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Using a News Article to Convey Climate Science Consensus Information

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Abstract

The current study investigates how people respond to a climate science consensus statement embedded within a news article. Participants (N = 1,048) were randomly assigned to read a news article about climate change, read the same article with a scientific consensus message included, read a simple consensus statement, or a control condition. Participants in consensus conditions had increased perceptions of scientific agreement compared with those who did not receive consensus information. Moreover, the article was similarly effective as an overt consensus statement. However, neither consensus statement affected other climate change attitudes, suggesting the effect may be limited to consensus perceptions.

Keywords

consensus messaging, climate change, gateway belief model, news articles

Global climate change presents a wide array of risks to both human society and ecological systems. In the United States, climate change has become a politically polarized topic, a trend that appears to be unique to the American public (Hornsey et al., 2018). For example, a recent poll shows that 78% of

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Democrats believe that climate change should be a top priority for the president and congress, but only 21% of Republicans agree, making it the most polarized topic in that poll (Pew Research Center, 2020).

One prominent approach for improving public knowledge about climate change involves communicating the scientific consensus, whereby researchers inform participants that 97% of climate scientists agree that human-caused global warming is happening. There has been abundant experimental work on consensus messaging (e.g., Myers et al., 2015; van der Linden, Leiserowitz, & Maibach, 2019) as well as numerous debates on the topic (Dixon et al., 2019; Kahan, 2017; Kerr & Wilson, 2018; Ma et al., 2019; van der Linden et al., 2017, 2018; van der Linden, Maibach, & Leiserowitz, 2019). Consensus messaging continues to be a prevalent research topic as evidenced by recent studies (e.g., Maertens et al., 2020; Williams & Bond, 2020) and multiple review papers (Bayes et al., 2020; Landrum & Slater, 2020).

Many of the studies using consensus messages provide participants with a single statement. Furthermore, all these experimental studies highlight scientific consensus as the central part of their experimental manipulation. Although this increases internal validity by isolating consensus information, many people will be exposed to consensus information in more subtle ways. For example, is it effective for a news article about an environmental story to mention the scientific consensus? Or is consensus messaging only effective if it is the focal point of a message? The current research adds to the work on consensus messaging by examining a potential boundary condition. We test if embedding consensus information in an environmental article is an effective way of communicating the consensus. Additionally, we examine if the effects of embedded consensus information extend to climate change attitudes in general or just beliefs about consensus. While it is important to test if a consensus message within a news article affects perceived consensus, the strongest practical implications rest on the message's effect on downstream climate change attitudes, such as support for climate action.

The Gateway Belief Model

A two-step framework, the gateway belief model (GBM) posits that increases in consensus beliefs (pre-post) predict increases in beliefs about climate change (e.g., worry), which then predict support for public action on global warming (van der Linden et al., 2015). Given that the scientific evidence for climate change is complex, most people do not directly examine the evidence themselves. Rather, people use agreement among scientists as an indicator of the strength of the evidence for climate change, which in turn informs their beliefs about climate change, further leading to worry and policy support

(Lewandowsky et al., 2013; van der Linden et al., 2015). Studies that use a pre-post design provide direct support for the GBM (e.g., van der Linden, Leiserowitz, & Maibach, 2019). Other experimental studies, using fully between-groups designs, indirectly test the model by measuring perceptions of the scientific consensus on climate change, comparing an experimental group that received a consensus message to participants in a control group (e.g., Bolsen & Druckman, 2018; Brewer & McKnight, 2017; Myers et al., 2015). Despite the variation in study designs, the experimental component of the GBM—that consensus messages increase perceived consensus—is well-supported (see Bayes et al., 2020, for a similar point), though with some exceptions (e.g., Kobayashi, 2018).

Importantly, the effectiveness of a consensus message on other climate change attitudes is less clear. While some studies find that participants who read a consensus message have more belief in global warming and support for action (e.g., Bolsen & Druckman, 2018; Brewer & McKnight, 2017), other experiments (or other dependent variables within the same studies) do not find any effects on downstream climate change beliefs (e.g., Cook et al., 2017; Dixon et al., 2017). Many studies highlight the more nuanced limitations of consensus messaging, such as having limited impacts for certain groups or displaying indirect but not total effects (e.g., Dixon, 2016; Dixon & Hubner, 2018; Kahan, 2017). Some studies—particularly those that use a pre-post design—provide support for the GBM, including the downstream effects on climate change beliefs and support for action (e.g., Goldberg et al., 2019; van der Linden, Leiserowitz, & Maibach, 2019). In summary, the evidence for the GBM and consensus messaging in general is mixed.

Ways of Communicating the Consensus

Despite the plethora of research on consensus messaging, most studies use a single phrase such as "97% of climate scientists have concluded that human-caused climate change is happening" (van der Linden et al., 2014, p. 257). However, a few studies have situated consensus messages in certain formats to increase their effectiveness. Harnessing the persuasive power of metaphors (e.g., Sopory & Dillard, 2002), van der Linden et al. (2014) compared climate change consensus to other expert situations, like a consensus of doctors for a medical diagnosis. Yet the authors found that a simple text or a pie chart were the most effective ways of relaying climate consensus. Relying on work that highlights the power of experience for understanding high probability events (e.g., Hertwig & Erev, 2009), Harris et al. (2019) portrayed consensus using silhouettes of 10 scientists with nine agreeing scientists shaded in green and one dissenting scientist in red. In this message format, which had a positive

(though somewhat weak) effect on perceived consensus, participants were able to experience consensus by visually observing a situation of 90% agreement. Similarly, Brewer and McKnight (2017) provided an opportunity to experience consensus by using a late-night talk show video clip where the host discusses the scientific consensus with one skeptic and a room full of climate scientists, finding that the clip was effective in influencing participants' climate change beliefs. Finally, some work has investigated ways of making messages more engaging through increased vividness (e.g., increasing how emotionally interesting a message is; Nisbett & Ross, 1980). Despite the mixed evidence of vividness as a persuasive tool, vivid messages can be persuasive when the central argument is vivid and is coherent with the rest of the message (Guadagno et al., 2011; Smith & Shaffer, 2000). Applying this work to consensus, Goldberg et al. (2019) found that a vivid video (which also used a metaphor) was especially convincing and was more effective than a transcript of the video.

Central to all of these consensus studies—whether they rely on metaphors, experience, or vividness—is a focus on consensus as the main point of the message. All these methods feature consensus prominently and nearly all solely focus on the scientific consensus. In contrast, the current research tests the boundaries of the effectiveness of consensus messaging by adding a consensus message to the end of a news article about a recent study on climate change. Compared with a simple consensus statement, news articles may be more vivid due to their description of a story with concrete examples and engaging descriptions of events. However, if the news story itself is vivid but the consensus information is added toward the end in a straightforward manner, then the effects of vividness—particularly its effect on memory—may not translate to the consensus message (Guadagno et al., 2011). Although a news article might perhaps be more memorable than a simple consensus statement, we would not necessarily expect this enhanced memory to translate to the consensus message at the end of the article (rather we might expect the main headline to receive the benefits of vividness).

Indeed, there may be reasons to expect that news articles might be less effective than a simple consensus statement. Although a news article may be more ecologically valid than a standalone consensus message, it lacks the overtness of a simple statement. Despite the variety of methods that researchers have used to communicate consensus messages, online news articles as a medium are noticeably missing. One previous study on consensus messaging used news articles as its medium, but the articles were centered on the consensus information and none of the topics involved climate change (Chinn et al., 2018). Another study relied on news articles to frame uncertainty in various ways, although the news article discussing consensus was focused on

scientific disagreement and debate (Gustafson & Rice, 2019). Online news articles are common ways for people to quickly receive news (Wilkins et al., 2018), presenting an opportunity for communicating the consensus. On the one hand, it seems that consensus messaging is effective across a range of mediums and thus will be effective for news articles. On the other hand, there is some evidence that responses are sensitive to the way consensus messages are portrayed (e.g., Deryugina & Shurchkov, 2016; Myers et al., 2015). While news articles could be a particularly effective medium due to their vividness, these benefits may be constrained to the focal narrative of the article rather than the consensus information; this uncertainty leads to our first research question:

> *Research Question 1*: Is scientific consensus information still effective if it is embedded within a longer message?

Hypotheses based on the GBM would predict that consensus messaging is insensitive to medium and would be effective even if presented at the end of a news article. However, given the numerous studies that do not provide support for the GBM, there is evidence to hypothesize that embedding a consensus message in a news article would dilute the intervention and make it even more unlikely to be effective. We test these competing hypotheses for two categories of outcomes: beliefs about the scientific consensus itself (i.e., thinking more climate scientists acknowledge human-caused climate change) and beliefs about climate change in general (e.g., belief about climate change and its impacts). As the research described earlier finds different results for these two outcomes, we investigate if a subtle consensus message influences consensus beliefs as well as climate change beliefs in general.

Politically Driven Responses to Consensus Messaging

Many studies using consensus messaging also investigate its interactions with political ideology. Research on motivated reasoning shows that people are generally overly accepting of information that confirms their prior beliefs and overly critical of information that disconfirms them (Ditto & Lopez, 1992; Kunda, 1990). Abundant evidence suggests that both liberals and conservatives engage in this process of motivated reasoning, including in the environmental domain (Ditto et al., 2019). Some studies even find evidence of a backfire effect beyond simple motivated reasoning, where people actually become more entrenched in their prior beliefs when confronted with counter-attitudinal information (e.g., Lord et al., 1979; Nyhan & Reifler,

2010). Yet the evidence on backfire effects in the domain of climate change is largely mixed, with a range of findings and little theoretical clarity (for overviews, see Druckman & McGrath, 2019; Hennes et al., 2020).

For consensus messaging specifically, the role of political ideology varies. Examining the direct link between treatment and belief in consensus, some experiments find that conservative participants display stronger treatment effects than liberal participants (e.g., van der Linden, Leiserowitz, & Maibach, 2019; van der Linden et al., 2015). For the downstream effects of consensus on climate change beliefs, the evidence is mixed on whether politics moderates the relation. Some studies show decreased polarization after a consensus message (Bolsen et al., 2014), and others show consensus messages work no matter the political beliefs of participants (e.g., Brewer & McKnight, 2017; Myers et al., 2015). A few studies find a backfire effect, where consensus messages provoke less belief in climate change for conservative participants (e.g., Cook & Lewandowsky, 2016; Ma et al., 2019).

The potentially complex relation between politics and consensus messaging led to our second research question:

> *Research Question 2*: Will political ideology moderate the relation between consensus messaging and perceived consensus or climate change beliefs?

Although previous research can be informative for this research question, the current study tests consensus messaging differently than previous experiments. If a consensus message is presented at the end of an article about climate change, perhaps conservatives will have tuned out and not picked up on the message. On the contrary, research in motivated reasoning provides evidence that individuals do not just immediately dismiss counter-attitudinal information; rather, they actually engage with it and look for reasons to disprove the information (Ditto & Lopez, 1992; Lord et al., 1979; Taber & Lodge, 2006). For example, Garrett (2009) found that the amount of counter-attitudinal information in an online news story was positively related to how much time participants spent reading it. Therefore, we would not expect conservatives to dismiss consensus messaging in a news article any more than they would in other mediums, especially within an experimental setting where they are specifically asked to read the article. Based on the mixed evidence reviewed above, we tested two competing hypotheses: ideology will not moderate the relation between a consensus message treatment and perceived consensus or climate change beliefs, and ideology will moderate the relation between a consensus message treatment and perceived consensus or climate change beliefs.

Pilot Study: Method and Results

In a pilot study using a college student sample (final $N = 472$), we tested whether news articles could effectively convey consensus information.[1] We created articles with consensus information and without consensus information, comparing them to a control condition with no article. All participants answered questions about their climate change beliefs and perceptions of the articles. The full results are in the Supplemental Analyses, and the text of all four articles and all study materials and data are available online (https://osf.io/cq8wp/).

Consistent with the GBM, a one-way analysis of variance showed that perceived consensus varied by experimental condition, $F(2, 468) = 9.98$, $p < .001$. Follow-up tests revealed that participants who read articles that included consensus information ($M = 87.36$, $SD = 13.31$) had significantly higher perceptions of the scientific consensus than those in the control group ($M = 79.54$, $SD = 15.84$), Tukey-adjusted $p < .001$, $d = 0.55$, and those in the conditions without consensus information, ($M = 82.83$, $SD = 15.56$), Tukey-adjusted $p = .01$, $d = 0.31$. Perceived consensus in the conditions without consensus information was not significantly different than that in the control group, Tukey-adjusted $p = .17$, $d = 0.21$. Additionally, compared with those in the control condition, participants who read an article with consensus information reported significantly more belief in climate change, perceived risk, and perceived impact ($ps < .05$). However, participants' levels of support for action did not significantly vary by condition. Additionally, political ideology was not a significant moderator of the effect of consensus article on any of the dependent variables.

Main Study

The pilot study provided initial evidence that embedding consensus information into a news article could influence both perceived consensus and other climate change beliefs. Therefore, we conducted a well-powered study to investigate our research questions using a more representative sample than college students. Hypotheses based on the pilot study would predict that people who read a news article with consensus information will have higher levels of both perceived consensus and downstream climate change beliefs than those who do not read an article. In the main experiment, not only did we use a more representative sample but we also added an additional experimental condition to test if news articles are equally effective as stimuli commonly used in consensus messaging experiments.

Method

Participants and Procedure. The study was preregistered (*aspredicted.org*) and recruited U.S. participants from Amazon Mechanical Turk (AMT) to take a "10-minute survey evaluating news items." The target sample size was 1,095 to detect a small interaction effect ($f^2 = .01$) between experimental condition and political ideology.[2] In total, 1,150 people consented to take the study. Following our preregistered analyses, we excluded those who incorrectly answered ($n = 63$) or failed to answer ($n = 20$) an attention check, those who expressed suspicion that the news article was fake ($n = 2$), and those who did not wish for their data to be included ($n = 17$), resulting in a final sample size of 1,048. The sample was majority male (63%) and White (70%), with an average age of 37.67 years ($SD = 11.98$).

Participants were randomly assigned to one of four conditions: two article conditions, a statement-only condition, and a control condition. In all conditions, participants first consented to take part in the study, which was institutional review board approved. Participants in the article (statement) condition were then asked to carefully read a "recent article from the Associated Press" ("statement taken from the news"), answer questions about the article (statement), answer questions about their attitudes on climate change, and finally answer demographic questions. When shown the article, participants could not advance the page until 60 seconds had elapsed (10 seconds for those in the statement-only condition). Participants in the control condition were also assigned to read an article or statement and answer the same questions, but they first answered the dependent variables before seeing the article or statement. At the end of the survey, all participants were debriefed, thanked for their time, and paid.

Stimulus Materials. For the treatment conditions, participants were randomly assigned to read a news article with consensus information (consensus), the same article but without consensus information (no consensus), or consensus information only (statement-only). To create the news articles, we slightly edited the text of a real news article (Borenstein, 2018) describing the results of a study that found that climate change is going to increase the price of beer (Xie et al., 2018). Taking on the logo and look of an *AP News* article, the text described how beer prices are projected to increase because of losses in barley production and discussed some of the impacts of climate change. For the consensus article, we also added two sentences about the scientific consensus on climate change as the second to last paragraph (Figure 1). Importantly, the consensus message was not the main point of the article; rather, the article detailed an outcome of climate change and only mentioned the scientific

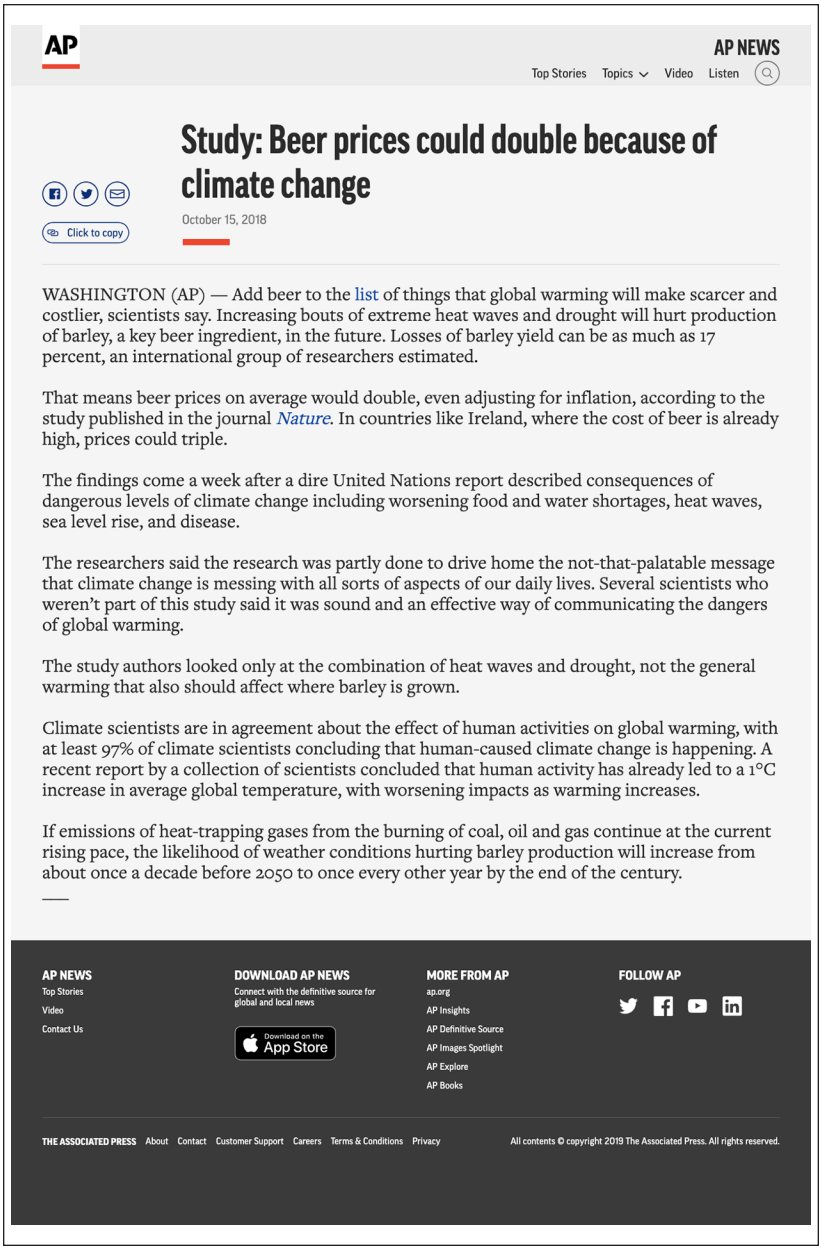

Figure 1. The beer article with consensus information.

consensus at the end. In the statement-only condition, participants read, "97% of climate scientists have concluded that human-caused climate change is happening." This statement was not embedded in an article and was only accompanied by a logo from the American Association for the Advancement of Science ([AAAS], as used in van der Linden et al., 2014).

Measures

Responses to the article. To maintain the cover story of evaluating recent news, we asked participants a few questions about the article or statement. These questions assessed relevance, importance, boringness, and difficulty of reading the article or statement, as well as participants' familiarity with the article or statement (see the OSF page for all study questions).

Perceived scientific consensus. We assessed participants' perceptions of the scientific consensus using two separate items: (1) "What percentage of climate scientists agree that humans are causing global warming," measured on a sliding scale from 0 to 100 ($M = 83.08$, $SD = 16.21$); and (2) "A vast majority of climate scientists agree that humans are causing global warming" (adapted from Brewer & McKnight, 2017), measured on a scale from 1 = *strongly disagree* to 7 = *strongly agree*. While the 0 to 100 item is more commonly used in consensus messaging research, this second item was included to capture a more normally distributed measure of perceived consensus, although scores were still very high ($M = 5.92$, $SD = 1.12$).

Belief in climate change. Belief in climate change was assessed with six items adapted from Dixon et al. (2017), such as "Climate change is a process that is already underway." The response scale ranged from 1 = *strongly disagree* to 7 = *strongly agree*, and the items were averaged to create an index of belief in climate change ($M = 5.10$, $SD = 1.27$, $\alpha = .84$).

Impact of climate change. Similarly, we used three items (Kellstedt et al., 2008) to assess participants' perceptions of the personal impact that climate change will have on their health, their economic situation, and the environment in which they live (e.g., "Global warming and climate change will have a noticeably negative impact on my health in the next 25 years"). Responses were measured on a scale from 1 = *strongly disagree* to 7 = *strongly agree* and averaged together to create an index of personal impact ($M = 5.14$, $SD = 1.26$, $\alpha = .83$).

Support for action. We included one item intended to measure participants' support for people to take more action toward global warming: "Do you think

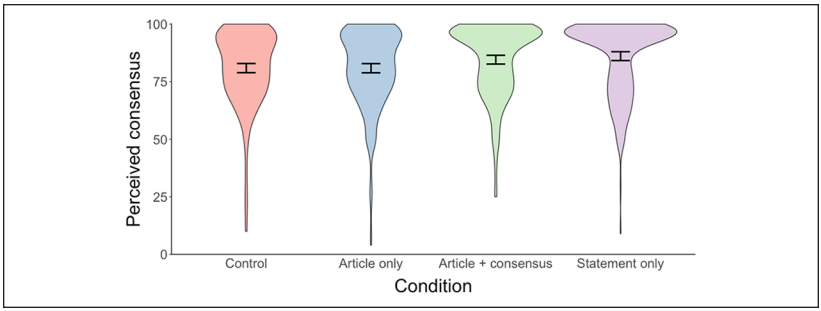

Figure 2. The effect of condition on perceived consensus.
Note. The distributions of perceived consensus scores are displayed separately for each condition, with 95% confidence intervals around each group mean shown in black.

people should be doing more or less to reduce global warming" (from van der Linden, Leiserowitz, & Maibach, 2019). Responses were measured on a scale from 1 = *much less* to 7 = *much more*, with the midpoint at 4 = *Same amount* ($M = 5.44$, $SD = 1.62$).

Political ideology. We measured participants' political ideology with one item from 1 = *very liberal* to 7 = *very conservative*, with an average score of 4.00 ($SD = 1.97$) and a relatively balanced number of participants scoring below the midpoint ($n = 441$) and above the midpoint ($n = 434$).

Results

We first ran a series of one-way analyses of variance to test if the dependent variables varied by experimental condition.[3] Visualized in Figure 2, there was a significant effect of experimental condition on the 0 to 100 perceived consensus variable, $F(3, 1043) = 7.06$, $p < .001$ (Table 1 for descriptive statistics).[4] Follow-up tests revealed that those who read an article with consensus information had significantly higher perceived consensus than those in the control group (Tukey-adjusted $p = .047$, $d = 0.23$) and those in the article without consensus group (Tukey-adjusted $p = .04$, $d = 0.23$). Similarly, those in the statement-only group also had significantly higher perceptions of consensus than those in the control group (Tukey-adjusted $p = .001$, $d = 0.32$) and those in the article without consensus group (Tukey-adjusted $p = .001$, $d = 0.33$). Those who read the article without consensus information were not significantly different than the control group (Tukey-adjusted $p > .99$, $d = -0.003$). Last, the two consensus groups (article and statement) were not significantly

Table 1. Means, Standard Deviations, and Sample Sizes Broken Down by Experimental Condition.

Experimental condition	Perceived consensus	Perceived consensus (Likert)	Belief	Impact	Support for action
Control					
M (*SD*)	80.92 (16.53)[a]	5.87 (1.00)[a]	5.04 (1.20)[a]	5.16 (1.20)[a]	5.34 (1.60)[a]
n	266	266	266	266	266
Article no consensus					
M (*SD*)	80.86 (16.50)[a]	5.83 (1.16)[a]	5.13 (1.24)[a]	5.20 (1.19)[a]	5.52 (1.54)[a]
n	264	264	264	263	263
Article with consensus					
M (*SD*)	84.57 (15.54)[b]	5.98 (1.09)[a]	5.16 (1.32)[a]	5.11 (1.38)[a]	5.52 (1.58)[a]
n	258	259	259	259	259
Statement only					
M (*SD*)	86.09 (15.66)[b]	6.02 (1.21)[a]	5.08 (1.31)[a]	5.08 (1.26)[a]	5.37 (1.75)[a]
n	259	259	259	259	259

Note. Within each column, rows with different superscripts are significantly different (Tukey-adjusted $p < .05$).

different in their perceptions of the scientific consensus on climate change (Tukey-adjusted $p = .70$, $d = 0.10$).

In contrast, experimental condition did not have a significant effect on perceived consensus on a Likert-type scale, $F(3, 1044) = 1.75$, $p = .16$, climate change beliefs, $F(3, 1044) = 0.45$, $p = .72$, perceived impacts, $F(3, 1043) = 0.41$, $p = .75$, or support for action, $F(3, 1043) = 0.96$, $p = .41$.[5]

To test if political ideology moderated the effect of experimental condition, we ran a series of linear regressions with the interaction between ideology and experimental condition predicting each outcome. As displayed in Table 2, ideology was not a significant moderator for either perceived consensus variable or any of the three downstream climate change attitudes dependent variables.

Discussion

The current research was conducted to test if consensus information embedded within a news article could be an effective way to convey a consensus

Table 2. Linear Regressions for the Interaction Between Condition and Ideology.

	Perceived consensus	Perceived consensus (Likert-type)	Belief	Impact	Support for action
	b [95% CI]	*b* [95% CI]	*b* [95% CI]	*b* [95% CI]	*b* [95% CI]
Intercept	81.05*** [78.99, 82.84]	5.88*** [5.76, 5.99]	5.06*** [4.93, 5.18]	5.16*** [5.02, 5.30]	5.37*** [5.18, 5.53]
Article without consensus	−0.02 [−2.83, 2.79]	−0.04 [−0.22, 0.14]	0.09 [−0.10, 0.28]	0.04 [−0.16, 0.24]	0.16 [− 0.08, 0.42]
Article with consensus	3.25* [0.54, 5.86]	0.08 [−0.10, 0.25]	0.05 [−0.14, 0.24]	−0.08 [−0.30, 0.13]	0.11 [−0.14, 0.35]
Statement only	5.10*** [2.41, 7.73]	0.14 [−0.04, 0.33]	0.03 [–0.16, 0.22]	−0.07 [−0.27, 0.13]	0.01[−0.25, 0.27]
Conservatism	−2.14*** [−3.17, −1.09]	−0.18*** [−0.24, −0.12]	−0.31*** [−0.38, −0.24]	−0.17*** [−0.24, −0.10]	−0.35*** [−0.43, −0.26]
Conservatism * No consensus	0.68 [−0.76, 2.14]	0.03 [−0.06, 0.12]	0.06 [−0.04, 0.15]	0.04 [−0.06, 0.15]	0.10[−0.03, 0.22]
Conservatism * Consensus	−0.20 [−1.50, 1.15]	−0.01 [−0.09, 0.07]	−0.09 [−0.18, 0.01]	−0.06 [−0.17, 0.05]	−0.05 [−0.18, 0.07]
Conservatism * Statement	0.10 [−1.10, 1.45]	0.02 [−0.07, 0.12]	−0.04 [−0.13, 0.06]	−0.004 [−0.11, 0.10]	0.01 [−0.11, 0.15]
N	1,044	1,045	1,045	1,045	1,045
R^2	0.08	0.09	0.27	0.08	0.17
F	12.76***	15.27***	54.61***	13.25***	29.71***

Note. Confidence intervals are bias-corrected and accelerated. Because the condition variables were dummy coded and conservatism was mean centered, the intercept represents the mean of the control condition for those with average conservatism.
*$p < .05$. **$p < .01$. ***$p < .001$.

message. In terms of changing beliefs about the scientific consensus on climate change, the results suggest yes: an article with consensus information significantly increased perceptions of consensus compared with a control group. In addition, the pilot study provided some initial evidence that consensus messages can influence general attitudes about climate change. However, in the main study, the effectiveness of the consensus article was generally limited to perceived scientific agreement, not affecting other beliefs about climate change. This key distinction—agreement with consensus versus downstream climate change attitudes—reflects previous research on the limitations of consensus messaging. Additionally, while embedding the message in the article did not detract from its impact, as evidenced by the similar effect of the overt statement, the article did not confer additional benefits beyond the standalone statement. This is in line with research on vividness that shows the persuasive impact of vividness is limited to the vivid part of the message (Guadagno et al., 2011).

The findings suggest that people can update their beliefs about consensus without altering other beliefs about climate change. Though perceived scientific consensus is tightly linked with other climate change beliefs (e.g., Ding et al., 2011)—and perceptions of scientific disagreement can fuel climate change skepticism (Gustafson & Rice, 2019)—consensus messages do not always correspond to increased belief in climate change. This disconnect may stem from a politicization of climate science (Gehlbach et al., 2019); perhaps conservatives can acknowledge that consensus among climate scientists exists, but remain unconvinced themselves and refrain from updating their beliefs about climate change in the face of consensus messages. Previous research finds that people can ultimately come to acknowledge counter-attitudinal facts while still rejecting the implications of those facts or selectively rationalizing them (Bisgaard, 2019; Ditto & Boardman, 1995). In contrast, since climate change is important to those on the left (Pew Research Center, 2020), perhaps liberals can believe strongly in climate change, and support climate policy, even if they are unaware of the specific level of agreement between climate scientists. While consensus messages may increase their perceptions of consensus, their downstream attitudes might be unchanged and remain at high levels. Our study highlights that consensus messages can influence consensus beliefs without changing other climate change beliefs, though the specific reasons for this disconnect are unknown.[6]

Adding to current debates (e.g., Ma et al., 2019), the findings do not provide any evidence for a backfire effect among conservatives. This is consistent with other work finding that political partisans may not engage in directional motivated reasoning as much as previously thought (Druckman & McGrath, 2019). The current findings could reflect that participants were

generally motivated to be accurate, with consensus information leading to increased perceived scientific consensus across the political spectrum (though this is only speculative as the study was not designed to probe for motivation). Given that the samples were not representative of the American political population, the current research is not a strong test of backfire but does provide suggestive evidence against it.

Surprisingly, consensus messages were only effective when perceived consensus was measured on a scale from 0 to 100 and not when measured as a Likert-type scale of agreement with the consensus. This could be due to a ceiling effect—the average perceived consensus score was nearly 6 out of 7—or it could be due to the ambiguity of the phrase "vast majority." We used this term to convey a strong majority, but it is unclear whether participants interpreted this as 60%, 70%, 80%, 90%, 99%, or some other percentage. There may have been more variance in responses if all participants had interpreted this as 97% or a similarly high percentage. Moreover, this is in line with previous research that it is important to convey 97% in consensus messages rather than just stating a majority (Deryugina & Shurchkov, 2016; Myers et al., 2015); this distinction between 97% and majority may play a role not only in experimental manipulations (e.g., effectiveness of 97% messages vs. others) but also in the measurement of the dependent variable.

Limitations

The current research has a number of limitations. First, it relied on convenience samples that are not representative of the general population. There is robust evidence that experiments using students and AMT have similar results as those using more representative samples (Buhrmester et al., 2011; Coppock et al., 2018; Crump et al., 2013; Mullinix et al., 2015); however, given that these samples may differ on key moderating variables (e.g., ideology), there may be differences in the observed treatment effects compared with those of nationally representative samples (Boas et al., 2020; Druckman & Kam, 2011). Moreover, both samples were likely more liberal than the general population and—although we tested for moderation between ideology and treatment—we may not have captured the behavior of representative liberals and conservatives (for more on AMT and political ideology, see Clifford et al., 2015). The left-leaning nature of the samples also plays out in the acknowledgment of consensus and overall strong beliefs about climate change. The effect sizes for perceived consensus were small, perhaps because of a ceiling effect from the more liberal student and AMT samples.

Second, although the results may generalize to other news articles, there could be aspects of this specific news article that influenced the results. For

example, because the article focused on the effects of climate change on beer, perhaps participants were particularly intrigued by the article and paid more attention to it. However, by comparing the article with consensus information to the same article without the information, we aimed to isolate the specific impacts of consensus information by keeping the article constant. Future research should investigate different types of articles to test if the type of article interacts with consensus information.

Third, we forced participants to stay on the page for at least 60 seconds which, along with paying participants to read the article as part of a study, increased the likelihood that they would read the full article. Although this was helpful to maximize participant engagement, it also reduced the ecological validity of the experiments. When people typically read news online, they are not forced to stay on the page for a certain amount of time or read an entire article. People likely read only headlines or the first few paragraphs of an article—if consensus information is embedded at the end of an article, many people may never see it. The current studies extend research on the GBM by using a subtle manipulation in a commonly seen online format, but more research is needed to increase the ecological validity of the manipulation in order to fully generalize to real online behavior.

Fourth, the consensus message in the article and the one in the statement-only condition differed slightly in ways that may have affected their effectiveness. The statement-only condition included the AAAS logo whereas the message in the article was presumably written by the author of the article (rather than a quote from the researchers or other scientists). Although this did not seem to limit the effectiveness of the article to convey consensus compared to the statement alone, consensus information is likely best presented (or endorsed) by scientists (e.g., with the AAAS logo). Additionally, the consensus message in the article included the amount of observed temperature rise while the statement by itself only included the level of consensus. While these differences between the two consensus messages may have influenced participants in subtle ways (e.g., AAAS message as more credible), the similar results of the two messages suggest that consensus messages are robust to these slight variations in description.

Conclusion

While there has been an abundance of research on consensus messaging, many questions remain. In a recent review, Bayes et al. (2020) noted that "we have little understanding about the ways in which variations in the wording of consensus messages, as well as the context and timing of any study, shape

the effectiveness of the overall strategy" (p. 7). Addressing this gap, the present findings suggest that consensus messaging can be employed even when scientific consensus is not the center of a message or the main point of an article. Traditional ways of communicating scientific consensus in experiments rely on straightforward and overt messages, unique to a research experiment. Not only do these methods tend to lack context (e.g., single statement on a page), but they also make the experimental manipulation very clear, increasing the possibility of demand characteristics. Including the consensus information at the bottom of a news article increases the ecological validity (news articles are a common medium for receiving climate change information) and makes it less obvious that the experimenter is interested in the effect of this consensus information. The current studies find that this subtle and more ecologically valid presentation of consensus has a similar effect as an overt message. Because the current findings provide no evidence of a strong backfire effect among conservatives, there seems to be little downside to adding consensus messages to news articles on climate change whenever possible. At the same time, however, the current research fails to provide evidence of much upside of consensus messages. If consensus messaging only influences perceived consensus with little impact on other climate change attitudes, then it has few practical implications. Future research should continue to address the mixed findings of consensus messaging by investigating the situations for which these messages impact attitudes beyond perceived consensus.

Authors' Note

All data and study materials are publicly available at https://osf.io/cq8wp/.

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Notes

1. The design of the pilot study was informed by a study conducted using similar stimuli but without a consensus manipulation. Additionally, another study (similar to the main study) was conducted with a different convenience sample and found comparable results. See the Supplemental Analyses (available online) for more information about both of these studies.
2. The target sample size was calculated using G*Power (Faul et al., 2007). Given the difficulty of detecting interaction effects, we powered the study (80% power) to detect a very small effect ($f^2 = .01$) using the setting: "*F* test: Multiple Regression – Fixed model, R^2 increase."
3. These analyses are slightly different from the preregistered plan (revised based on reviewer feedback). Results analyzed using the preregistered plan are in the Supplemental Analyses (available online).
4. As would be expected, the perceived consensus variable was negatively skewed. Most studies in consensus messaging still analyze this outcome variable using parametric tests (e.g., *t* tests, regression). Regressions with robust standard errors are reported in the Supplemental Analyses (available online).
5. Since the GBM predicts that changes in perceived consensus lead to changes in climate change attitudes, we also tested mediation models with the three climate change attitudes variables as outcomes and perceived consensus as the mediator, comparing the consensus article with the control condition. The consensus article had a significant positive indirect effect on each outcome variable through perceived consensus, although without a pre-post design we could not directly test the GBM. Full mediation results are shown in the Supplemental Analyses (available online).
6. Another explanation is that the effect of consensus messages on perceived consensus is larger than the effect of the message on downstream climate change attitudes, making it difficult to detect the latter. This is reasonable to expect given that perceived consensus is the target of the message. This distinction could lead to small effects on perceived consensus and even smaller effects (and thus nonsignificant) on other climate change beliefs. A pattern such as this would imply that there is not a strict disconnect between perceived consensus and other climate change beliefs, but rather the impact of consensus messages on downstream climate change beliefs is often too small to detect.

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