The metacognitions of climate change

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A R T I C L E   I N F O

A B S T R A C T

How do individuals think about global climate change? Although a body of research on the cognitive elements of climate change has begun to accumulate (e.g., Bord, O'Connor, & Fisher, 2000, few studies have distinguished between categories of cognitions. One key distinction is between primary, direct thoughts such as perceptions and evaluations, and secondary, indirect thoughts which reflect upon and control primary cognitions (Petty, Brinol, Tormala, & Wegner, 2007); secondary thoughts are thus considered metacognitive. This distinction is important to climate change engagement given that primary and secondary thoughts may exert independent effects on behavior. Three metacognitive elements of climate change are delineated: metacognitive knowledge, or assessments of confidence in one's thoughts; metacognitive certainty, or assessments of the likelihood of an outcome; and metacognitive importance, or the relative emphasis placed on one's thoughts. The relations between these dimensions and climate change-relevant behaviors are explored. Possibilities for future research are also discussed.

Climate change evokes different cognitive responses than do other environmental problems because of its magnitude, perceived distance, and abstractness (Chess & Johnson, 2007; Leiserowitz, 2007; Vlek, 2000; Wolf, Lorenzoni, Few, Abrahmson, & Raine, in press). For instance, Vlek (2000) described some of the difficulties associated with comprehending climate change, including uncertainty and perceptions of geographical and temporal distance. He noted that "people generally cannot

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handle long-term complexity, they are limited information processors, and they are mentally biased towards the 'us, here, and now' " (p. 153). A comprehensive understanding of which cognitions are typical to climate change will reveal how humans conceptualize this complex environmental problem, as well as how governments and organizations can best communicate the issues to the public. Indeed, much remains to be uncovered about the cognitive and behavioral aspects of climate change, and this critical task is one well-suited for the social psychologist (e.g., Gifford, 2008).

Once identified, the cognitive processes relevant to climate change could inform education and communication campaigns. Maladaptive thought processes that disengage people from the issue could be targeted, and adaptive, or engaging thought processes could be encouraged. Some work examining the cognitions of climate change has already been used to establish preliminary communication, such as the research presented in Moser and Dilling's (Leiserowitz, 2007) book. Within this volume, for instance, Leiserowitz (2007) proposed several strategies to effectively communicate the issues, based on his exploration of Americans' thoughts about climate change. One suggestion was that messages should emphasize local impacts because individuals do not usually include these in their representations of climate change, and yet, thinking about local impacts may be more engaging than thinking about global impacts.

In addition to practical applications of the cognitive elements of climate change, such research also has theoretical value because it applies and tests existing principles from social cognition within a new domain. Toward the aim of developing solutions to climate change that are grounded in theory, this literature review draws upon relevant social psychological principles to organize and explain the research on climate change cognitions.

One perspective that has not been fully explored but that would add much to the understanding of climate change-related thinking is the study of metacognition. Whereas perceptions and evaluations are *primary* cognitions, or direct thoughts about objects, experiences, and people, metacognitions are *secondary*, higher-order cognitions in which we attend to, reflect upon, and sometimes attempt to control primary thoughts (Petty, Brinol, Tormala, & Wegner, 2007). Therefore, we explore two key questions. First, which dimensions of metacognition are applicable to climate change? And second, how do these metacognitions influence behavioral responses to climate change?

Based on the available research, three metacognitive dimensions appear relevant to climate change thinking. The first dimension is metacognitive knowledge, or the reflection of, and confidence in, one's knowledge level about climate change facts. We briefly discuss how primary knowledge relates to climate change behavior, and then present the research on metacognitive climate change knowledge. The second metacognitive dimension is certainty, or judgments about the likelihood of a given climate outcome. Most of the research about this dimension explores the role of the media in shaping impressions of certainty. We also review the effects of certainty on perceptions of climate change-related behavior. The third metacognitive dimension is the degree to which climate change attitudes are perceived to be important. We review the relevant literature, with particular emphasis on how metacognitive importance is postulated to contribute to behavior.

1. Metacognitive knowledge

Knowledge is constructed, organized, and recalled in units called mental representations (Wyer, 2007). These mental representations can also guide judgment, intentions, and sometimes behavior. Within the realm of climate change, this principle has proved important; people's mental representations about the causes and consequences of climate change and how to implement appropriate strategies predict mitigation intentions and behaviors. For instance, in a large-scale survey of Americans, actual knowledge of climate change was the strongest predictor of their intentions to engage in climate change mitigating behaviors (Bord, O'Connor, & Fisher, 2000). Similarly, research has found that citizens who possess more knowledge about climate change are more willing to accept mitigation policies (Lazo, Kinnell, & Fisher, 2000; O'Connor, Bord, & Fisher, 1999).

How does knowledge about climate change exert its effects on behavior? One explanation is that knowledge represents the availability as well as accessibility of climate change constructs in memory. As such, this knowledge serves as a readily available heuristic that guides intention and behavior (e.g., Förster & Liberman, 2007). Another explanation is that knowledge about the causes and potential consequences of

climate change effectively encourages action because it provides individuals with a rationale for adopting relevant behaviors and policies. This occurs via a reflective system that relies on "if-then" propositions to categorize stimuli and make behavioral decisions (Strack & Deutsch, 2007). For instance, one might decide that "if transportation contributes to climate change, and if the effects of climate change will be negative, then I will try to reduce my car use." Of course, knowledge does not unequivocally predict behavior, because the reflective system must contend with impulses, habits, and competing cognitive demands. Nevertheless, it seems that knowledge plays a key role in an individual's intent to act.

Knowledge also contains metacognitive elements, such as how confident we are about our existing mental representations and propositions, or, as Metcalfe and Shimamura (1994) describe, "what we know about what we know" (p. xi). Thus, metacognitive knowledge refers to personal judgments about one's level of knowledge, in which the accuracy of retrieved knowledge is monitored. This has also been referred to as metacognitive confidence. According to Petty et al. (2007), metacognitive confidence is among the most important dimensions of metacognition because it moderates whether thoughts will predict behavior. When confidence in knowledge is low, information-seeking behaviors are activated in an attempt to confirm or disconfirm existing knowledge, which ultimately serves to fulfill the need for accuracy (Chaiken, Liberman, & Eagly, 1989).

Empirical studies have shown that assessments of one's own knowledge have behavioral implications. For instance, metacognitive knowledge was investigated in relation to risk perception and risky sexual behaviors among a sample of over 8000 female adolescents interviewed as part of the National Longitudinal Study of Adolescent Health (Jaccard, Dodge, & Guilamo-Ramos, 2005). They found that, controlling for actual knowledge, individuals who perceived that they possessed high levels of knowledge about specific birth control methods were more likely to have an unplanned pregnancy in the subsequent year than those who did not perceive high levels of knowledge. In a different study, smokers who perceived themselves to be adequately informed about the health risks of smoking were less likely to engage in information-seeking behaviors (Rothman & Salovey, 2007). Jaccard et al. reasoned that confidence in one's knowledge may provide a false sense of control over risky outcomes, and thereby inhibit precautionary behaviors. In addition, actual and perceived knowledge were weakly correlated, which suggests that the metacognitive aspects of knowledge can contribute to behavior above and beyond that of actual knowledge.

1.1. Metacognitive knowledge and climate change

Some research on metacognitive knowledge has begun to emerge in the climate change literature. For example, actual and metacognitive knowledge about various climate change causes and impacts have been investigated (Sundblad, Biel, & Garling, 2007). Participants first completed a series of true/false questions, and then reported their level of confidence in each of their answers. Confidence in knowledge about the causes of climate change was greater than confidence in knowledge about current environmental conditions or future consequences. Moreover, participants were more confident in their knowledge about sea, glacier, and weather consequences than about health consequences. Given that confidence in knowledge about health consequences was low, and these consequences are the most personally relevant, Sunblad et al. (2007) surmise that if messages more often alluded to the health consequences of climate change, individuals' motivation to seek out more information about climate change would increase. Thus, it seems that confidence in knowledge about climate change differs depending on the type of consequence considered.

Another feature of metacognitive knowledge is that it differs among people, where experts are the most confident about their climate change knowledge, followed by journalists, politicians, and laypersons (Sundblad, Biel, & Garling, 2009). This is congruent with the principle that confidence in knowledge increases with direct experience, accessibility, and prior thinking (Petty et al., 2007). Somewhat unexpectedly, however, Sundblad et al. also observed that actual and perceived knowledge correlated most strongly among journalists and less so among experts. The authors suggest that this may have resulted from experts' higher standards about the level of knowledge required to claim confidence.

Finally, metacognitive knowledge has been linked to perceptions of climate change risk. Individuals often report feeling confident about their climate change knowledge (e.g., Lorenzoni & Pidgeon, 2006), but these metacognitions in turn, may decrease perceptions of risk. For example, when individuals feel

that they are well-informed about climate change issues, they are less likely to be concerned (Kellstedt, Zahran, & Vedlitz, 2008). This is congruent with studies on risk perception and precautionary sexual behaviors (e.g., Jaccard et al.), but is in contrast to actual climate change knowledge, which is associated with greater concern (e.g., Bord et al., 2000).

Taken together, these studies demonstrate that actual and metacognitive knowledge about climate change are not the same, and could potentially exert opposite effects on behavior. Actual knowledge about climate change seems to increase information-seeking or precautionary behaviors, but high levels of metacognitive confidence could, in fact, decrease these types of behaviors. However, research on metacognitive knowledge about climate change remains sparse, and its effects on behavior have not yet been investigated.

2. Metacognitive certainty

A second type of metacognition related to climate change is certainty, or judgments about the likelihood of a given climate change outcome. Likelihood refers to the probability that particular beliefs will occur in the future, and is thus a parameter of expectancy (Roese & Sherman, 2007). Certainty is therefore metacognitive, because it involves appending a probability value to an existing expectation. In other words, expectations are primary cognitions about possible futures whereas certainty is a reflection of the likelihood of these future-directed thoughts.

One important factor that plays a role in judgments of certainty about climate change is actual knowledge. For example, Swedish participants judged their thoughts about the likelihood of serious climate change effects occurring in Sweden, Holland, and Bangladesh over three different time frames (Sundblad et al., 2007). Those who possessed greater actual knowledge of the causes and health consequences related to climate change viewed negative outcomes as more likely.

Most of the research on the factors that contribute to certainty about climate change has considered how exposure to information in the media influences beliefs in the likelihood of various climate change outcomes. Because climate change effects are not always experienced directly, the media plays an important role in the construction of mental representations about climate change as well as the likelihood judgments that are appended to these representations. For instance, the 2004 film *The Day After Tomorrow* dramatized a worst-case scenario resulting from climate change, where the Earth faces a possible ice age following the disruption of the thermohaline circulation (i.e., the Gulf Stream). Exposure to this film seemed to have an impact on beliefs about the likelihood of serious consequences from climate change (Lowe et al., 2006). Moviegoers (who completed questionnaires before and after viewing the film) became less certain about the likelihood of serious climate change effects upon viewing the film. These results are somewhat surprising when considering the fact that heightened accessibility of knowledge tends to *increase* judgments of certainty (e.g., Förster & Liberman, 2007). However, this could be linked to the science fiction nature of the film, which may have blurred the distinction between scientific facts and a fictionalized portrayal of climate change.

Nevertheless, even "factual" media representations of climate change seem to heighten perceptions of uncertainty. For instance, following a period of media interest in climate change topics that occurred as a result of the 1997 White House conference on climate change, individuals reported less certainty about negative climate change consequences than they had in previous months (Visser, Krosnick, & Simmons, 2003).

Often, media representations about climate change do not help to resolve judgments of uncertainty; if anything, they merely heighten ambivalence (Corbett & Durfee, 2004). In an effort to remain non-partisan and objective, journalists sometimes frame climate change issues in terms of controversy and do not incorporate the relative veracity of either side (Antilla, 2005). Consequently, the credibility of climate change skeptics without empirical evidence appears to be equal to that of climate scientists. Furthermore, news stories rarely place findings in the broader context of research that has already been conducted on the topic (Corbett & Durfee, 2004). Thus, when journalists report on a rare study that does not support global warming (e.g., that the ice in the West Antarctic is actually thickening), but do not mention that the majority of other studies on this topic are in opposition, the reader may conclude that this new study is the truth.

To test the influence of such journalistic factors on climate change certainty, Corbett and Durfee (2004) manipulated the extent to which news stories included context, and controversy. Participants read one of four stories: context only, controversy only, both context and controversy, or a control message. As expected, they found that including the broader research context in a news story increased certainty about the existence of climate change, but presenting opposing sides of a research issue decreased judgments of certainty.

What is the mechanism through which media exposure influences judgments of certainty about climate change? The information ecology perspective (Fiedler, 2007) could provide insight into this issue. According to this theory, the informational environment contains three properties that influence decision making: density, variance, and redundancy. Density refers to the amount of information that is presented. If a large proportion of news stories present climate change as a controversial issue, certainty judgments may be reduced. Variance refers to the changes in density. When stimuli change, individuals direct more attention toward them. Thus, controversial climate change messages may capture attention more readily than messages which remain constant. Finally, redundancy is the amount of information that is repeated and learned. Thus, the lack of consistent reporting may hinder learning, and deflate certainty.

Scientists also face the challenge of communicating probability information in a way that the public will understand it. The Intergovernmental Panel on Climate Change attempted to address this issue in their 2007 report by translating numerical probability estimates of projected climate changes and impacts into a standard, qualitative language using a seven-point scale that ranged from "extremely unlikely" to "virtually certain." For instance, a probability of less than 10% would be written in the text as "very unlikely," and a probability of greater than 90% would be written as "very likely." Although the aim was to improve ease of interpretation of results, this did not occur; rather, individuals over-estimated their judgments of uncertainty of the phrases containing these terms (Budescu, Broomell, & Por, 2009). When numerical information and qualitative terms were presented together, under-standing improved, but estimates remained biased in the direction of uncertainty. This suggests that individuals' certainty judgments are largely inaccurate.

2.1. Metacognitive certainty and climate change

An important question is how metacognitive judgments of certainty might influence climate change-related behavior. Although few studies have assessed this, uncertainty about the negative outcomes of climate change seems to decrease engagement with climate change issues (Moser & Dilling, 2004). Similarly, individuals who were more certain about negative climate change outcomes were more likely to donate to a climate change-related cause, as well as engage in non-monetary behaviors such as attending a public meeting about climate change (Visser, Krosnick, & Simmons, 2003).

In sum, media practices of presenting both sides of an issue has decreased certainty about the likelihood of negative climate change consequences, and therefore this style of reporting may act as a force that disengages the public from climate change issues.

3. Metacognitive importance

Another type of metacognition evident in the literature on climate change is importance. Meta-cognitive importance refers to the weight or emphasis that individuals place on various primary cognitions, such as evaluations, beliefs and attitudes. Attitudes deemed to be more important are stronger, more persistent, less susceptible to persuasive influences, and more consequential for deci-sion making (Holbrook, Krosnick, Berent, Visser, & Boninger, 2005). Metacognitive importance has been investigated with respect to topics such as abortion and other political issues. For instance, undergraduate participants who viewed their attitudes toward abortion as important paid more attention to information that was presented on this issue, were more interested in obtaining additional relevant information, and reported talking about the issue with others more frequently (Visser, Krosnick, & Simmons, 2003). In a follow-up study, those who viewed their attitudes toward a number of political issues as more important were more likely to vote on Election Day.

3.1. Metacognitive importance and climate change

Importance is also relevant to the domain of climate change. Individuals who viewed their climate change beliefs as more important were more likely to have donated money to an environmental organization in recent months, and were more likely to have written a letter or attended a meeting about climate change (Visser et al., 2003). The effects were even greater among those who were also confident about their climate change beliefs. In addition, importance ratings increased slightly over time as participants were exposed to media stories about climate change. Congruent with these findings, individuals who attributed greater importance to their beliefs about the general functioning of the government were more likely to endorse hypothetical climate change mitigation policies (O'Connor, Bord, & Fisher, 1999).

How might attitude importance exert its effects on behavior? One potential path is through its effects on the cognitive processing necessary for knowledge development (Holbrook et al., 2005). First, because we cannot attend to all information at all times, we must be selective about the information we notice. Attitude importance helps to guide this initial selective exposure, and it also initiates selective elaboration (i.e., the frequency of thinking about climate change) and deeper processing of the information, thereby facilitating the construction of mental representations. Holbrook et al.'s model of attitude importance was developed through a series of studies, and one of these examined the effects of importance of climate change issues on selective elaboration. In this study, Americans were interviewed before and after the 1997 US national debate on climate change. Results showed that attitude importance led to more thinking about climate change both prior to, and after the debate. Consistent with this, Karpinski, Steinman, and Hilton (2005) showed that attitude importance moderated the correlation between explicit and implicit attitudes via its effects on elaboration. In other words, explicit and implicit attitudes are more closely aligned among those who view their attitudes as important, and this importance leads to more frequent thinking and deeper processing of attitudinal-relevant information.

Therefore, importance is a key cognitive element in climate change engagement and behavior. However, although people are aware of the existence of climate change and many are concerned about potential negative consequences (e.g., Heath & Gifford, 2006), importance is deflated when individuals consider climate change in relation to other issues (Lorenzoni & Pidgeon, 2006; Poortinga & Pidgeon, 2003). For instance, several British surveys revealed that health, family, safety, finances, and concerns about terrorism took precedence over climate change issues (Norton & Leaman, 2004; Poortinga & Pidgeon, 2003). These issues may be prioritized over climate change issues because they are more temporally, spatially, and socially salient (e.g., Gattig, 2002). Because competing issues attenuate the importance we attach to climate change, it is not surprising that engaging people in climate change issues can be such a great challenge.

4. Critique

Thus far, climate change researchers have provided evidence for three dimensions of climate change thinking that can be considered metacognitive: metacognitive knowledge, certainty, and importance. These dimensions are distinct in that they initiate different processes which exert unique effects on behavior. Metacognitive knowledge monitors the accuracy of actual knowledge, and serves as a gauge for whether further information-seeking is required. Thus, a strong sense of metacognitive knowledge may inhibit involvement with the issue. In contrast, metacognitive certainty assigns probability values to expectations. Greater certainty about negative climate change outcomes therefore may heighten risk perception and encourage action. Finally, metacognitive importance assesses the centrality of the issue, which in turn, guides the use of one's attentional resources. Greater importance is associated with greater climate change engagement. These dimensions also seem to influence decision making and behavior beyond that of primary cognitions. This approach should alert researchers to distinguish between cognition and metacognition in their operationalizations of climate change thought processes. Because this topic is still quite understudied, however, several issues remain unanswered, such as whether the metacognitive dimensions are interrelated, and how many of these dimensions exist.

4.1. Defining concepts

Divergent effects between actual and perceived climate change knowledge suggests that the two should be clearly distinguished by researchers, and this may resolve discrepancies that have begun to emerge. In particular, authors should be clear as to whether they are measuring actual or metacognitive knowledge. Kellstedt, Zahran, and Vedlitz (2008) concluded that more knowledge was associated with less concern about climate change, which contradicts the knowledge-deficit hypothesis that those who are less knowledgeable are also less concerned. The authors' conclusion that their study "contributes another parcel of evidence that the knowledge-hypothesis is inadequate," (p.122) is unwarranted. Rather, their operationalization of knowledge is more suited to a metacognitive approach, because they asked participants to indicate "how well-informed they considered themselves to be on climate change and global warming." Thus, their findings apply to confidence in knowledge but not actual knowledge. Perhaps this confusion arose because metacognitive concepts are not typically considered within the climate change literature. This underlines the importance of considering a metacognitive model for climate change engagement.

One advantage to determining that these constructs related to climate change thinking are metacognitive is that previously established principles about metacognition can then be applied to them. For instance, Petty et al. (2007) describe how metacognitions "can magnify, attenuate, or even reverse first order cognition" (p. 274). Thus, when knowledge, certainty, and importance are denoted as metacognitive, these assumptions may also be relevant, and could potentially serve as tools for behavior change.

4.2. Relations among the metacognitive dimensions

Another issue is whether the metacognitive dimensions can indeed be considered separate, or whether they would just as usefully be subsumed under a general metacognitive construct. It is our view that metacognitive knowledge, certainty, and importance are distinct factors with unique influences on other variables. For example, results from a series of three studies consisting of different samples and attitude issues (i.e., global warming, abortion, and political issues), revealed that importance and metacognitive knowledge (or confidence in knowledge) are related to attitude expressive behaviors in different ways (Visser et al., 2003). Specifically, this study showed that individuals' voting behavior was predicted by importance ratings, but not by confidence. Confidence and importance about abortion attitudes both predicted interest, attention, and discussion on the issue, but only importance predicted efforts to seek out more information on the topic. In addition, exposure to media about climate change increased importance but not confidence. Given their divergent effects on attitude expressive behaviors, the authors conclude that importance and confidence are separate constructs.

More of this type of research is necessary to distinguish between the other metacognitive dimensions, such as knowledge and certainty. However, the above literature review suggests that this distinction is promising, because metacognitive knowledge seems to reduce precautionary behaviors, but metacognitive certainty seems to facilitate such behaviors.

Another interesting line of research is how the metacognitive constructs are related to one another, and how they interact to influence behavior. In one of the few studies to investigate the metacognitive aspect of thought frequency, Holbrook et al. (2005) showed that those with higher ratings of attitude importance thought about climate change more often.

4.3. Other dimensions of metacognition

The central shortcoming in the extant literature on the metacognitions of climate change is simply the lack of it. Very few studies have assessed the relation between metacognitions and climate change-related behavior. However, what little research has emerged, along with research on metacognition outside the domain of environmental psychology, suggests that this may be a fruitful area of study.

One possible avenue would be to explore other dimensions of metacognition as they relate to climate change behaviors. The literature discussed touches upon three metacognitive elements,

including confidence about one's climate change knowledge, certainty or uncertainty about the likelihood of climate change thoughts, and the importance of climate change-related thoughts. The frequency of thinking about thoughts is an additional metacognitive dimension (e.g., Petty, Brinol, Tormala, & Wegener, 2007), but has only been included in one study about climate change (i.e., Holbrook et al., 2005).

Other classifications of metacognitive elements exist. One such work is that of Petty et al. (2007), wherein several metacognitive dimensions are proposed. It would be interesting to determine whether these dimensions could also apply to climate change. Specifically, three of Petty's dimensions that do not overlap with those already discussed, seem to possess relevance to climate change: target, origin, and acceptability. First, the target describes what someone perceives their thoughts to be about (e.g., what do you think about when you are thinking about climate change?). Second, the origin denotes whether the person considers the thought to have originated from themselves (e.g., your fear of the negative effects of climate change come from your own deliberation) or from others (e.g., your thoughts about climate change come from the movie, *An Inconvenient Truth*). Third is the valence and acceptability of one's thoughts. For instance, we might assess whether people perceive their thoughts about climate change to be negative or positive, and whether these thoughts are wanted or unwanted. This last dimension would be particularly interesting when examined in concert with certainty, given that most of the studies that investigate the degree to which individuals are certain about their climate change expectations focus on negative consequences. Would certainty still predict engagement with climate change among those who are certain about positive consequences?

4.4. Metacognitive awareness as a tool for behavior change

Metacognition has often been studied in educational settings, and has been used to enhance students' learning skills (e.g., Schraw, 1998). Specifically, Schraw describes several strategies to enhance metacognitive capabilities, including fostering awareness and self-regulation, and creating supportive learning environments. Could these strategies be useful in climate change education campaigns? Possibly they could assist individuals who pursue climate-friendly goals. Bartiaux (2007) emphasized that reporting one's habits aids behavior change because it activates metaawareness, and the subsequent monitoring of behavior. In turn, this improves self-regulation. Indeed, habit is one of the key barriers to climate change action (Gifford, 2008). This suggests that awareness and other uses of metacognition could curb individuals' mindless, yet environmentally harmful behaviors.

5. Future research

One possible program of future research is as follows. First, development and validation of a metacognitive model of exploring climate change engagement is needed, such as through development of a scale that simultaneously assesses multiple metacognitive dimensions, and a factor analysis of that scale. Following this, additional studies should determine the key antecedents of each of the dimensions. For instance, exposure to media about climate change may decrease metacognitive certainty, but increase metacognitive importance. How would such exposure influence metacognitive knowledge? Similarly, studies have suggested that actual and metacognitive knowledge are weakly correlated, but that actual knowledge consistently predicts metacognitive certainty. Third, the model should be tested in settings of varying environmental quality and culture, to ensure its generalizability and to determine its realistic boundaries (e.g., Hill, 2006). Finally, the model may be applied in intervention studies that aim to increase the metacognitive elements most important for engaging individuals in lifestyle decarbonisation. In addition, given that much of the research on climate change cognitions and behavior is devoted to mitigative actions, the model should also highlight whether the same dimensions are relevant for adaptive actions.

6. Conclusion

Climate change thought processes include both primary and secondary cognitions. The existing research provides evidence that three metacognitive dimensions are applicable to climate change

thinking, and may also be related to behavior. Metacognitive knowledge, or confidence in one's knowledge about climate change facts is not always associated with actual knowledge, and may in fact, suppress information-seeking behaviors. Certainty, or assessments of the likelihood of negative climate change outcomes, tends to increase intentions to take precautions, but the tradition in two-sided media reporting reduces judgments that negative outcomes are likely. Finally, when individuals attribute importance to their climate change beliefs, they are more likely to engage in climate change behaviors. In sum, research supports the metacognitive approach to climate change thinking, but much remains to be uncovered, including the existence and effects of other possible metacognitive dimensions. Upon further inquiry, this exciting line of research will provide a richer understanding of the cognitive processes surrounding climate change. Metacognitive concepts that have rarely been considered in relation to climate change may enhance models of climate change cognition, and may also generate novel solutions about how to target the cognitive barriers to climate change engagement.

Acknowledgement

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