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Current Opinion in Psychology

Review

The Gateway Belief Model (GBM): A review and research agenda for communicating the scientific consensus on climate change

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Abstract

Empirical research on the Gateway Belief Model (GBM) has flourished in recent years. The model offers a dual-process account of how attitude change happens in response to normative cues about scientific agreement. A plethora of correlational and experimental evidence has emerged documenting the positive direct and indirect effects of communicating the scientific consensus on global warming. I review recent scholarship and argue that the next generation of research on the GBM should focus on better justifying the inclusion of moderators on both a theoretical and empirical level, explicitly manipulate motivations to process the consensus message, model how consensus cues operate in competitive information networks and test the model in field settings using causal chain experiments.

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Current Opinion in Psychology 2021, **42**:7–12

This review comes from a themed issue on **42 Psychology of Climate Change**

Edited by **Mark F. Ferguson** & **Michael T. Schmitt**

For a complete overview see the Issue and the Editorial

Available online 23 January 2021

https://doi.org/10.1016/j.copsyc.2021.01.005

Keywords

Scientific consensus, GBM, Attitude change, Climate change.

In 2002, political strategist Frank Luntz wrote a memo to the Bush White House administration detailing strategies to help 'win the global warming debate'. The first principle of which was to stress that the scientific debate on the issue remains open because '*should the public come to believe that the science is settled, their views will change accordingly*' [1, p. 11]. Yet, the central tenet of Luntz' assertion has remained untested for many years: are people's personal attitudes about global warming intricately linked to their perceptions of scientific agreement?

The Gateway Belief Model (GBM) is a recent dual-process theory of attitude change, which has confirmed what political strategists have intuited for decades: perceived scientific agreement plays a key role in people's attitudes about contested scientific issues [2,3]. Specifically, the GBM (Figure 1) postulates that a change in the public's perception of the scientific consensus on an issue acts as a 'gateway' to changes in other important cognitive and affective judgments that people may hold, such as the degree to which people think climate change is real, human-caused, and how much people worry about the issue. In turn, changes in these private attitudes are hypothesized to predict public support for the issue [3].

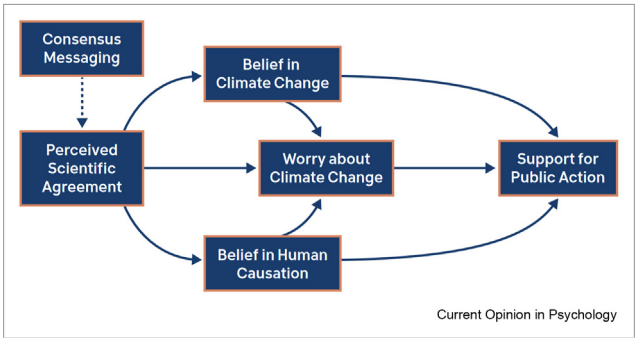
Although the GBM has been applied across a wide variety of contexts, including vaccine hesitancy [4], GMOs [5,6], attitudes toward Brexit [7], and other issues [8], the scholarly literature on its application in the context of climate change has grown rapidly over the last few years. In the current review, I will discuss the theory's most prominent features, the state of the evidence, received criticisms, as well as an agenda for future research on the GBM.

Empirical evidence: from perceived consensus to support for action

Early correlational research discovered that public perceptions of the scientific consensus on climate change correlate significantly and consistently with policy support via key beliefs that people hold about the issue [9–12]. A recent meta-analysis [13] synthesized these findings by pooling 30 studies that included measures of scientific agreement and concluded that out of all measures, perceived scientific consensus was the 'third largest psychological predictor' (p. 623) of belief in climate change.

These correlational findings paved the way for experimental research attempting to establish a clear line of causality. Some of the first experiments were conducted by Lewandowsky and colleagues [14], as well as van der Linden and colleagues [15] who found in randomized experiments that communicating the scientific consensus on climate change led to not only increased perceptions of scientific agreement but also greater

Figure 1



Gateway Belief Model. *Note*: The GBM posits a two-stage mediational process where exposure to messages about scientific agreement influence perceived consensus. Changes in perceived consensus predict subsequent changes in private attitudes, which, in turn, predict support for public action [3].

personal acceptance that climate change is human-caused. In subsequent studies, van der Linden and colleagues [2,3] consolidated these findings into a hypothesized causal model (the GBM) where changing people's perceptions of the scientific consensus leads to changes in key private attitudes (step 1) that people hold about the issue which, in turn, predict support for public action (step 2).

Since then, numerous studies have found causal evidence for the posited mediational structure of the GBM in that shifting people's perceptions of the scientific consensus leads to positive direct or indirect effects on climate change beliefs and support for public action [6,16–20]. Yet, it is worth noting that studies typically only test a few core mediational mechanisms (e.g., the indirect effect of a consensus message on private attitudes) rather than all hypothesized causal paths of the GBM. Unfortunately, this approach is somewhat inefficient and can lead to conflicting conclusions. For example, some studies tend to focus on the right-hand side of the model (public support) and find no total effect of the consensus message on support for public policy [21,22], and therefore, question the applied relevance of the model [23] but may fail to test for indirect effects via the hypothesized multiple mediators. This is an important step as the scientific consensus message itself does not directly speak to the need for climate action.[a]

To adjudicate on this matter, van der Linden and colleagues recently conducted the largest direct confirmatory replication of the GBM to date in a national sample of 6000 Americans [3]. The authors found that a scientific consensus message had a significant main effect on all hypothesized mediators, including perceived consensus, the belief that climate change is happening, human-caused, how much people worry about the issue, and their support for public action. Results also revealed that while the effect of the scientific consensus message on support for action was largely mediated via changes in private attitudes, a significant direct effect on support for public action remained. The largest effect was on perceived consensus ($d = 0.88$) and the smallest effect on public support ($d = 0.09$). This is consistent with the theory in the sense that the initial consensus-effect results in smaller cascades throughout the model.

Dual-processes, informational influence, and belief updating

Significant debates have erupted over the theoretical status of the GBM as a process model and as a theory of social influence [25]. Although sometimes criticized as being fully systematic in terms of appealing to declarative knowledge and conscious deliberation [23], the GBM is a dual-process theory of persuasion that finds its roots in the classical literature on central vs. peripheral and heuristic-systematic processing [26,27]. In typical consensus experiments, people are exposed to a cue about normative agreement among experts, which is assumed to activate judgmental heuristics stored in memory such as 'expert statements can be trusted' and 'consensus implies correctness' [27, p. 74]. Changes in perceived consensus then influence both how people *think* (belief) and *feel* (worry) about climate change. Nearly all prior theorizing on the GBM has assumed a heuristic processing view [2,3,9,13,14], although no claims have been made as to whether heuristic processing occurs primarily consciously or unconsciously in this context [3]. Moreover, although it is often assumed that people heuristically accept consensus cues, both heuristic *and* central processing routes are possible [28,63], particularly when people have a motivation to elaborate on a message (e.g., through explicit politicization of the consensus, see Ref. [16]) but future research should test more explicitly under what conditions people process scientific consensus cues heuristically versus centrally.

A second discussion revolves around the role of belief updating and what kind of 'information-deficit' the GBM is correcting. At its core, the prototypical consensus message; '*97% of climate scientists agree that human-caused climate change is happening,*' is leveraging both a classic descriptive norm or informational influence [29], as well as an appeal to expert authority [11]. Although people may not (always) identify with scientists as a social group [25], as Cialdini et al. note, 'audiences are powerfully influenced by the combined

[a] It is now well-established that mediation does not require significant total effects from both a statistical and theory development perspective [24]. Moreover, small effects can still have large consequences [see 3, p. 56].

judgment of multiple experts' [30, p. 23]—especially when forming judgments under uncertainty.

Importantly, it is well-known that people misperceive the scientific consensus on climate change [3,31]. This misperception offers an opportunity to 'correct' or 'align' people's perception of the norm with the actual norm. Norm-perception can be used as a vehicle for social change, where correcting people's perception of the norm first often leads to subsequent (smaller) adjustments in private attitudes and behaviors [32]. The GBM operates on the same principle: it is easier to correct people's misperception of the norm than to change deep-rooted worldviews. In short, through an 'estimate and reveal' technique [33], it is assumed that highlighting the gap between people's perception of the scientific norm and the actual norm helps elicit accuracy-motivation. False distinctions between 'cognitive' and 'social' approaches in this context are discouraged [34]. For example, people can learn about the scientific consensus through discussion with people in their social networks, and in turn, greater awareness of the scientific consensus can lead to more discussion about the issue with friends and family [35].

Motivated cognition, ideology, and selective exposure

Another area of debate surrounds the role of political ideology and (directional) motivated reasoning in the GBM. The most uncontroversial aspect of the model is arguably the first step [25]: communicating scientific consensus leads to increased recognition of scientific agreement on the issue—a finding present in nearly all consensus studies [2–7,14–20,22,33,36]. Yet, researchers have questioned for whom these belief updates are occurring? The cultural cognition of scientific consensus thesis specifically predicts that when different groups are exposed to evidence that is (un) congenial to their values and ideology, they polarize away from the evidence [37]. A more specific variant of this is known as the 'motivated numeracy hypothesis,' where polarization is expected to be greatest amongst the most numerate and educated partisans [38]. At least within the literature on scientific consensus messaging, these predictions have not materialized. Studies often show that highlighting the consensus has the opposite effect: reducing political conflict over climate change by bringing the beliefs of liberals and conservatives closer together [2,3,14,18,19,39]—regardless of education level [40]. The predominant explanation for this pattern is that perceived consensus can neutralize politicization as the source of the consensus message is nonpartisan [3], and climate scientists are the most trusted source of information about climate change [9]. In addition, second-order normative beliefs (beliefs about what other groups believe) can function as a nonthreatening gateway to opinion change [also see Ref. 41] especially for conservatives because—as opposed to partisan policy messages—they do not directly threaten underlying worldviews [3]. Although some research finds no significant interactions with ideology [22,33]—implying that the consensus message works equally well across the political spectrum—more nuanced findings also exist [e.g., see Ref. 21]. But even when research finds no general effect, the observation is often made that '*it is notable that a backfiring effect amongst conservatives was not observed*' [21, p. 52]. This is not to say that a backfire effect is not possible; there are isolated instances of backfire [e.g., see Ref. 42], as well as discussions about reactance [43 but c.f., 44]. Moreover, positive consensus effects might also be diminished by negative downstream effects of political ideology on support for action [16], but the general tendency for backfire effects to be uncommon and specific to small subgroups is consistent with a growing literature questioning its stability, generality, and reproducibility [45–48].

Other scholars have noted that motivations and processing goals are typically not manipulated explicitly in climate change experiments (e.g., political ideology is often used as a noisy proxy for prior motivations), and therefore, little can be concluded about the causal role of directionally motivated reasoning in climate change cognition [48]. For example, in one experiment, van der Linden and colleagues [40] replicated a two-way interaction between political ideology and education on a large national sample (balanced on ideology) so that higher educated conservatives were indeed especially unlikely to accept the scientific consensus on climate change. Yet, in the second and experimental part of the study, after exposure to the consensus cue, all groups—including highly educated conservatives—converged toward the scientific consensus. Although ideology was still used as a proxy for motivation, this illustrates the 'observational equivalence' [48] fallacy that can stem from a basic correlation causation error. In other words, having strong priors does not mean that individuals are immune to belief updating. Accordingly, scholars have started to conceptualize the belief updating process from a Bayesian perspective where people may come to the table with prior (identity-based) beliefs but can still update toward (rather than polarize away) from the evidence [42,48].

In fact, a plausible alternative account of lack of updating is rooted in theories of selective exposure and source credibility [49]. Krosnick and colleagues note that it is not motivated reasoning but selective exposure that leads to divergent public opinion on the issue of global warming [49]. It is well-established that consensus cues are highly sensitive to contrarian information [50], and experiments have shown that politicization and disinformation campaigns about the

scientific consensus can cancel out the positive effect of the consensus message [16,39,51]. These findings may help elucidate why only 20% of Americans are aware of the near-unanimous scientific consensus even after several decades of communicating climate science [30]. However, it is important to note that perceived consensus has been on the rise since 2015 and changes in perceived consensus appear to move in tandem with personal acceptance [52].

Open questions in consensus messaging research

Yet, many important open questions remain. For example, some scholars have repeatedly suggested that trust in (climate) scientists could be an influential moderator of the consensus effect [5,53]. Research to date has only found suggestive but not clear evidence that the consensus effect is moderated by trust in science [8,17,42] although different mental models of science (e.g., 'search for truth' vs 'science as debate') may play a role [54]. Identity processes such as the benefits of leveraging prototypical in-group messengers of the consensus message (whether partisan, religious, or otherwise) also remain unexplored in GBM (but see Ref. [55]). In general, future work should consider preregistering hypotheses about conditional effects in the GBM and restrict testing to situations in which high-powered subsamples of the moderator group can be included. Arguably part of the reproducibility issue in the motivated reasoning literature has to do with testing exploratory interactions on small, nonrepresentative samples. The inclusion of moderators also needs to be better justified in the literature not only theoretically but also empirically by demonstrating an improvement in GBM model fit or in terms of consequential effect-sizes of the moderation.

Another important question surrounds the longevity of the consensus effect. As longitudinal studies are generally more intensive and expensive, scant research currently exists on the duration of the consensus effect. Some longitudinal panel studies have started to explore how belief in the consensus at one time point influences acceptance of climate change six months later [see Ref. 56,57]. One study finds that the consensus message decays by about 50% over the course of one week [58], while others have reported no residual effect after several months [22]. A decay function or dose–response model of the consensus effect would, therefore, be a welcome addition to the literature. Related work informed by the literature on experiential vs analytical processing has started to investigate the persuasive appeal of the consensus message as a function of how it is presented, for example, by using entertaining videos, analogies [59], and exemplars [7] rather than factual messages.

Interestingly, little work exists on low-consensus messages. In other words, does decreasing perceived consensus lead to lower belief in climate change, which, in turn, predicts lower support for action? Only a few studies [e.g., 6,8] have investigated this to date, although other studies have shown that interference through dissent [60], politicization [16], and misinformation [39,51,61] can indeed lower perceived consensus and policy support. Yet, formal 'reverse' tests of the GBM are lacking.

Lastly, there is a paucity of fieldwork on the GBM. Perhaps the time is ripe for the ultimate test of any psychological theory: will predictions from the lab emerge in real-world settings? Longitudinal field studies will also offer the possibility of causal chain experiments [62] that go beyond simple mediation in testing the staged process model of the GBM across diverse populations.

Concluding remarks

Although research on the Gateway Belief Model (GBM) is only in its infancy, consistent empirical evidence has emerged on the promising effects of communicating expert consensus. At the same time, key open questions remain. The next generation of research on the GBM should focus on establishing the boundary conditions of the effects for different audiences by more explicitly manipulating the direction of consensus (e.g., high vs low), motivations to process the message (e.g., centrally vs heuristically [63]), the information environment (e.g., contrarian cues) and by testing the model in the field (e.g., via door-to-door canvassing) and in non-WEIRD settings using high-powered samples.

Conflict of interest statement

Nothing declared.

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* of special interest
** of outstanding interest

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