

# Metacognition and Climate Change: Why Dealing with Politicized Science Requires Self-Insight

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**Abstract.** Climate change is a prototypical example of a complex problem. Here, we argue that metacognition, our insight into the reliability and fallibility of our own knowledge and thought, is a critical aspect in the area of climate change for two reasons: Metacognition is negatively affected by the noisy information environment of climate change; yet it is at the same time required for its solution. By showcasing the importance of metacognition for climate change, the present chapter thereby provides theoretical and empirical arguments for a link between individual-level psychology and one of the biggest challenges facing societies today.

An American saying states that “For every complex problem, there’s a solution that is simple, neat, and wrong.” In this chapter, we argue and present empirical evidence for the claim that, in order to successfully address the complex problem of climate change, humans need appropriate insight into the reliability and fallibility of their own understanding of the world. In other words, we argue for the claim that, to successfully mitigate climate change, human metacognition is an essential skill.

Climate change is a prototypical example of a complex problem. Joachim Funke writes that complex problems are characterized by five critical aspects: *Complexity* of the involved system, which typically comprises a high number of variables; *interconnectivity* of the variables that interact with each other, producing complex causality and temporal *dynamics*; *intransparency* concerning the involved variables and their interactions; and *polytely*, the fact that solving complex problems often requires meeting not just one, but several—and potentially conflicting—goals (Funke, 2012). What makes climate change complex? The climate system itself is complex in that it is composed of a plethora of variables which are *connected* and interact in typically nonlinear ways (Masson-Delmotte et al., 2021). The global and temporal scale, the multitude of effects on the natural, economic and social systems—all of these interacting variables make it difficult to unambiguously predict mid- to long-term consequences. Adding to this, our behavior constantly interacts with the physical problem of climate change, which shapes collective (in)action, and, in turn, feeds back into the climate system. Moreover, any technological or political response strategies such as climate engineering, carbon capture and storage, or mitigation options add further potential for feedback loops, interactions, and, consequently, ambiguities to the mix, as even mere debate about potential deployment of climate engineering technologies or the adoption of any other response strategy may affect current decisions and behavior (see Amelung & Funke, 2015; Burns, 2011; Dana, 2021).

### **Climate Change as a Complex Problem**

Via a document leak, it has become public just how much governments with vested interests in the fossil fuel industry, such as Saudi Arabia, and other stakeholders with agendas directly in conflict with recommended climate action, such as the meat industry, watered down scientifically derived key recommendations in the 2023 Summary for Policymakers of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). These stakeholders view climate change through the filter of how it affects their personal agendas rather than a

collective welfare or a sustainability filter—and their combined action has the potential to create a push-back effect on more ambitious climate goals: The leaked document revealed that more than 36,000 submissions were made by governments, corporations, and other stakeholders with the aim of influencing the climate discourse via text change requests for the 2023 IPCC report, the main communication channel of the international climate science community (Rowlatt & Gerken, 2021). While this procedure is an expression of the democratic principles guiding the IPCC's actions, it also becomes clear that interpretations of climate change differ between stakeholders, indicating how economic and political worldviews filter even highly consensual scientific climate change evidence.

How is it possible that perspectives on the problem of climate change can vary so much? This is because climate change is not merely a problem waiting for a solution but, rather, a global phenomenon with implications for almost every area of planetary and human life. As such, it is not only physically observable and measurable; it also is a topic that is highly contested and subject to political agendas. We could also say it is a complex problem that is perceived through our individual mental filters and interpretations (see Amelung & Funke, 2013).

The complexity of climate change has many implications for how our mental models are formed: as predictions of complex effects are based on scientific uncertainty (Latif, 2011) and, sometimes, even contrasting pieces of evidence or interpretations (Sarewitz, 2004), perceptions of these effects may vary based on how uncertainties and contrasts are communicated (Amelung et al., 2016; Pidgeon & Fischhoff, 2011; Schmid-Petri & Arlt, 2016; Weiss, 2003) as well as understood (Broomell & Kane, 2017; Visschers, 2018); how much various sources of communication are trusted (Arbuckle et al., 2015); and what values, beliefs, or social filters existed prior to receiving the communication (Hornsey et al., 2016). Common cognitive biases (Fischer et al., 2019; Zaval & Cornwell, 2016) as well as misinformation campaigns (Lewandowsky et al., 2012) may add to the confusion.

If, for all of these reasons, our perceptions and interpretations of the meaning of climate change are as multifaceted as the physical phenomenon thereof—is it any wonder that we struggle to find consensus on how to deal with it?

## Metacognition and Climate Change

Here, we argue that metacognition—our insight into the accuracy of our understanding of, and reasoning about, the problem at hand—is both affected by the noisy and complex information environment of climate change while, at the same time, being required for its solution. Three cognitive reasons suggest such a twofold involvement of metacognition in the domain of climate change.

First, in the domain of politicized science in general and climate change in particular, citizens are not only confronted with an unmanageably high amount of information but also with a mix of accurate information, misinformation, and outright disinformation, that is, misinformation that is spread with the intention to deceive. This noisy information may reduce the accuracy with which citizens can assess their own understanding of the domain: If citizens habitually sample low-reliability evidence, this necessarily reduces metacognitive sensitivity, the extent to which confidence differentiates between correct and incorrect pieces of knowledge (Fischer & van den Broek, 2021; Rollwage & Fleming, 2021). Indeed, research suggests that metacognitive insight into one's distinction of true and false statements about the domain is reduced for climate change compared to non-politicized science, even when controlling for differences in object-level understanding of the domain (Fischer et al., 2019). In this study, we presented two national samples of German citizens with true and false statements about climate change (e.g., "Climate change is mainly caused by a natural variation in sunbeam and volcanic eruption") as well as about non-politicized science (e.g., "Antibiotics kill viruses as well as bacteria"). Results revealed that citizens lacked metacognitive sensitivity for climate change, although they had high awareness for the accuracy and inaccuracy of their knowledge about non-politicized science. These results are in line with a mechanism whereby widespread misinformation about climate change renders citizens "metacognitively confused" about truth and falsehood.

Second, metacognitive evaluation of our cognitions can lead to enhanced humility about their validity: while object-level reflections take our cognitions for

granted, metacognition enables us to take a step back and critically reflect on the appropriateness of our cognitions. Lacking insight into the fallibility of our cognitions, in contrast, manifests itself in unjustified (biased) confidence, and can foster the psychological tendency to interpret novel evidence selectively such that it confirms prior beliefs. Metacognitive insight into the validity of our cognition may, therefore, be necessary to be appropriately attentive to belief-disconfirming evidence about climate science and to use it for belief-updating. This is particularly so since climate change is a highly politicized domain where strong inclinations exist to process novel evidence such that it confirms a desired conclusion, such as reaffirming one's political or economic worldviews (for reviews, see Hornsey, 2020, 2021). Indeed, empirical results support this theoretical reasoning (Fischer et al., 2022; Said et al., 2021): Metacognitive insight into the accuracy of novel evidence about as well as into one's own understanding of climate change predicted belief updating in response to noisy information that could be interpreted to confirm a desired conclusion, such that individuals with more accurate metacognitive insight were less prone to such motivated belief-updating. In one study, we presented a national sample of German citizens with noisy evidence about climate change and tracked their prior beliefs (the beliefs they had before seeing the evidence) and posterior beliefs (the ones they had after seeing the evidence). In addition, we comprehensively measured their knowledge of climate change and their political and economic attitudes. Results showed that, at one particular level of climate change knowledge, citizens with a more accurate metacognitive insight into this knowledge were less likely to update their beliefs in the direction of misleading evidence. In other words, citizens with more accurate metacognitive awareness of their knowledge—and knowledge gaps—were less susceptible to climate-skeptical belief updating in response to noisy evidence.

And third, people use the confidence they have in their object-level beliefs to guide subsequent judgment and behavior (Balsdon et al., 2020; Desender et al., 2018; Fischer et al., 2023). Hence, high metacognitive sensitivity—where confidence matches the accuracy of the underlying belief—should relate to accurate judgment and behavior in relation to climate change with almost analytical ne-

cessity: When beliefs are weighted by appropriate confidence, low-confidence beliefs that are likely to be inaccurate (such as believing that evidence for anthropogenic climate change is a hoax) are down-weighted and less likely to inform subsequent behavior (such as delaying mitigative policy), while high-confidence beliefs that are likely to be accurate (such as that there is overwhelming evidence for anthropogenic climate change, and its risks) are up-weighted and more likely to inform subsequent behavior (such as supporting mitigative policy). Indeed, metacognitive confidence was found to predict climate change beliefs, above and beyond object-level climate change knowledge (Fischer & Said, 2020). Similarly, we found in another national sample of German citizens that the sensitivity with which confidence matched the accuracy of underlying beliefs about COVID-19 predicted compliance with public health measures and willingness to get vaccinated during the pandemic; and this held at one particular level of accuracy of the COVID-19 beliefs. This result hence suggests that the ability to reflect upon and evaluate our own beliefs can help us make decisions that are informed by the best available evidence, rather than only the accuracy of the beliefs themselves.

It is for all of these reasons that we propose that an insight into the accuracy and fallibility of our own understanding of the world—that is, metacognitive ability—is required for humans to successfully mitigate the complex problem of climate change.

## Conclusion

Climate change is a prototypical example of a complex problem. By showcasing how metacognition is both affected by the noisy and complex information environment of climate change while, at the same time, being required for its solution, the present chapter highlights the link between individual-level psychology and one of the biggest challenges facing societies today. This chapter hence provides theoretical and empirical arguments for the claim that to *avoid* a solution that is simple, neat, and wrong, human metacognition is an essential skill.

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