Editorial overview: Can behavioral science solve the climate crisis?

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Editorial overview: Can behavioral science solve the climate crisis?

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The latest Intergovernmental Panel on Climate Change report [1]—the first update since 2013—concluded that climate change is now affecting every single inhabited region in the world, with human behavior being the major contributor to changes in weather and climate extremes such as heatwaves, droughts, and flooding. Described by UN Secretary-General António Guterres as 'code red for humanity', it is now very likely that the 1.5°C warming limit agreed upon at the Paris UN Conference of the Parties will be breached by 2040 if global emissions are not drastically reduced to net-zero. Because climate change is fundamentally a problem that concerns human judgment, communication, and decision-making, in this special issue, we ask whether behavioral science can help solve the climate crisis.

National implementation of effective behavioral change interventions has the potential to reduce direct household emissions by as much as 20% [2]. Unfortunately, this potential is rarely achieved in practice, partly because although the need for 'behaviorally informed' climate policies is increasingly recognized [3,4], public policies often fail to implement state-of-the-art interventions [5] and critical insights from the social and behavioral sciences are not integrated with recommendations from climate science, engineering, and economics [6,7]. There is no shortage of reviews on the nexus of behavioral science and climate change [e.g. see Refs. 8,9] but what's missing from the debate is an attempt to orchestrate a conversation across the behavioral sciences about what we know and perhaps more importantly, what it is that we do *not* (yet) know to help avert the climate crisis. Accordingly, in this special issue, we invited prominent experts from across the behavioral sciences, including neuroscience, economics, geography, political science, sociology, computer science, marketing, communication, and psychology (to name a few) to showcase the diversity of insights that behavioral science has to offer through state-of-the-art reviews of key research areas. These reviews identified six psychological barriers that need to be overcome to generate large-scale action on climate change; (1) cognitive barriers, (2) affective barriers, (3) motivational barriers, (4) social barriers, (5) political barriers, and (6) behavioral barriers. We discuss progress on each barrier in turn.

Cognitive barriers

The term 'bounded rationality' refers to the fact that humans have limited cognitive capacity. Whereas 'homo economicus' can be a perfect rational

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agent in its ability to attend to, store, and retrieve all relevant information when making a decision, 'homo sapien' is limited in its ability to absorb information and thus uses adaptive short-cuts. Recent cognitive science research documents important perceptual biases that result from selective attention. In their review, Luo and Zhao identify at least three such biases to illustrate how they shape our perception and action on climate change. For example, using eye-tracking software, studies have shown that political orientation orients people to different aspects of global temperature graphs. Similarly, using attentional blink paradigms, studies have found that people who are more concerned about climate change attend more to climate words or images than people less concerned about the issue. There is feedback between attention and perception: the more we attend to climate change, the more concerned we might become (and *vice versa*). Luo and Zhao's (this issue) review also shows that people seem to have a poor understanding of the carbon footprint or mitigation potential of different consumer behaviors, a finding buttressed by the literature review from Thøgersen.

Ranney and Velautham review educational work, with interventions in schools and beyond that seek to close the knowledge gap on climate change. One particularly interesting insight is that although many attempts to educate the public about climate change seem to struggle with circumventing the aforementioned attentional and perceptual biases, providing so-called mechanistic explanations about climate science ('the how') can improve knowledge without triggering (political) biases. Ranney and Velautham (this issue) note that although there is no silver bullet for climate denial, there are ten facts about climate change (communicable in under five minutes) that have shown to incrementally improve acceptance of and concern about human-caused climate change.

Affective barriers

Almost 15 years ago, one of us wrote an article [10] entitled 'Why Global Warming Does Not Scare Us (Yet)' making the basic point that if people are not sufficiently alarmed about a risk, they will not take appropriate precautions. Since then, much research has evidenced the important role of emotion and affect in risk perceptions of climate change. Because people cannot experience climate change directly, it fails to trigger a sense of personal worry. This raises the important question: how do experiences with extreme weather and climatic change impact our emotions and behavior? Howe reviews studies that often match geospatial data on weather and climate trends with survey data on public opinion to understand whether people are (accurately) perceiving environmental changes and whether such changes can motivate belief change. He concludes that the evidence is mixed: there is a positive link, but increases in extreme weather have not shown to systematically motivate opinion or behavior changes and may even fall prey to attentional biases so that they mostly mobilize people who were already worried about climate change and thus do not necessarily convince unconcerned individuals. These findings are consistent with a meta-analysis from Sugerman *et al.* on the 'local warming' effect. Analysing 17 studies published since 2006 with over 82 000 participants the authors find that local temperatures do robustly influence climate change concern, albeit by a small amount: a 1°C increase in local temperature corresponds to a 1.2 percent increase in worry about climate change.

Zooming out, Brosch brings some much-needed nuance to the role of emotions in climate change communication. Although emotions clearly play an important role—including the emerging concept of 'climate anxiety'—much of the research has been observational in nature and mixed findings on

the efficacy of emotional appeals point to the need to better understand and causally disentangle underlying mechanisms when designing interventions. For example, Brosch (this issue) argues that different appraisal patterns (associate versus deliberative) underlie the elicitation of different kinds of emotions which could differentially influence key cognitive and motivational judgments. Integration of neurophysiological measures would help researchers better differentiate alternative pathways through which emotions are elicited.

Schneider *et al.*'s review specifically focuses on the role of positive emotions in motivating behavior change. Importantly, their review introduces a key conceptual distinction between positive emotions as *antecedents* (anticipatory emotions) or as *consequences* (experienced emotions) of climate change engagement. Both Brosch (this issue) and Schneider *et al.* (this issue) highlight the possibility of virtuous cycles or upward spirals, with positive emotional experiences leading to greater anticipation of positive emotions from engaging in climate-friendly behaviors which, in turn, boost the experience of positive emotions. To document such positive feedback systems, future work will need to measure the impact of emotions on behavior (rather than merely intentions) and over much longer time scales.

Social barriers
Social norms, defined by Cialdini and Jacobson as the 'predominant behaviors, attitudes, beliefs, and codes of conduct of a group' are one of the most revered levers for behavior change in the social and behavioral sciences. Cialdini and Jacobson (this issue) reviewed 58 papers (published since 2017) to examine the influence of social norms on climate-relevant behaviors. Most interventions reported positive results for both *descriptive* (what others do) and *injunctive* (what others think we should to do) social norms, especially when these two sources of influence are aligned. There is growing evidence that dynamic or trending norms (which signal that more and more people are adopting a given behavior) can also encourage uptake of low prevalence pro-environmental actions (such as reducing meat consumption). Important potential moderators of social norm interventions include the relationship between personal (moral) and social norms, group identification, and how norms align with people's social identities.

In fact, Masson and Fritsche argue that people's responses to climate change are very much shaped by their social identities (the idea that people derive substantial parts of their self-concept from the different groups that they belong to). They review work on the Social Identity Model of Pro-Environmental Action (SIMPEA), which suggests that the collective (in-group) emotions and motivations people experience shape the group's norms and goals which, in turn, drive collective

action on climate change. Masson and Fritsche (this issue) specifically argue that future research should not only focus on individuals but rather on the effectiveness of group-based interventions, which may depend on the extent to which groups identify with and share pro-climate norms and how the group perceives its ability to effectively counter climate change.

Political barriers
In the context of climate change—especially in the United States—partisan identity is often discussed as one of the most salient group identities for judgments and decisions about climate change. Doell *et al.* note growing political polarization in the United States, highlighting that Republicans are now six times more likely to dismiss human-caused climate change as compared to Democrats. Their review also describes several strategies for overcoming the partisan divide, for example, by communicating the fact that a substantial proportion of Republicans do believe in climate change, or through targeted-messaging based on people's religious, political, and social identities, including identity leadership from political elites.

Van Boven and Sherman review emerging research showing that elite cues may influence public opinion by signaling social norms. According to this account, citizens use elite cues to infer social norms which explain the influence of elites. In other words, people support climate policies if and when they are proposed and endorsed by political elites from their own party. If true, this result would be problematic, because elites often do not accurately represent the opinion of the masses and thus such inferences could further increase existing pluralistic ignorance. For example, an individual might believe in climate change but (incorrectly) assume that most fellow in-group members do not because the belief is not supported by political elites. Doell *et al.* (this issue) and Van Boven and Sherman (this issue) rightly point to the fact that people may therefore overestimate or misperceive the degree of political polarization on climate change, which suggest that interventions that correct people's perception of political norms could be effective.

Motivational barriers
Arguably one of the biggest challenges in initiating and sustaining action on climate change is figuring out why people are not *motivated* to change their attitudes and behavior. To this extent, Hornsey discusses the importance of examining the 'roots' that underlie surface attitudes. In particular, he argues for the importance of two worldviews that dominate in fossil-fuel reliant nations, namely views about the role of government in society (free-market ideology or individualism) and views about social power structures (social dominance orientation or hierarchism). Meta-analyses show moderate negative correlations ($r = -0.30$) between these constructs and

climate attitudes so that people who endorse strong hierarchies and oppose government regulation are less motivated to believe that climate change mitigation is necessary and important. The recommendation is to frame climate messages in a way that aligns rather than conflicts with people's worldview. But this is easier said than done.

For example, Lewandowsky argues that any policy strategy to combat climate change ultimately has economic and political implications that are fundamentally at odds with the ideals of free-market ideology. He raises the important question of whether science denial and associated climate disinformation campaigns are therefore an inherent consequence of a deeper motivational conflict between libertarian and scientific ideals, where one worldview focuses on property rights, power, and commerce and the other emphasizes the importance of unrestricted access to free, universal, and communal knowledge.

Both Van Lange and Bouman et al. take a more optimistic view, and their reviews suggest that all individuals have the capacity to value the environment (biospheric), other people (altruistic), and themselves (egoistic), but that people and groups prioritize these values differently. Importantly, Bouman et al. (this issue) report that many individuals do express moderate to strong pro-environmental values. At the same time, they also point to empirical evidence that people are more likely to think that others care less about the environment.

Lewis et al. point to the importance of being aware of such misperceptions for building diverse climate coalitions. They draw attention to the important fact that race, social class, and income differentially shape how people view environmental issues and that despite the fact that racial and ethnic minorities are most vulnerable and concerned about the environment, they themselves perceive that other groups, such as Whites and young Americans are more likely to be alarmed. It therefore seems important to make pro-environmental group values salient. To help achieve this, Van Lange (this issue) advocates for taking a 'broader mind' approach, which leverages three social values in service of the environment, by highlighting that climate change will harm our grandchildren (prosociality), vulnerable and marginalized populations (egalitarianism) and the planet (concern for nature and non-human animals).

These insights point to the need for tailored communication based on people's unique values and motivations. 'Know your audience' is the first rule of communication. Leiserowitz et al. review work on the field's most prominent segmentation of attitudes toward global warming 'Global Warming's Six Americas'. The Six Americas segmentation differentiates the values, beliefs, and motivations that different communities express about climate change, ranging from the Alarmed (about 26% of the population) to the Dismissive (8%). Leiserowitz et al. (this issue) highlight how Americans have become relatively more alarmed over the last decade and how the Six Americas framework can be used to evaluate targeted message campaigns and inspire international segmentations in other countries, such as India.

The notion that people reason about climate science in ways that are biased by preexisting worldviews, social values, and political identities runs deep throughout the special issue contributions, but Bayes and Druckman raise important critiques of this assumption in their review of the motivated reasoning literature. They argue that partisanship is often confounded with prior beliefs and that most research has failed to disentangle accuracy from motivational goals. For example, it may very well be the case that citizens are motivated by accuracy but simply fail to form accurate opinions because they discount the credibility of mainstream sources or have been duped by misinformation disseminated by political elites. Future research must therefore carefully hypothesize, measure, and manipulate how different motivations influence climate change judgments.

Behavioral barriers

There has been a long-standing mismatch between what people say is important to them and what they actually do—also known as the value-action or attitude-behavior gap. To explain this gap, Kaiser introduces the Campbell paradigm, a behavioral model that relates motivational forces (such as people's commitment to an environmental value or goal) and associated costs to goal-directed climate mitigation behaviors. The model assumes that people engage in climate-friendly behaviors when the strength of an attitude offsets the cost of engaging in the behavior. According to this logic, attitudes can be inferred from behavior (rather than vice versa). If people truly care about combatting climate change, then they will likely perform various behaviors with that goal in mind (at increasing personal cost), from which we can more reliably infer their attitudes. Of course, this raises a circularity issue: if attitudes are inferred from observed behaviors, is it really surprising that those same attitudes reliably predict the behavior? Kaiser (this issue) suggests so if the measures for attitudes (e.g. self-report) and behaviors (e.g. energy use) are sufficiently different.

But not all behaviors are goal-directed. In fact, Verplanken and Whitmarsh argue that climate-relevant behaviors are more often habitual than goal-directed. Habits are defined as behavioral responses that are automatically activated by environmental cues and acquired over time through repetition. Verplanken and Whitmarsh (this issue) suggest that socio-cognitive models account poorly for habitual behaviors. The difficulty is that

unsustainable habits are reinforced by a 'habit architecture' that makes breaking 'bad habits' difficult, except for a promising method known as 'habit discontinuity' that capitalizes on disruptions in people's lives (e.g. moving, pandemic) as opportunities for breaking old patterns. Verplanken and Whitmarsh (this issue) argue that the challenge now is to establish sustainable habits by designing performance contexts in which sustainable conduct is the norm, triggered automatically, and difficult to change.

These recommendations align with a review of the consumer behavior literature from Thøgersen (this issue), who concludes that although research has been able to identify impactful behavioral changes (e.g. travel), people struggle with identifying what these behaviors are. Policies should thus make these climate-friendly behaviors 'the easy' option, for example, by using green defaults and carbon labels to help climate-friendly options stand out more.

Stepping back from individual behavior, Attari asks what individuals can do to change the larger energy system itself? She notes that most people do not have a good grasp of the energy usage of their appliances and hold incorrect mental models of how energy systems work. In answering how behavioral science can help transform the energy system, Attari (this issue) suggests that people need to understand how they are part of a larger system and reminds us of the important role of context for policy design and uptake. She also points to the need to investigate the importance of local values, needs, and constraints. For example, solutions that are effective in the global north may not be relevant for the global south and climate policies that are non-controversial in some countries might face significant political barriers in others.

Velez and Moros echo these concerns in asking whether the behavioral sciences have delivered on their promise to influence environmental policy. In their review of systematic reviews, Velez and Moros (this issue) look to uncover larger trends and lessons from the behavioral sciences. They find that common behavioral approaches such as feedback, framing, defaults, and social norms can be effective but that much work remains to be done when it comes to (a) scaling up these kind of interventions, and (b) applying them to high-impact domains beyond the household such as farming, policy-making, and businesses, and especially in the global south.

One promising avenue for scaling up the effect of interventions is through behavioral spill-over. As Carrico explains, spill-over occurs when engagement in a behavior targeted by an intervention increases the probability that other non-targeted behaviors are adopted. However, spillover can both be positive and negative. Carrico's (this issue) review suggests that positive spillover effects do exist, but are generally small in magnitude and depend on whether intention or self-reported (versus observed) behavior measures are employed. An important limitation is that not all spillover research isolates causal mechanisms. Important emerging research examines the potential of personal behavior to spill over to policy support, showing that behavioral interventions can both undermine or boost political will for climate change policies.

Wrap up

Across the six psychological barriers that this special issue identified, we hope to have illustrated both the tremendous progress that the behavioral sciences have made in understanding the cognitive, emotional, social, political, and behavioral challenges that need to be addressed but also the key questions that the behavioral science community still needs to answer. The review by Sawe and Chawla of environmental neuroeconomics, for example, cuts across the six barriers, by demonstrating the neuroscience data can better forecast population-level behavior and characterize individual differences in ways that assist climate policy, integrated assessment models, welfare analyses, and benefit-cost analyses.

Future efforts will be more fruitful to the extent that behavioral scientists of all stripes will collaborate, both with each other but also with the engineering, modelling, and policy communities who need to better appreciate the heterogeneity and complexity of human behavior [7,11] and the important contributions of demand-side solutions [12]. There are at least two answers to the question posed in our title 'Can behavior science solve the climate crisis?' One is that the behavioral sciences cannot do so in isolation. The other is that the world will surely not successfully address this grand challenge of our time *without* the behavioral sciences.

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