 'objective' facts about temperature variation, ocean acidification or biodiversity loss, an awful lot of ideological baggage may be weighing people's judgements behind the scenes.

Because climate change has different social meanings, messages about climate change are 'framed' in very different ways – and how a message is framed is an important determinant of how persuasive or effective it is (Corner & Hahn, 2010), particularly for different audiences (Nisbett, 2009). According to Nisbett, frames are "interpretive storylines that set a specific train of thought in motion, communicating why an issue might be a problem, who or what might be responsible for it, and what should be done about it" (Nisbett, 2009). Certain words activate certain frames – for example, the words 'protecting the environment' trigger a conceptual framing of the environment as external to human behaviour – something distinct to 'be protected' rather than inextricably linked to human behaviour (Lakoff, 2010). Arguments about international climate change policy – for example, the provision of finance for an adaptation fund – tend to focus on *fairness* and *justice*. Concerns about domestic energy policy are often couched in terms of *threat* or *security*. At the individual level, the most frequent frame for climate change messages in the United Kingdom

is the *financial gain* or *personal benefit* that pro-environmental behaviour may bring (see, e.g., Defra, 2008). Different frames tend to be utilised by different information sources – and the trustworthiness of these sources is central to the persuasiveness of their arguments.

There is empirical evidence that suggests that trust in science (and scientists) as reliable sources of information is essential for arguments about climate change to be perceived as convincing (Corner & Hahn, 2009; Hahn, Harris, & Corner, 2009). In an experiment with undergraduate students, Corner and Hahn (2009) found that participants were particularly sensitive to the reliability of sources of scientific information. While sources presenting strong scientific arguments were rated as *more* reliable than sources presenting non-scientific arguments, when scientific sources presented weak arguments they were perceived as *less* reliable than non-scientific sources presenting weak arguments. Corner and Hahn (2009) concluded that weak scientific arguments reflect badly on the perceived reliability of scientific sources and suggested that contradictory scientific evidence may impact badly on perceptions of scientists themselves – which will then feed into the evaluation of scientific messages.

A study conducted by Malka et al. (2009) supports this conclusion. Malka et al. conducted a telephone survey with participants in the United States to establish whether people who trusted scientists responded differently to information about climate change compared to people who did not trust scientists. The study found that increased knowledge about climate change was positively correlated with increased concern about climate change – but only among those individuals who reported trusting scientists. Among those individuals who expressed distrust towards scientists, additional knowledge about climate change had no impact on their level of concern – that is, the effect of the argument was moderated by the trust that participants expressed towards scientists.

Another recent event highlighted just how important public trust in climate science is. In November 2009, less than a month before the highly publicised climate change negotiations at the United Nations Conference of Parties in Copenhagen, a series of private email exchanges between members of the Climate Research Unit (CRU) at the University of East Anglia (UEA) in the United Kingdom and external collaborators were illegally published on the internet. Initial reports focussed on a handful of emails involving Professor Phil Jones, the head of CRU, which were said to contain evidence of climate scientists seeking to suppress inconvenient data and subvert the peer-review process. In the months following the release of the emails, a House of Commons Science and Technology Committee inquiry found no evidence of wrongdoing by Phil Jones or his colleagues. A separate independent investigation – a Science Assessment Panel comprised of climate scientists from other institutions – found no evidence of dishonesty or impropriety. However, the event received media attention around the world, generating a significant amount of controversy, and the incident became widely known as ‘climategate’.

The British Broadcasting Corporation (BBC) opinion polls conducted around the time of the incident found that the percentage of the public agreeing that climate change is ‘largely man-made’ fell from 50 to 34% between November 2009

and February 2010 (BBC, 2010). The BBC data were supported by evidence from the United States, where several polls had indicated a substantial increase in scepticism towards climate change in the second half of 2009 (e.g., Pew Research Centre, 2009). Media commentators began to speculate about the impact of the UEA emails on public opinion. However, data collected by Corner et al. (in press) from university students found that most of the students had heard little or nothing about the email controversy, despite a significant amount of coverage in the UK press. Interestingly, among the students who had heard about the event, only 25% reported becoming more sceptical about climate change because of it.

While 'climategate' did not seem to alter their belief in the reality of climate change, Corner et al. found that the incident had a negative impact on participants' perceptions of the trustworthiness of climate scientists. This finding fits with the conclusions of Corner and Hahn (2009) – arguments containing 'mixed messages' produced lower judgments of source reliability – an effect that was strongest for arguments about scientific topics. Scientific controversies may lead to sources of scientific arguments being perceived as less reliable, undermining their ability to construct compelling and trustworthy arguments in the future. A critical factor in the acceptability of arguments about climate change is the extent to which the general public trust the communicators of the arguments.

Conclusion

In this chapter, I have sought to examine four challenges in the communication of climate change that all have a direct bearing on the way that people evaluate arguments about climate change – knowledge about climate change, uncertainty about climate change, the negative consequences of climate change and trust in the communicators of climate change arguments. The four challenges I have focussed on are by no means the only barriers to the successful communication of climate change. The 'social' barriers to engagement with climate change identified by Lorenzoni et al. (2007) include such diverse factors as a lack of pro-environmental social norms and concern about 'free riders' who might reap the rewards of others making behavioural sacrifices as a response to messages about climate change.

However, the analyses in this chapter do shed some light on the sorts of concerns that anyone interested in communicating about climate change must consider. In particular, and in keeping with Hulme (2009), this chapter demonstrates that the relationship between climate change (as a scientific phenomenon) and the construction of climate change (as a social phenomenon) is complex and challenging. But a consideration of the ways in which people evaluate arguments about climate change does at least highlight the considerable potential for social science researchers to contribute towards the goal of making climate change communication more effective.

The research presented in this chapter has some practical implications for climate change communicators. While structured education programmes are likely to enhance engagement with climate change, simply bombarding individuals with

more and more information about climate change is unlikely to be an effective communication tactic. Similarly, a consideration of the way in which people evaluate consequentialist arguments about climate change suggests that a seemingly persuasive argument that revolves around the negative consequences of climate change will be mediated by the level of sacrifice required by the recipient of the argument. Uncertainty is an unavoidable aspect of communicating climate change, but paying more attention to the prior attitudes and beliefs of the recipients of climate change arguments might help to predict how they will respond to uncertain evidence. Trustworthy communicators are essential for arguments about climate change to seem compelling – and people seem especially sensitive to the reliability of sources presenting scientific messages.

A major factor influencing the extent to which the negative impacts of climate change will be mitigated is the level of public engagement with climate change and an international preparedness to support and promote sustainability policies and behaviours. The way that people evaluate arguments about climate change is an important determinant of their level of engagement. This means that there is a pressing need for argumentation scholars (and social researchers more broadly) to conduct and communicate research on the way that ordinary people respond to arguments about climate change. This chapter represents a small contribution to that goal.

Acknowledgements I would like to thank Ulrike Hahn, who co-designed the experiment reported in this chapter, and Lorraine Whitmarsh and Rob Evans for helpful comments on earlier versions of this chapter.

References

Adams, S. (1999). Critiquing claims about global warming from the world wide web: A comparison of high school students and specialists. *Bulletin of Science, Technology & Society, 19*(6), 539–543.

American Psychological Association Task Force on the Interface Between Psychology and Global Climate Change. (2009). *Psychology and global climate change: Addressing a multi-faceted phenomenon and set of challenges*. Washington, DC: American Psychological Association.

Bonnefon, J. F., & Hilton, D. J. (2004). Consequential conditionals: Invited and suppressed inferences from valued outcomes. *Journal of Experimental Psychology: Learning, Memory & Cognition, 30*(1), 28–39.

Bord, R. J., O'Connor, R. E., & Fischer, A. (2000). In what sense does the public need to understand global climate change? *Public Understanding of Science, 9*, 205–218.

Bows, A., Upham, P., & Anderson, K. (2005). *Growth scenarios for EU & UK aviation: Contradictions with climate policy*. Report for Friends of the Earth Trust Ltd.

Boykoff, M. (2007). Flogging a dead norm? Media coverage of anthropogenic climate change in United States and United Kingdom, 2003–2006. *Area*, *39*(4), 470–481.

British Broadcasting Corporation. (2010). *BBC Climate Change Poll – February 2010.* Retrieved May 1, 2010, from http://news.bbc.co.uk/nol/shared/bsp/hi/pdfs/05_02_10climatechange.pdf

Budescu, D. V., Broomell, S., & Por, H. (2009). Improving communication of uncertainty in the reports of the intergovernmental panel on climate change. *Psychological Science, 20*, 299–308.

Butler, C., & Pidgeon, N. (2009). Media communications and public understanding of change – reporting scientific consensus on anthropogenic climate change. In T. Boyce & J. Lewis (Eds.), *Climate change and the media* (pp. 43–58). New York: Peter Lang.

Collins, H. M., & Evans, R. (2007). *Rethinking expertise.* Chicago: University of Chicago Press.

Cooper, J., & Fazio, R. H. (1984). A new look at dissonance theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 17, pp. 229–266). New York: Academic.

Corbett, J. B. & Durfee, J. L. (2004). Testing public (un)certainty of science: Media representations of global warming. *Science Communication, 26*, 129–151.

Corner, A., & Hahn, U. (2009). Evaluating scientific arguments: Evidence, uncertainty & argument strength. *Journal of Experimental Psychology: Applied, 15*(3), 199–212.

Corner, A., & Hahn, U. (2010). Message framing, fallacy & normative advocacy. *Argumentation, 24*(2), 153–163.

Corner, A., Hahn, U., & Oaksford, M. (2006). The slippery slope argument: Probability, utility and category boundary re-appraisal. In *Proceedings of the 28th annual conference of the cognitive science society* (pp. 1145–1151). Vancouver: Cognitive Science Society.

Corner, A., Whitmarsh, L., & Xenias, D. (in press). Trust, uncertainty and attitudes towards climate change. *Climatic Change*.

Defra. (2008). *A framework for pro-environmental behaviours*. Retrieved January 8, 2010, from http://www.defra.gov.uk/evidence/social/behaviour/documents/behaviours-jan08-report.pdf

de Vries, N., Ruiter, R., & Leegwater, Y. (2002). Fear appeals in persuasive communication. In: G. Bartels & W. Nelissen (Eds.), *Marketing for sustainability: Towards transactional policy making* (pp. 96–104). Amsterdam, The Netherlands: IOS Press.

Doran, P. T., & Zimmerman, M. K. (2009). Examining the scientific consensus on climate change. *EOS, Transactions American Geophysical Union, 90*(3), 22–23.

Douglas, M., & Wildavsky, A. (1982). *Risk and culture: An essay on the selection of technological and environmental dangers.* Berkley, CA: University of California Press.

Dunlap, R., & McCright, A. M. (2008). A widening gap: Republican and democratic views on climate change. *Environment, 50*(5), 26–35.

Edwards, W. (1961). Behavioural decision theory. *Annual Review of Psychology, 12*, 473–498.

Festinger, L. (1957). *A theory of cognitive dissonance.* Stanford, CA: Stanford University Press.

Friedman, S. M., Dunwoody, S., & Rogers, C. L. (Eds.). (1999). *Communicating uncertainty: Media coverage of new and controversial science.* Hillsdale, NJ: Erlbaum.

Hahn, U., Harris, A. J. L., & Corner, A. (2009). Argument content and argument source – and exploration. *Informal Logic, 29*(4), 337–367.

Hahn, U., & Oaksford, M. (2006). A Bayesian approach to informal fallacies. *Synthese, 152*, 207–237.

Hahn, U., & Oaksford, M. (2007). The rationality of informal argumentation: A Bayesian approach to reasoning fallacies. *Psychological Review, 114*, 704–732.

Harris, A. J. L., & Corner, A. (2011). Communicating environmental risks: Clarifying the severity effect in interpretations of verbal probability expressions. *Journal of Experimental Psychology: Learning, Memory, and Cognition.* Advance online publication. doi: 10.1037/a0024195

HM Government. (2008). *Climate change bill*. London. Retrieved January 2010, from http://www.publications.parliament.uk/pa/ld200708/ldbills/087/2008087.pdf

Hogg, M., & Shah, H. (2010). *The impact of global learning on public attitudes and behaviours towards international development and sustainability.* Development Education Authority, UK.

Hoog, N., Stroebe, W., & de Wit, J. B. F. (2005). The impact of fear appeals on processing and acceptance of action recommendations. *Personality & Social Psychology Bulletin, 31*, 24–33.

Hulme, M. (2009). *Why we disagree about climate change: Understanding controversy, inaction and opportunity*. Cambridge: Cambridge University Press.

Irwin, A., & Wynne, B. (Eds.). (1996). *Misunderstanding science? The public reconstruction of science and technology.* Cambridge, MA: Cambridge University Press.

Kahan, D. M., Braman, D., Slovic, P., Gastil, J., & Cohen, G. (2009). Cultural cognition of the risks and benefits of nanotechnology. *Nature Nanotechnology, 4*(2), 87–90.

Keeney, R. L., & Raiffa, H. (1976). *Decisions with multiple objectives: Preferences and value tradeoffs.* New York: Wiley.

Korpan, C. A., Bisanz, G. L., Bisanz, J., & Henderson, J. M. (1997). Assessing literacy in science: Evaluation of scientific news briefs. *Science Education, 81*, 515–532.

Lakoff, G. (2010). We are the polar bears: What's wrong with the way the environment is understood. In *From Hot Air to Happy Endings: How to inspire public support for a low carbon economy*. London: Green Alliance.

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), 2098–2109.

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

Lorenzoni, I., Pidgeon, N. F., & O'Connor, R. E. (2005). Dangerous climate change: The role for risk research. *Risk Analysis, 25*(6), 1287–1398.

Maio, G., Verplanken, B., Manstead, T., Stroebe, W., Abraham, C., Sheeran, P., & Conner, M. (2007). Social psychological factors in lifestyle change and the relevance to policy. *Social Issues & Policy Review, 1*(1), 99–137.

Malka, A., Krosnick, J. A. & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis, 29*, 633–647.

McKenzie-Mohr, D., & Smith, W. (1999). *Fostering sustainable behavior: An introduction to community-based social marketing*. Canada: New Society Publishers.

Miller, A. G., McHoskey, J. W., Bane, C. M., & Dowd, T. G. (1993). The attitude polarization phenomenon: Role of response measure, attitude extremity, and behavioural consequences of reported attitude change. *Journal of Personality and Social Psychology, 64*(4), 561–574.

Munro, G. D., & Ditto, P. H. (1997). Biased assimilation, attitude polarization, and affect in reactions to stereotype-relevant scientific information. *Personality & Social Psychology Bulletin, 23*(6), 636–653.

Nisbett, M. (2009). Communicating climate change: Why frames matter for public engagement. *Environment, 51*(2), 514–518.

Norris, S. P., Phillips, L. M., & Korpan, C. A. (2003). University students' interpretation of media reports of science and its relationship to background knowledge, interest and reading difficulty. *Public Understanding of Science, 12*, 123–145.

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*, 355–379.

Oppenheimer, M. (2005). Defining dangerous anthropogenic interference: The role of science, the limits of science. *Risk Analysis, 25*(6), 1399–1407.

Pachauri, R. K., & Reisinger, A. (Eds). (2007). *Climate change 2007: Synthesis report*. Geneva: IPCC.

Patt, A. (2007). Assessing model-based and conflict-based uncertainty. *Global Environmental Change, 17*, 37–46.

Patt, A. G., & Schrag, D. P. (2003). Using specific language to describe risk and probability. *Climatic Change, 61*, 17–30.

Pew Research Centre for the People and the Press. (2009). *Fewer Americans see solid evidence of global warming.* Retrieved January 2010, from http://people-press.org/report/556/global-warming

Pidgeon, N. F., Kasperson, R. K., & Slovic, P. (2003). *The social amplification of risk.* Cambridge: Cambridge University Press.

Pollack, H. N. (2005). *Uncertain science . . . uncertain world.* Cambridge, U K: Cambridge University Press.

Randall, R. (2009). Loss and climate change: The cost of parallel narratives. *Ecopsychology, 1*(3), 118–129.
Ratcliffe, M. (1999). Evaluation of abilities in interpreting media reports of scientific research. *International Journal of Science Education, 21*, 1085–1099.
Risen, J. L., & Gilovich, T. (2007). Another look at why people are reluctant to exchange lottery tickets. *Journal of Personality and Social Psychology, 93*, 12–22.
Savage, L. J. (1954). *The foundations of statistics*. New York: Wiley.
Shome, D., & Marx, S. (2009). *The psychology of climate change communication: A guide for scientists, journalists, educators, political aides and the interested public.* Columbia: Centre for Research on Environmental Decisions.
Spence, A., Pidgeon, N., & Uzzell, D. (2009). Climate change – psychology's contribution. *The Psychologist, 22*, 108–111.
Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. (2011). Perceptions of climate change and willingness to save energy related to flood experience. *Nature Climate Change, 1*(1). doi:10.1038/NCLIMATE1059
Stern, P. C. (2000). Towards a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*(3), 407–424.
Tannert, C., Elvers, H. D., & Jandrig, D. (2007). The ethics of uncertainty: In the light of possible dangers, research becomes a moral duty. *European Molecular Biology Organisation Reports, 8*(10), 892–896.
Thøgersen, J., & Crompton, T. (2009). Simple and painless? The limitations of spillover in environmental campaigning. *Journal of Consumer Policy, 32*, 141–163.
UK Climate Impacts Programme. (2009). *Adapting to climate change: UK climate projections*. Retrieved November 2009, from http://ukclimateprojections.defra.gov.uk/content/view/824/517/
Upham, P., Whitmarsh, L., Poortinga, W., Purdam, K., Darnton, A., McLachlan, C., et al. (2009) *Public attitudes to environmental change: A selective review of theory and practice.* A research synthesis for the Living with Environmental Change Programme, Research Councils UK.
Uzzell, D. L. (2000). The psycho-spatial dimensions of global environmental problems. *Journal of Environmental Psychology, 20*(4), 307–318.
Walls, J., Rogers-Hayden, T., Mohr, A., & O'Riordan, T. (2005). Seeking citizens' views on GM Crops – Experiences from the United Kingdom, Australia, and New Zealand. *Environment, 47*(7), 22–36.
Weber, E. U. (2006). Evidence-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change, 77*, 103–120.
Weber, E. U. (2010). What shapes our perceptions of climate change? *Wiley Interdisciplinary Reviews: Climate Change.* doi:10.1002/wcc.41
Western Strategies & Lake Research Partners. (2009). *Climate and energy truths: Our common future.* Washington, DC: EcoAmerica.
Whitmarsh, L. (2008). Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research, 11*(3), 351–374.
Whitmarsh, L. (2011). Scepticism and uncertainty about climate change: Dimensions, determinants and change over time. *Global Environmental Change, 21*, 690–700.
WRAP/WI. (2008). *Love food champions report.* Retrieved June 2009, from http://www.wrap.org.uk/retail/case_studies_research/report_love_food.html
Zehr, S. (2000). Public representations of scientific uncertainty about global climate change. *Public Understanding of Science, 9*, 85–103.