

The future that may (or may not) come:

How framing changes responses to uncertainty in climate change communications

Thomas A. Morton, Anna Rabinovich, Dan Marshall, & Pamela Bretschneider

University of Exeter, UK

In press, Global Environmental Change

Acknowledgment: Thanks to Tim Kurz for feedback on an earlier draft. This work was funded by EPSRC grant (no. EP/F038305/1) to the first author and by GWR Fellowship (n0. 15) to the second author.

Address correspondence to Thomas Morton, School of Psychology, University of Exeter, Exeter, EX4 4QG, United Kingdom. (Ph: +44 1392 264625; Fax: +44 1392 264623). E-mail: T.Morton@exeter.ac.uk

Abstract

Communicating possible effects of climate change inevitably involves uncertainty. Because people are generally averse to uncertainty, this activity has the potential to undermine effective action more than stimulate it. The present research considered how framing climate change predictions differently might moderate the tendency for uncertainty to undermine individual action. Two studies ($Ns = 88$ & 120) show that higher uncertainty combined with a negative frame (highlighting possible losses) decreased individual intentions to behave environmentally. However when higher uncertainty was combined with a positive frame (highlighting the possibility of losses not materializing) this produced stronger intentions to act. Study 2 revealed that these effects of uncertainty were mediated through feelings of efficacy. These results suggest that uncertainty is not an inevitable barrier to action, provided communicators frame climate change messages in ways that trigger caution in the face of uncertainty.

Keywords: Uncertainty, framing, climate change, communication, intentions

1. INTRODUCTION

Communicating climate change in ways that inspire individual action is complicated by a number of features inherent to the climate change message. Although it may be one of the most important issues currently facing humanity, as an issue of personal concern climate change remains quite distant from the lives and thoughts of most individuals, at least in the developed world (Postmes, Rabinovich, Morton, & van Zoomeeren, forthcoming; Swim et al., 2009). Despite scientific consensus over the existence of human-caused climate change (IPCC, 2007), there remains considerable uncertainty over the precise extent, time-scale, and consequences of climate change. Indeed, the (un)certainty of climate science has become a prominent issue in the public eye. Partly this controversy reflects a disjuncture between what the public expects of science and what scientists themselves can convey. From the latter perspective, being explicit about uncertainties is important for good science. From the public's perspective, however, uncertainty compromises the perception of scientific authority. Because of this, managing uncertainty is a key issue for those who are engaged in the process of climate change communication.

This raises a number of important questions. Principally how can these two orientations—scientific goals to be explicit about uncertainties versus the desire certainty among lay audiences—be reconciled in ways that maximise the impact of climate change messages? The aim of the present research was to begin to address this issue by exploring the framing of climate change messages and how this might determine whether uncertainty leads to issue avoidance or engagement among the audience. Before presenting two studies that explored this issue, we briefly review the academic literature on the role of uncertainty and framing in climate change communication.

1.1 Communicating uncertainty about climate change

Uncertainty attached to the climate change message is likely to have important consequences for individual thought and behaviour in this domain. A considerable body of research has established that people are generally averse to uncertainty and vagueness (Camerer & Weber, 1992; Curley, Yates & Abrams, 1986; Ellsberg, 1961; Fox & Weber, 2002; Highhouse, 1994; Keren & Gerritsen, 1999). Accordingly, people are reluctant to take action in response to information that comes with uncertainty (e.g., Tversky & Shafir, 1992; van Dijk and Zeelenberg, 2003). More than this, communicating uncertainty can actively interfere with adaptive behaviour. For example, Hine and Gifford (1996) showed how environmental uncertainty influences behaviour toward collectively shared resources. Increasing uncertainty (e.g., about the extent of a shared resource or the degree to which it might be replenished) increased individual tendencies to act in their own self-interest rather than for the collective good. This experimental situation has many parallels to current environmental dilemmas. For example, although fossil fuel reserves are declining, uncertainty around the rate of this may allow people to defer personal restraint in energy consumption.

The effect of uncertainty on individual behaviour is thought to be driven by a range of processes. Cognitively, increasing uncertainty in communication increases the demands on the audience's ability to understand: Statements of certainty are easier to decipher and respond to than statements of uncertainty (Tversky & Shafir, 1992). Motivationally, uncertainty about negative futures can allow people to maintain a relatively optimistic stance about current behaviour (see also Budescu et al., 1990; Rapoport et al., 1992) and may provide a convenient justification for self-interested actions (Hine & Gifford, 1996, see also Curley, et al 1986). For example, when faced with uncertainty, people may well adopt the attitude that "if we don't know what will

happen in the future, why should I take action now?” Finally, uncertainty about the future can threaten individual needs for predictability and control (Fiske, 2004; Lopes, 1987; van den Bos & Lind, 2002). When uncertainty triggers feelings of threat, this might lead to coping processes such as denial as people try to regain feelings of control over their environment (e.g., Langford, 2002; Rogers, 1975, 1983).

While the above suggests that communicating uncertainty is unwise when trying to motivate people to take action, human behaviour is not always maladaptive in the face of uncertainty. Uncertainty about the future sometimes leads people to be cautious and to act in ways that seek to avoid possible negative outcomes (e.g., through taking insurance). A range of psychological perspectives, mainly from the domain of health psychology, suggest that one key determinant of action is the feeling of efficacy (e.g., Ajzen, 1991; Bandura, 1977). When people feel as though they personally have the capacity to act effectively (self-efficacy), and that advocated behaviour could successfully avoid negative outcomes (response-efficacy), feelings of threat and uncertainty may lead to action rather than denial (e.g., Prentice-Dunn & Rogers, 1986; Rutter, Abraham, & Kok, 2001). In situations where uncertainty cannot be avoided, it would seem important to ensure that people feel empowered to take effective action in response (Grothmann & Patt, 2005). In the absence of efficacy, additional uncertainty is more likely to contribute to denial and defensiveness as people focus their attention on coping rather than responding.

1.2 Message framing and responses to uncertainty

The potential for uncertainty to trigger confusion, disengagement, defensiveness and denial, raises the question of whether it is possible to incorporate uncertainty into scientific communications in ways that do not result in inaction. One solution to this problem may lie in how uncertain messages are framed. When

communicating the future possibilities, communicators always have a choice about how to present their message. For example, a 20% chance of death can equally be portrayed as a 80% chance of life, thereby focussing the audience on the chances of a positive outcome rather than the negative outcome this message also implies. Subtle variations in how the same outcomes are framed have been found to exert a surprising degree of influence on responses.

For example, Tversky and Kahnemann's (1981) classic research on prospect theory presented participants with scenarios that described two competing disease treatment programs in terms of the number of lives that could be saved as a result or the number of lives that could be lost. Importantly, these framings highlighted different aspects of the outcome (lives saved versus lost), the absolute outcome itself was the same. Participants were then asked to choose between these alternative treatments, one of which represented a safe and certain choice and the other a risky choice associated with uncertainty. When the task was framed in terms of gains (i.e., lives saved) people tended to make choices on the basis of certainty, however when the task was framed in terms of losses (i.e., lives lost) people's choices became more risky (see also Kuhn, 1997).

The effect of message framing extends beyond forced choices between risky versus safe alternatives. Meyerowitz and Chaiken (1987) found that breast self-examination pamphlets that emphasised the costs of not performing this behaviour (a loss frame) were more effective at eliciting compliance than when the pamphlet instead highlighted the benefits of performing the same behaviour (a gain frame). Connecting with the above discussion of self-efficacy, feelings of efficacy played a role in explaining this effect: people felt a greater sense of efficacy in response to the loss frame and acted accordingly. In a general sense, loss frames seem particularly

effective for motivating for precautionary behaviours, such as breast self-examination. However, for other forms of behaviour, such as adopting a healthy diet, gain frames may be more effective than loss frames (Rothman, Bartels, Wlaschin, & Salovey, 2006; Salovey, Schneider, & Apanovitch, 2002). Rather than being exclusively motivated to avoid losses, individuals are most responsive to frames that “fit” the desired goal (e.g., Lee & Acker, 2004). Depending on the specific domain of behaviour, gain frames can sometimes be more motivating than loss frames.

Although gain versus loss framing is the most commonly studied distinction in the literature, other variations in framing have received some attention. For example, a typology of framing by Levin, Schneider and Gaeth (1998) distinguished between three different types of framing: risky choice framing, goal framing and attribute framing. The risky choice framing maps on to the gain/ loss distinction identified in Tversky and Kahnemann’s studies of choices between hypothetical disease treatment programmes. Goal framing maps on to the differential focus on advantages of behavioural enactment versus disadvantages of non-enactment as studied by Meyerowitz and Chaiken (1987). Finally, attribute framing refers to manipulations that focus perceivers on differently valued aspects of an item being evaluated (e.g., beef that is 75% lean or 25% fat). With respect to attribute framing, studies reveal that item evaluations vary depending on whether negative or positive attributes are fore-grounded (beef that is 75% lean is more desirable than beef 25% fat; Levin & Gaeth, 1988).

Although there are many ways to conceptualise framing, the key message that has emerged is that subtle changes to what is fore-grounded in a judgmental context can have surprising consequences. What is particularly striking about framing effects is that these occur even though the different descriptions are informationally

equivalent. While framing may involve choices, attributes or goals, in all these domains framing involves a comparison between presenting a single piece of information in ways that are either more negative (losses, prevention, and undesirable attributes) versus more positive (gains, promotion, and desirable attributes; Levin, Gaeth, Schreiber & Lauriola, 2002).

When thinking about how framing might affect communication about climate change, it is unclear which form of framing (choice, goal, or attribute) is most relevant. Possible negative impacts of climate change are themselves neither choices nor goals, although responding to these impacts involves both. In terms of the value associated with climate impacts these are necessarily negative rather than positive, although some individuals might consider a rise in temperature a positive outcome. Instead, the possibility of negative impacts of climate change is best contrasted with the countervailing possibility that these impacts will not eventuate. In the present research we focussed on this variation—that is, whether the effects of communicating climate change impacts are presented in ways that fore-ground the likelihood of negative outcomes (e.g., “It is 20% likely that global warming of 2°C will make a quarter of all species extinct”) versus the possibility of avoiding these (i.e., “It is 80% likely that global warming of 2°C will NOT make a quarter of all species extinct”).

1.3 The present research

Previous research has established that people are generally uncertainty averse: they become less responsive to messages as the communicated uncertainty increases. Parallel to this, research on message framing suggests that subtle variations in the way information is presented can guide how people respond. Some research has also considered how framing influences the ways in which people engage with uncertainties. Specifically, when a choice is framed in terms of loss people become

more risky in their preferences, whereas when the same choice is framed in terms of gains people become risk-averse (i.e., they prefer a “sure thing” over a riskier alternative). Our interest in the present research was to explore how uncertainty and framing might together affect individual responses to communications about future climate change.

Past research suggests that communicating increasing levels of uncertainty about future climate change should generally undermine individual willingness to engage in actions that might mitigate against this risk. To the extent that this pattern of responding reflects riskiness in the face of uncertainty, our expectation was that this would be most pronounced when the framing of climate change highlights the negatives (or possible losses) that will occur because choices have been found to be riskier under such circumstances (Tversky & Kahnemann, 1981). However, reframing climate change communications by focussing people on the possibility of avoiding losses (i.e., a more positive frame), should also change preferences from risk to caution. If people are focussed on caution, they should consequently display stronger intentions to behave environmentally, particularly as uncertainty increases. Thus we predicted a two-way interaction between level of uncertainty and framing on individual action in response to climate change messages. The two studies reported below tested this possibility: Study 1 provides an initial test of the prediction and Study 2 extends this by exploring the process behind the effects observed in Study 1.

2. STUDY 1

To test the interactive effects of message framing and communicated uncertainty, we presented participants with a list of climate change impact statements adapted from the Stern Review (2006). The statements were written such that they

either focused on the chances of negative impacts occurring as a result of climate change (a negative frame) or the countervailing chances of these impacts not occurring (a more positive frame). These statements included either exact probabilities for the listed impacts (e.g., 80% chance of X; lower uncertainty) or they gave a range of probabilities (e.g., 70-90% chance of X; higher uncertainty). After reading these statements about the possible effects of climate change, we assessed participants' intentions to engage in a range of climate change mitigating behaviours (e.g., reducing carbon emissions, adopting more environmental forms of transport and consumption, recycling, taking political action). Our prediction was that increasing uncertainty around climate change impacts would reduce intentions to act, but only when the message fore-grounded these negative outcomes (henceforth, the "negative frame" condition). When the message fore-grounded possibility of avoiding such losses (henceforth "positive frame"), we predicted that uncertainty about these would increase intended actions.

2.1 Method

2.1.1 Participants and design. Eighty-eight adult participants (30 male, 58 female; mean age = 27.24, $SD = 8.15$) were recruited via emails sent to university mailing lists and personal networks and advertisements posted on social networking sites. By following a link embedded within these emails, participants were directed to a webpage where they could complete the study. The majority of these participants reported having completed some undergraduate (40%) or postgraduate (32%) study, indicating that this was a fairly educated sample. Participants were randomly assigned to one of the four conditions of a 2 (framing: positive versus negative) x 2 (uncertainty: high versus low) between-subject design. The main dependent variable was intentions to behave in an environmentally friendly way.

2.1.2 Procedure and measures. On the first page of the study participants were given a brief explanation of the Stern Review (“a government report prepared by leading climate change experts from the UK,... which details the likely impacts of climate change”). They were then asked to read six statements that were said to be taken from the Stern Review. Framing and certainty were manipulated by varying the wording of these statements.

In the negative framing condition, all statements concerned the likelihood that certain negative consequences *will happen* as a result of climate change (e.g. “It is 80% likely that global warming of 2°C will cause abrupt and severe changes to regional weather patterns such as monsoons or the El Niño”). In the positive framing condition, the same statements were rephrased to describe the likelihood of these negative consequences *not* happening (e.g. “It is 20% likely that global warming of 2°C will not cause abrupt and severe changes to regional weather patterns such as monsoons or the El Niño”). Importantly, the percentages in each of these framing conditions were matched so that the statements communicated the same likelihood of the climate change impact described (i.e., 80% likelihood that there will be severe changes to regional weather patterns equals 20% likelihood that this will not happen). The six statements in each condition referred to a mixture of high (80%) and low (20%) likelihood impacts. The order of the statements was counterbalanced.

We crossed this manipulation of likelihood framing with a manipulation of the certainty around the likelihood estimates being given. In the low uncertainty condition, the likelihood was estimated by a single figure (e.g. 20%). In the high uncertainty condition, the likelihood was estimated by a percentage range around the likelihood estimate (for example, in the high uncertainty condition a 20% likelihood was presented as 10-30% likelihood). The single-figure likelihood in the low

uncertainty condition always matched the mean of the likelihood interval in a corresponding sentence of the high uncertainty condition.

After reading the climate change likelihood statements, participants were asked about their own behavioural intentions in relation to the issue of climate change. Specifically, they were asked to report how likely it was that they would perform a number of environmental behaviours during the following month (e.g. decrease non-green energy consumption, walk or take public transport instead of using a car; overall eight items, $\alpha = .83$). Participants responded to all items on a 7-point scale from 1 “very unlikely” to 7 “very likely”. After completing the questionnaire participants were thanked and debriefed.

2.2 Results

A 2 (framing: negative vs. positive) \times 2 (uncertainty: high vs. low) ANOVA was performed on the environmental intentions measure. The analysis revealed a significant interaction effect between framing and uncertainty, $F(1, 84) = 4.55, p = .036, \eta^2_p = .05$ (depicted graphically in Figure 1). Follow-up comparisons revealed that in the negative framing condition, low uncertainty resulted in stronger willingness to act ($M = 4.43, SD = 1.02$) than high uncertainty ($M = 3.74, SD = 1.36$): $F(1, 84) = 4.18, p = .044, \eta^2_p = .05$. However, in the positive framing condition, high uncertainty ($M = 4.37, SD = 1.04$) did not similarly undermine behavioural intentions relative to low uncertainty ($M = 4.01, SD = 1.13$), $F(1, 84) = 1.02, p = .32, \eta^2_p = .01$.

Looked at differently, this interactive effect was also partly attributable to a marginally significant effect of framing when the predictions were highly uncertain, with positive framing leading to higher willingness to act than negative framing: $F(1, 84) = 2.90, p = .092, \eta^2_p = .03$. Framing did not effect on responses in the low uncertainty condition: $F(1, 84) = 1.68, p = .199, \eta^2_p = .02$.

2.3 Discussion

The overall pattern of results of this study provide some support for our predictions. Specifically, the way in which (factually equivalent) climate change statements were framed, and the uncertainty with which these were communicated, had an interactive effect on individual intentions to engage in climate relevant actions. When messages were negatively framed (i.e., focussed on the likelihood of climate change losses), increasing levels of uncertainty decreased individual intentions to engage in climate change relevant behaviours. However, when the message was framed more positively (i.e., by focussing on the possibility of losses not occurring), uncertainty did not have a similarly negative effect on intentions. Indeed, the pattern of means in this condition were in the opposite direction, with (non-significantly) higher intentions reported under high uncertainty.

This pattern is broadly consistent with research on framing effects in other domains. For example, classic research by Tversky and Kahnemann established that people behave differently in response to choices framed as losses versus gains. When a choice is framed in terms of losses, people were found to display patterns of choice that reflect risk. The reverse was true for choices framed in terms of gains, where caution was more likely than risk. To the extent that engaging in environmental behaviour reflects a strategy of caution rather than risk, the observed pattern of results in this study mirrors those in previous research on choice. Uncertainty about negative impacts reduced environmentally responsible action (i.e., risk), whereas uncertainty about the possibilities of a more positive outcome seemed to increased such action (i.e., caution).

3. STUDY 2

Having established some support for our predictions in Study 1, a number of questions remain. First, there is a question of the robustness of the observed pattern. The sample used in Study 1 was relatively small. Given this, it was considered important to establish whether the pattern could be replicated and strengthened with a larger sample. Assuming that the pattern is robust, a second question concerns the processes behind these effects. An additional goal of Study 2 was to explore this.

As outlined in the Introduction, a range of processes have been suggested to underlie the effects of framing on individual responding. Other than the different subjective meaning of losses versus gains outlined in prospect theory, self-efficacy has been suggested as one important mediator of framing effects. For example, Meyerowitz and Chaiken (1987) found that loss framed messages (i.e., that highlight the negative consequences of not performing a behaviour) increased women's compliance with breast self-examination relative to gain framed messages (i.e., that highlighted the benefits of performing that behaviour) and that this effect was mediated by increased feelings of self-efficacy in the loss frame relative to the gain frame. More recent research by Williams, Clarke, & Borland (2001) has also suggested that self-efficacy plays a role in framing effects on health behaviour. Given this evidence for self-efficacy as mediator of framing effects, we also examined the role of this variable in our second study.

3.1 *Method*

3.1.1 Participants and design. One hundred and twenty University students (48 male, 71 female, 1 unidentified, mean age = 21.1) participated in the study voluntarily. Participants were randomly assigned to one of the four conditions of a 2 (framing: negative versus positive) x 2 (uncertainty: high versus low) between-subject

design. The main dependent variable was intentions to behave in an environmentally friendly way. In addition, we measured feelings of efficacy about preventing or minimising negative consequences of climate change.

3.1.2 Procedure and measures. Participants were randomly recruited on a University campus and asked to complete a questionnaire. Framing and certainty of climate change predictions were manipulated in a similar way to Study 1. As in the previous study, participants read six sentences (supposedly taken from the Stern Review) that communicated likelihood of various consequences of climate change. Framing and certainty were manipulated by changing the wording of these sentences in the same way as Study 1. In this study, however, the basis of the predicted consequences included in the statements was “If we continue emitting CO₂ at the same level as now” rather than “global warming of 2°C”. This change was made to simplify the statements and to remove a possible second source of uncertainty in the original study about whether temperatures would actually rise by 2°C.

After participants read the statements, participants were asked to write down their thoughts about this information. They then completed measures of efficacy and individual environmental intentions. To measure efficacy four items were used (e.g. “Climate change can be averted by mobilising collective effort”, “If we act collectively, we will be able to minimise the consequences of climate change”, $\alpha = .80$). Participants responded to items on a 7-point scale from 1 “strongly disagree” to 7 “strongly agree”. To measure environmental intentions, eight items were used. Participants were asked to report how likely it was that they would perform a number of environmental actions during the next month (e.g. reducing non-recycled household waste, reducing non-green energy consumption, $\alpha = .84$). Participants

responded to these items on a 7-point scale from 1 “very unlikely” to 7 “very likely”.

After completing the questionnaire participants were thanked and debriefed.

3.2 Results

A 2 (framing: positive vs. negative) \times 2 (uncertainty: high vs. low) ANOVA on environmental intentions again revealed a significant interaction between framing and uncertainty, $F(1,118) = 7.17, p = .009, \eta^2_p = .06$ (see Figure 2). When the message was framed negatively, high uncertainty ($M = 3.63, SD = 1.24$) reduced intentions to act pro-environmentally relative to low uncertainty ($M = 3.96, SD = 1.09$), however the difference between these means was not significant, $F(1,118) = 1.12, p = .292, \eta^2_p = .01$. In the positive framing condition, high uncertainty ($M = 4.59, SD = 1.00$) was instead associated with stronger intentions to act pro-environmentally than low uncertainty ($M = 3.75, SD = 1.37$), a difference that was significant, $F(1,118) = 7.47, p = .007, \eta^2_p = .06$.

Looked at differently, the interaction was again the result of an effect of framing when climate change predictions were highly uncertain, with positive framing leading to significantly higher willingness to act than negative framing: $F(1,118) = 9.58, p = .002, \eta^2_p = .08$. In comparison, framing had no effect on responses in the low uncertainty condition: $F(1,118) = 0.46, p = .498, \eta^2_p < .01$.

3.2.1 Mediation. To begin exploring the role of efficacy as a possible mediator of the above effects, we repeated the analysis on this variable. This also revealed a significant interaction between framing and uncertainty: $F(1,118) = 4.12, p = .045, \eta^2_p = .04$ (see Figure 3). This interaction was due to a significant effect of framing when the predictions were highly uncertain, with positive framing ($M = 5.86, SD = 0.82$) resulting in higher efficacy than negative framing ($M = 5.18, SD = 1.29$): $F(1,118) = 6.21, p = .014, \eta^2_p = .05$. In comparison, positive versus negative framing

had no effect on efficacy in the low uncertainty condition ($M_s = 5.58$ & 5.68 , $SD_s = 0.94$ & 1.07 , respectively): $F(1,118) = 0.14$, $p = .712$, $\eta^2_p < .01$.

Given the parallel effects of framing on intentions and efficacy under conditions of high uncertainty, mediation was a possibility. To further establish this, we conducted a moderated mediation analysis via regression following the procedures described by Muller, Judd, and Yzerbyt (2005). The results of this analysis met the conditions for mediation. Briefly, in addition to the significant interaction between uncertainty and framing on environmental intentions ($\beta = .41$, $p = .01$) and efficacy ($\beta = .32$, $p = .045$), efficacy was also a significant predictor of intentions ($\beta = .38$, $p = .002$). Finally, when efficacy was included as a predictor of intentions, the previously significant interaction between framing and uncertainty was substantially reduced ($\beta = .28$, $p = .068$). Using a bootstrapping analysis (Preacher & Hayes, 2008), the bias corrected bootstrap estimate of the indirect effect of the interaction between uncertainty and framing had a 95% confidence interval of 0.0777 to 0.7663. As this confidence interval does not cross zero, this suggests a significant pattern of mediation on behavioural intentions via feelings of efficacy.

3.3 Discussion

The results of Study 2 provide further support for our predictions. Again, the way in which climate change statements were framed, and the uncertainty with which they were communicated, had an interactive effect on individual intentions to engage in climate relevant actions. When climate change predictions were framed in terms of the losses that will happen (what we have termed “negative framing”), uncertainty produced non-significantly lower intentions to act than certainty. Conversely, when climate change predictions were framed in terms of losses that might not materialize (“positive framing”), uncertainty produced significantly stronger intentions to act than

certainty. The implication of this pattern was that when communicating the uncertainties of climate change, a positive frame was more effective at stimulating action than a negative frame.

Further, the combined effect of framing and uncertainty on intentions was mediated through feelings of efficacy (i.e., that collective action against climate change would be effective). In the face of uncertainty, people were more convinced of the effectiveness of action when climate impacts were framed positively rather than negatively, and they intended to individually take action as a result of these feelings of efficacy. Although this again highlights the role of efficacy in framing effects (e.g., Meyerowitz & Chaiken, 1987; Williams, et al., 2001), the precise pattern we observe is somewhat different to previous demonstrations. Meyerowitz and Chaiken (1987) found that a loss frame increased women's engagement with breast self-examination relative to a gain frame because loss increased efficacy relative to gain. In our study, a message that focused on losses due to climate change (i.e., the negative frame), reduced feelings of self-efficacy relative to a message focused on the possibility of these losses not occurring (i.e., the positive frame), at least when the message also conveyed uncertainty about these predictions.

This different pattern may be attributable to the specifics of the behavioural domains being considered in these studies, and whether these represent risk or caution (Tversky & Kahnemenn, 1981). To explain the effects of loss framing on breast self-examination, researchers have noted the riskiness of such detection behaviour (i.e., the possibility of finding something wrong) and how this matches the general tendency toward risk in the face of possible loss outlined by prospect theory. In contrast, engaging in climate change mitigating actions seems to represent caution rather than risk. This being the case, such behaviour should be more responsive to framings that

do not emphasize loss, as we have demonstrated. The different effects of framing as a function of behavioural domain underscores the notion that framing effects are not universal, but instead depend on a motivational “fit” between the frame and the behaviour of interest (Rothman, et al. 2006; Salovey, et al., 2002).

4. GENERAL DISCUSSION

Communicating climate change in ways that inspire people to take action is complicated. The intangible nature of climate change means that this issue is psychologically distant from most individuals. Moreover, the inevitable uncertainty of this message is likely to further undermine responsiveness among a public that has been characterised as generally averse to uncertainty. Against this backdrop, however, scientists are increasingly explicit about the uncertainties around their predictions in order to conform to scientific standards and to be transparent about what they do, and do not, know. The question we raised in the introduction to this paper is whether there is any possibility to reconcile these different approaches to uncertainty among the public and climate change scientists. To provide some answer to this question, two studies explored the role of message framing in shaping public responses to increasing uncertainty in climate change communications.

Both studies revealed a pattern of effects whereby the implications of communicating uncertainty in climate change predictions depended on how the message was framed. When message framing emphasised possible losses due to climate change (i.e., by presenting predictions about what *will happen*), increasing uncertainty resulted in decreased intentions to engage in climate change mitigating action. This reflects the typically negative effect of uncertainty on behaviour. However, when the same message was framed in a way that emphasised the

possibility of avoiding loss (i.e., by presenting predictions about what *will not happen*), the effect of uncertainty reversed. Under this frame, increasing uncertainty was associated with a more cautious response to climate change.

These combined effects of framing and uncertainty on intentions are broadly consistent with the tenets of prospect theory, which argues that loss framing disposes people to risk whereas gain framing disposes people to caution. Also consistent with previous research, the effects of framing on responses to uncertainty were mediated through feelings of efficacy. When highly uncertain climate change predictions were framed positively (i.e., in terms of what will not happen), people felt that action to avoid these impacts would be more effective, and were more willing to contemplate engaging in such actions themselves. In addition to elucidating the processes through which the observed effects occurred, this finding further underscores the importance of efficacy for adaptive action.

4.1 Implications, limitations, and directions for future research

One important implication of this research is that communicating uncertainty need not be a barrier to the climate change message. In fact, subtle shifts in the framing of such messages can turn uncertainty into an asset if it motivates people to be cautious in the face of such uncertainty. Despite this, the dominant way in which climate change is communicated involves negative, or loss, framing—for example, by highlighting the undesirable impacts that we might expect in the future. At least in part, the emphasis given to negative impacts reflects an assumption that this vision of the future will shock people into action. Yet, however scary this may be, it remains an uncertain vision of the future. As we have demonstrated, focusing on negative impacts (i.e., losses) is likely to leave people feeling as though they might as well “take a chance” rather than act with caution. Simply reframing this message to emphasise the

losses that may not occur (with an embedded implication that they may occur nonetheless) might instead elicit caution and a willingness to act in ways that avoid a negative future. At least in this domain, it seems that uncertain optimism about the future is more motivating than uncertain pessimism.

Framing effects have been studied in a variety of areas—most notably in relation to health communication. Although the potential importance of framing effects for climate change communication has been acknowledged elsewhere (Center for Research on Environmental Decisions, 2009), to date very little research has examined framing in this specific context. Given this, there would seem to be considerable scope for further exploring framing effects in this domain. To investigate our predictions, we made use of a framing manipulation that shifted whether negative climate change impacts were fore-grounded or back-grounded in the message (i.e., by focussing people on the probability that these impacts will happen or the countervailing probability that they will not happen). We labelled this distinction negative framing versus positive framing in recognition that it does not fully map onto traditional distinctions between loss and gain framing. Indeed, in the language of prospect theory, our manipulation more closely resembles a loss frame versus a non-loss frame. It remains to be seen whether the positive effects of uncertainty on intentions to act would be further amplified in response to a more strongly gain-framed message. However, it is also unclear precisely what a gain framed message about negative climate impacts would be.¹ This reality constraint guided the choice of the framing manipulation investigated here. Nonetheless, it would seem important, and productive, for future research to consider how various framing manipulations might effectively overcome some of the barriers to effective climate change communication.

A second limitation of this work is that we have focussed on intentions as the dependent measure of interest. Although this incorporated a variety of environmentally relevant actions, and although intentions are a useful indicator of responsiveness to climate change messages, intentions are not a substitute for actual behaviour. Notwithstanding the limitations of the present studies, some previous research on framing effects has investigated actual behaviour, and demonstrated that framing effects can be surprisingly persistent over time (e.g., Meyerowitz & Chaiken, 1987). The relative ease of reframing climate change communications, combined with this promise of behavioural effects, suggests that this would be a useful focus for future research.

Finally, it should be noted that the effects observed in these studies were produced among fairly educated samples—participants in both studies were mostly students. While this permits some exploration of the role of framing and uncertainty on possible responses to climate change messages, among broader samples the picture is likely to be more complicated than presented here. For example, in comparison to students, other sections of the community may be more sceptical about the reality of climate change. Pre-existing scepticism is likely to be a significant barrier to any communication in this area, irrespective of how the message is framed. Moreover, it is likely that sceptical individuals would react to scientific uncertainty differently to those less sceptical. Given these possibilities, it would seem important to explore the processes identified here among more diverse samples, and to consider the complicating role of other variables, such as pre-existing attitudes or scepticism.

4.2 Conclusion

Scientific messages about the impacts of climate change communicate a future that may or may not come. This uncertainty about the future often allows people to

disengage from the message and defer responsibility for immediate action. However, this negative effect of uncertainty is not inevitable. Re-framing climate change messages away from (possible) losses might make it easier for people to feel capable and willing to act in the face of uncertainty. This highlights the importance of framing as a tool for those concerned with communicating the uncertainties of climate change without simultaneously undermining responsive action.

Notes

1. Beyond the specific issue of communicating negative climate impacts, the viability of gain frames is more obvious. For example, not reducing carbon emissions could cause catastrophic climate change (i.e., a loss), whereas reducing carbon emissions could improve local air quality (i.e., a gain).

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191-215.
- Budescu, D.V., Rapoport, A., & Suleiman, R. (1990). Resource dilemmas with environmental uncertainty and asymmetric players. *European Journal of Social Psychology*, 20, 475-487.
- Camerer, C. & Weber, M. (1992). Recent developments in modeling preferences: uncertainty and ambiguity. *Journal of Risk and Uncertainty*, 5, 325–370.
- Center for Research on Environmental Decisions. (2009). *The Psychology of Climate Change Communication: A Guide for Scientists, Journalists, Educators, Political Aides, and the Interested Public*. New York.
- Curley, S. P., Yates, F. J. & Abrams, R. A. (1986). Psychological sources of ambiguity avoidance. *Organizational Behavior and Human Decision Processes*, 38, 230–256.
- Ellsberg, D. (1961). Risk, ambiguity, and the savage axioms. *Quarterly Journal of Economics*, 75, 643–669.
- Fiske, S.T. (2004). *Social beings: A core motives approach to social psychology*. New York: Wiley.
- Fox, C. R., & Weber, M. (2002). Ambiguity aversion, comparative ignorance, and decision context. *Organizational Behavior and Human Decision Processes*, 88, 476–498.

- Grothmann, T. & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change, 15*, 199-213.
- Highhouse, S. (1994). A verbal protocol analysis of choice under ambiguity. *Journal of Economic Psychology, 15*, 621–635.
- Hine, W., & Gifford, R. (1996). Individual Restraint and Group Efficiency in Commons Dilemmas: The Effects of Two Types of Environmental Uncertainty. *Journal of Applied Social Psychology, 26*, 993-1009.
- Intergovernmental Panel on Climate Change (IPCC). (2007). *Summary for policy makers: contribution of working group I to the fourth assessment report of the Intergovernmental Panel on Climate Change*. Retrieved from <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg-spm.pdf>
- Keren, G., & Gerritsen, L. E. M. (1999). On the robustness and possible accounts of ambiguity aversion. *Acta Psychologica, 103*, 149–172.
- Kuhn, K. M. (1997). Communicating uncertainty: Framing effects on responses to vague probabilities. *Organizational Behavior and Human Decision Processes, 71*, 55–83.
- Langford, I.H., (2002). An Existential Approach to Risk Perception. *Risk Analysis, 22*, 101 – 120.
- Lee, A.Y., & Aaker, J.L., (2004). Bringing the Frame Into Focus: The Influence of Regulatory Fit on Processing Fluency and Persuasion. *Journal of Personality and Social Psychology, 86*, 205-218.
- Levin, I. P., & Gaeth, G. J. (1988). Framing of attribute information before and after consuming the product. *Journal of Consumer Research, 15*, 374-378.

- Levin, I.P., Gaeth, G.J., Schreiber, J. & Lauriola, M. (2002). A New Look at Framing Effects: Distribution of Effect Sizes, Individual Differences, and Independence of Types of Effects. *Organizational Behavior and Human Decision Processes*, 88, 411-429.
- Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All frames are not created equal: A typology and critical analysis of framing effects. *Organizational Behavior and Human Decision Processes*, 76, 149-188.
- Lopes, L.L., (1987). Between hope and fear: The psychology of risk. *Advances in Experimental Social Psychology* 20, 255–295.
- Meyerowitz, B. E., & Chaiken, S. (1987). The effect of message framing on breast self-examination attitudes, intentions, and behavior. *Journal of Personality and Social Psychology*, 52, 500-510.
- Muller, D., Judd, C. M., & Yzerbyt, V. Y. (2005). When moderation is mediated and mediation is moderated. *Journal of Personality and Social Psychology*, 89, 852-863.
- Postmes, T., Rabinovich, A., Morton, T.A., & van Zomeren, M. (forthcoming). Towards sustainable social identities: Including our collective future into the self-concept. Chapter to appear in D. Stapel & H. van Trijp (Eds.), *Multiple selves: Angels, demons, and sustainable behavior*. London: Psychology Press.
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, 36, 717–731.
- Prentice-Dunn, S. & Rogers, R.W. (1986). Protection Motivation Theory and preventive health: beyond the Health Belief Model. *Health Education Research*, 1, 153-161.

- Rogers, R.W. (1983). Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In J. Cacioppo & R. Petty (Eds.), *Social Psychophysiology*. New York: Guilford Press.
- Rothman, A.J., Bartels, R.D., Wlaschin, J., & Salovey, P. (2006). The strategic use of gain- and loss-framed messages to promote healthy behavior: How theory can inform practice. *Journal of Communication*, 56, 202-221.
- Ruiter, R.A.C., Abraham, C., & Kok, G. (2001). Scary warnings and rational precautions: A review of the psychology of fear appeals. *Psychology and Health*, 16, 613-630.
- Salovey, P., Schneider, T.R., & Apanovitch, A.M. (2002). Message framing in the prevention and early detection of illness. In J.P. Dillard & M. Pfau (Eds.), *The persuasion handbook: Theory and practice* (pp. 391-406). Thousand Oaks, CA: Sage Publications.
- Stern, N. (2006). The Stern review report on the economics of climate change. H M Treasury. Retrieved from http://www.hmtreasury.gov.uk/sternreview_index.htm
- Swim, J.K., Clayton, S., Doherty, T., Gifford, R., Howard, G., Reser, J., Stern, P., & Weber, E. (2009). *Psychology and Global Climate Change: Addressing a multifaceted Phenomenon and St of Challenges*. A Report by the American Psychological Association's Task Force on the Interface between Psychology and Global Climate Change.
- Tversky, A., & Shafir, E. 1992. The disjunction effect in choice under uncertainty. *Psychological Science*, 3, 305-309.
- Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, 211, 453-458.

- Van den Bos, K., & Lind, E. A. (2002). Uncertainty management by means of fairness judgments. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 34, pp. 1-60). San Diego, CA: Academic Press.
- Dijk, E. van, & Zeelenberg, M. (2003). The Discounting of Ambiguous Information in Economic Decision Making. *Journal of Behavioral Decision Making*, 16, 341-352.
- Williams, T., Clarke, V., & Borland, R. (2001). Effects of message framing on breast-cancer-related beliefs and behaviours: the role of mediating factors. *Journal of Applied Social Psychology*, 31, 925-950.

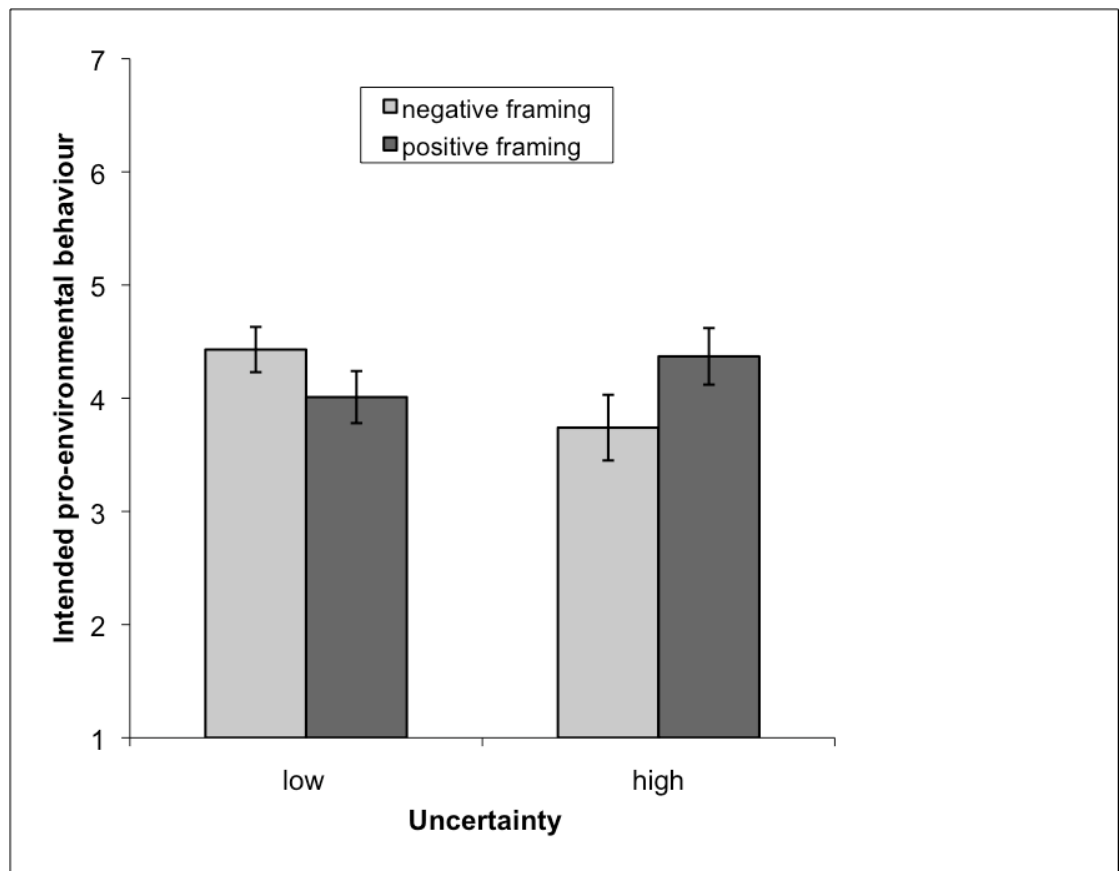


Figure 1. The effects of uncertainty and framing of climate change predictions on intended pro-environmental behaviour (Study 1).

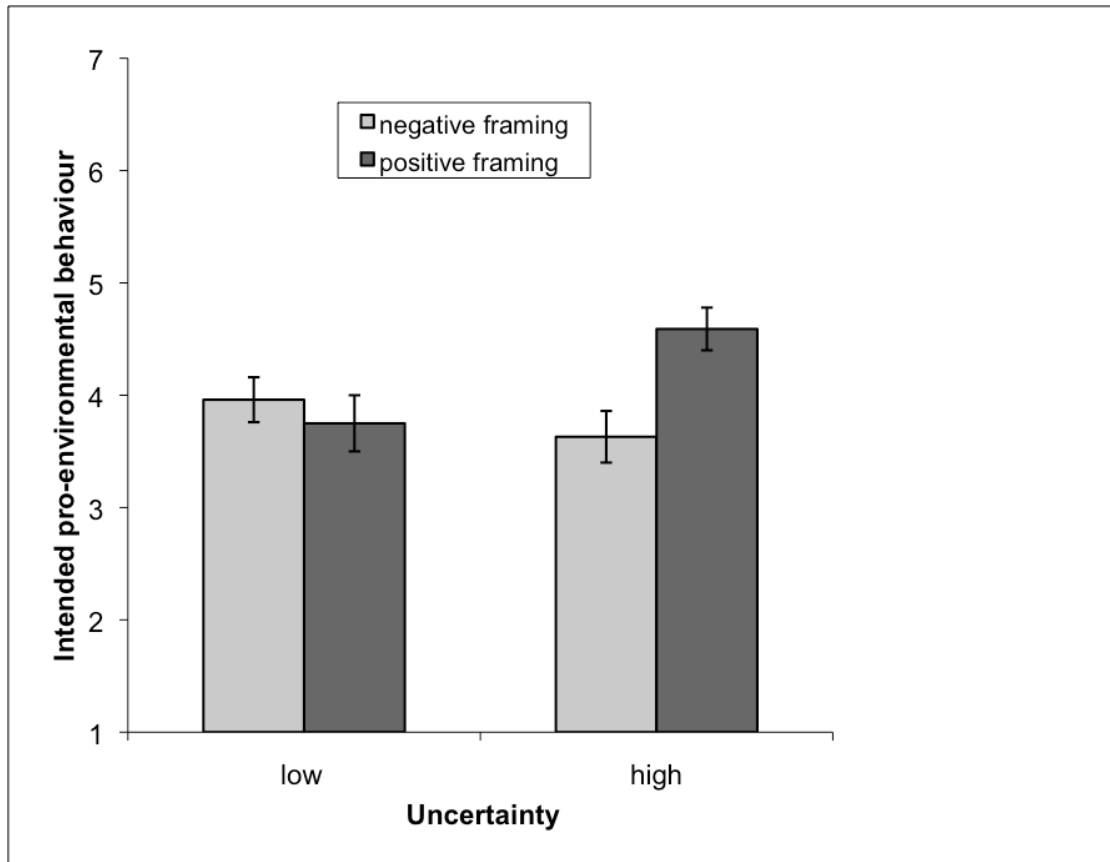


Figure 2. The effects of uncertainty and framing of climate change predictions on intended pro-environmental behaviour (Study 2).

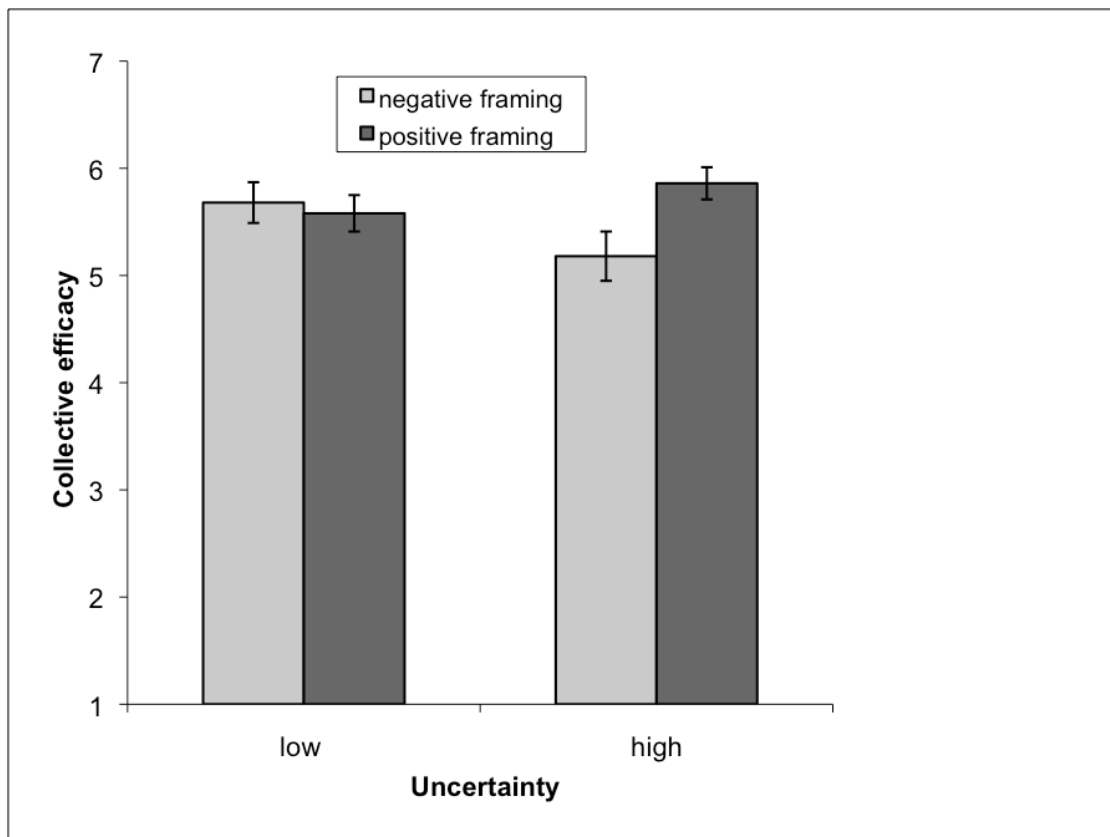


Figure 3. The effects of uncertainty and framing of climate change predictions on feelings of collective efficacy (Study 2).