Improving GM consensus acceptance through reduced reactance and climate change-based message targeting

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Abstract

Public understanding of and support for GM foods in the U.S. are generally low and out of step with the scientific community, and particularly among those who identify as environmentalists. In order to communicate the scientific consensus on GM foods to these audiences, messages may need to be tailored to reduce reactance. We employ a messaging experiment that tests the potential for first-person narratives to link acceptance of the scientific evidence on climate change to the scientific evidence on GM foods among individuals high in environmental concern. Our study found that such messages were generally more effective than non-narrative or narrative without climate change information, and they were especially effective at conveying scientific consensus and influencing personal views on GM foods among those who identify as environmentalists, through reduced reactance. The results offer evidence of a theoretically driven, practical technique for communicating scientific consensus about GM foods in a way that can help reduce reactance in people who are especially likely to oppose GM foods.

Keywords: genetic modification, scientific consensus, environmentalism, reactance, climate change

Accepted at *Environmental Communication*

Controversies surrounding issues such as climate change and vaccines have demonstrated not only the ease with which science information can be misused or misinterpreted but also the difficulty of correcting false beliefs and persuading individuals to accept scientific consensus on controversial topics. One such controversial science issue is genetically modified (GM) foods. Although several GM foods are widely available for consumer purchase and there is scientific consensus that GM foods are as safe as conventionally grown foods (National Academies of Sciences, Engineering, and Medicine, 2016), a majority of Americans have little knowledge of GM foods, or believe that they are harmful to human health and the environment (Funk & Kennedy, 2016). In the U.S., the issue of GM foods has not been polarized along partisan lines as with issues like climate change and stem-cell research, but the public are still exposed to a wide range of conflicting information about GM foods that varies considerably in its accuracy (Ronald, Jiang, Anderton, & Barnett, 2018). Because of this, the challenge of how to communicate scientific consensus on GM remains.

Many scientific issues present unique communicative contexts that can inhibit the acceptance of science information and expert conclusions. In the context of GM foods, messages that contain folk biology or incorrect information about how genes work are often appealing to the lay public and can be difficult to refute or debunk because they intuitively feel correct (Blancke, van Breusegem, De Jaeger, Braeckman, & van Montagu, 2015). Further, there is an overwhelming preference for "natural" in our food system, which informs attitudes about GM foods (Gaskell, Allum, Wagner, Kronberger, Torgersen, Hampel, & Bardes, 2004; Rozin, Spranca, Krieger, Neuhaus, Surillo, Swerdlin, & Wood, 2004; Scott, Inbar, Wirz, Brossard, & Rozin, 2018). Even conveying that there is scientific consensus on the safety of GM foods has not been particularly effective in swaying public opinion among those who strongly oppose it (Dixon, 2016; Landrum, Hallman, & Jamieson, 2018). Our research draws on previous work on reactance, narrative persuasion, and science communication to examine how non-fictional narrative messages can be used to inform and persuade audiences of scientific consensus of GM foods, via reducing reactance.

Reactance is a psychological state that is aroused when a person perceives that their autonomy or freedom has been threatened; it can result in negative affective and cognitive responses, as well as the motivation to reject the message that inspired reactance (Dillard & Shen, 2005; Moyer-Gusé & Nabi, 2010; Rains & Turner, 2007). Our study examines two particular message strategies that have been shown to effectively reduce reactance. Narrative messages and messages that connect an issue to other resonant values have both been shown to reduce reactance in target audiences. Our experiment tests the effects of combining these strategies, using real world video messages, to examine the effectiveness of a narrative that compares the science of GM foods to the science of climate change. We find that narrative messages are more effective at conveying scientific consensus than direct messages, as they lead to a reduction of psychological reactance. We also find that among those who identify as environmentalists, narrative messages that compare the science of GM to the science of climate change are more effective at reducing reactance than other narrative messages.

Risks and benefits of GM foods

The issue of GM foods is particularly important because they have the potential to help address global issues related to famine, disease, and the environmental impact of conventional agriculture. As with many new technologies, there are real risks and benefits associated with their use around the world. With regards to human health, long-term studies have yet to be conducted, but based on the epidemiology studies concluded thus far there were no differences noted in human health risks from consuming products containing GM ingredients compared to consuming non-GM products (Institute of Medicine and National Research Council, 2004;

National Academies of Sciences, Engineering, and Medicine, 2016). In fact, genetic engineering is able to precisely alter genetic materials to produce crops that can enhance human health (Voytas, 2014). For example, genetic engineering is being used to produce plant-based applications such as tomatoes with high levels of cancer fighting antioxidants (Purdue University, 2002), peanuts without the protein that causes allergies (Dance, 2018), rice with enhanced vitamin A to prevent blindness (Dubock, 2017), and wheat that produces less gluten (Saplakoglu, 2017). Animal-based applications produced through genetic engineering include pigs that produce low-fat bacon (Stein, 2017) and mosquitos that can reduce the spread of Zika and other diseases (Olena, 2017).

Similarly with regards to environmental impacts, there have been no studies that have shown GM crops to have harmful effects on the environment, though there is a need for longitudinal analyses to ensure that GM applications do not have negative environmental effects (National Academies of Sciences, Engineering, and Medicine, 2016). GM applications have been found to reduce insecticide and herbicide use compared to conventional methods of growing maize and soybeans (Perry, Ciliberto, Hennessy, & Moschini, 2016). No effects on insect diversity have been noted (Entomological Society of America, 2014; Truter, Van Hamburg, & Van Den Berg, 2014) and instead some even note increase in insect diversity (National Academies of Sciences, Engineering, and Medicine, 2016). There have however been effects on the growth of weeds in some locations developing resistance to the herbicide glyphosate, which has been reported as an environmental issue (Borel, 2018; National Academies of Sciences, Engineering, and Medicine, 2016). There is also an on-going debate on whether the decrease of Monarch butterflies can be attributed to GM crops (Clarke, 2001; National Academies of Sciences, Engineering, and Medicine, 2016; Losey, Rayor, & Carter, 1999). To summarize, GM foods are not without potential risk, but they also present potential benefits for a wide range of stakeholders. As adoption and regulation of GM foods continues across the globe, there is a need for an informed public debate that examines the possible and acceptable risks, given the potential benefits.

Public attitudes

Despite the global, scientific conversations about the risks and benefits of GM foods, most Americans have heard little or nothing about foods with genetically modified ingredients (Pew Research Center, 2018). Some estimates suggest that as much as 75% of processed foods in the U.S. contain GM ingredients, but only 26% of people believe they have ever eaten food containing such ingredients (Hallman, Cuite, & Morin, 2016). Though people have generally heard little about GM foods, the public tends to be wary of them. About 57% of Americans believe GM foods are unsafe to eat (Funk & Kennedy, 2016) and 47% say they would not knowingly eat GM crops (Runge, Brossard, Scheufele, Rose, & Larson, 2017). As described above, scientific reviews have generally found that GM foods are as safe as conventionally grown foods when it comes to human consumption. The belief gap between the scientific community and the lay public on GM foods is larger than it is for other controversial issues like climate change, nuclear energy, or evolution (Funk & Rainie, 2015). Further, this general wariness seems to be increasing, especially among those with lower levels of scientific knowledge (Pew Research Center, 2018). It is unclear why these perceptions are increasing, but there are several possible explanations including lay public perception of GM foods as unnatural or immoral (Blancke et al., 2015; Hasell & Stroud, 2019; Rozin et al., 2004) and news media coverage surrounding labelling laws (Bulter & Vossler, 2017).

It is worth noting that though people seem to be generally averse to GM foods, most do not have a particularly strong interest in or concern about the issue. Only 22% of Americans care a great deal about the issue of GM foods (Pew Research Center, 2018). For those who are most concerned about GM foods, perceptions of potential risks seem to be driving attitudes. They tend to believe that GM foods are very likely to lead to health and environmental problems for the larger population; this group also sees a lower likelihood of benefits (Pew Research Center, 2018). This is consistent with reviews of research that find attitudes about GM foods tend to be driven by perceptions of known and unknown risks, rather than perceptions of potential benefits (Finucane & Holup, 2005; Scott et al., 2018). In other words, most people are not very concerned about the issue of GM foods, but those who are, tend to be very concerned about the perceived potential risks to human health and the environment.

Together, this research shows that people have pervasive concerns about the risks of GM foods, despite the general scientific consensus that they are safe for human consumption. At the same time, the majority of Americans say science has had a mostly positive effect on the quality of food in the U.S. (Pew Research Center, 2018). This brings up the question of why people have general aversions to GM foods, while still holding mostly positive views of science's role in the food supply. A great deal of research has attributed these attitudes to strong preferences of naturalness in foods (Gaskell et al. 2005; Rozin et al., 2004; Scott et al., 2018). These ideas about naturalness are intuitively appealing to the lay public, who are often unable to devote the time and energy needed to acquire working knowledge of complex science (Blancke et al., 2015). Belief that nature is inherently good or benevolent—known as the naturalistic fallacy—seem to be especially relevant to beliefs about GM foods (Blancke et al., 2015; Scott et al., 2018). The idea that genetic modification is unnatural or somehow immoral pervades many of the conceptions that the lay public has about GM foods (Hasell & Stroud, 2019; Rozin et al., 2004; Scott et al., 2018). These intuitive ideas about the naturalness and purity of food appeal to a wide range of people, though there is little scientific evidence to support them.

Communicating Science

Because of this state of public understanding of GM foods, there is a need to understand how science communicators, scholars, and journalists, can present information about GM foods in a way that encourages consideration of the scientific evidence rather than in favor of pseudo-scientific arguments. Messages that emphasize scientific consensus offer one way to do this. Research has demonstrated that perceptions of scientific consensus are associated with attitudes that are more consistent with science (Kerr & Wilson, 2018; Lewandowsky, Gignac, & Vaughan, 2013; McCright, Dunlap, & Xiao, 2013; van der Linden, Clarke, & Maibach, 2015; van der Linden, Leiserowitz, & Maibach, 2019). For example, one study found that an increase in perceptions of scientific consensus on vaccines lead to an increase in belief in vaccine safety and more public support for vaccines (van der Linden et al., 2015), and similar results have been found on the issue of climate change (e.g., van der Linden et al., 2019).

However, direct communication of the scientific consensus on such issues may instead induce reactance (Byrne & Hart, 2009; Cook & Lewandowsky, 2016; Hart & Nisbet, 2012; Ma, Dixon, Hmielowski, 2019; Zhou, 2016). Psychological reactance theory posits that humans need autonomy and like to have control over their decisions. People respond to threats to their autonomy with negative thoughts and anger that lead to opposition to the threat by behavior or attitude (Brehm, 1966; Brehm & Brehm, 1981). Researchers conceive of reactance as the perception of threatened autonomy, the arousal of motivation to reject messages inspiring it, and the resultant negative affective and cognitive responses (Dillard & Shen, 2005; Rains & Turner, 2007). To understand how these intertwined processes intervene in audiences' reception of persuasive messages, researchers employ approaches such as gauging the degree to which audiences feel their freedom threatened by a message (Moyer-Gusé & Nabi, 2010; Moyer-Guse, Jain & Chung, 2012) and the generation of thoughts that dispute the persuasive message (i.e., counter-arguing) (Slater & Rouner, 2002).

This psychological reactance can have important influences on persuasive messages, as it can negatively impact compliance with health advice, beliefs about controversial policies, and attitudes about scientific issues (Gardner & Leshner, 2015; Ma et al., 2019; Miller et al., 2007). As such, simply providing information about scientific consensus may not be enough to overcome lay (mis)understanding about GM foods. Research that has examined the effect of consensus messaging in the context of GM foods has found consensus messages to be either mostly ineffective (Landrum et al., 2018) or only effective among those who were not predisposed to have negative attitudes towards GM foods (Dixon, 2016); though this research did not directly examine reactance.

Given this prior research on consensus messaging, it is worth exploring ways in which strategic communicators can tailor consensus messages themselves to reduce reactance. There are a number of ways in which researchers attempt to do this, but two methods in particular have shown to be effective. The first is using narrative persuasion to reduce reactance. Research has begun to explore how non-fictional narratives can influence attitudes by reducing these responses (Cooper & Nisbet, 2016; Kreuter et al., 2007; Weber & Wirth, 2014). Narrative styles, across a range of formats, rely on the fact that people easily process information in story form (Dalhstrom, 2014; Green, Strange, & Brock, 2002). They tend to be effective because they can reduce the motivation to respond to information with reactance and counterarguing (Gardner & Leshner, 2015) and can encourage people to accept normative evaluations (Slater & Rouner, 2002). Research has demonstrated that non-fiction narratives have been successful in communicating complex science to lay publics (Dalhstrom, 2014) and such narrative styles may provide a good opportunity to communicate scientific consensus. Researchers have discussed the idea of using narrative to reduce reactance to consensus messaging (e.g., Dixon, 2016), but to our knowledge, there is little research that tests the effect of narrative consensus messaging.

In addition to conveying consensus in narrative form, another practical way to limit reactance might be to connect scientific consensus about GM foods to other relevant values. Prior attitudes, worldviews, and values all play an important role in shaping opinions. Information that challenges existing views is often subject to motivated reasoning or biased processing so that it has little effect on those views (Kahan, 2015; Lodge & Taber, 2013). These prior views can influence the experience of reactance. For example, Ma et al. (2019) found that climate skeptics experienced the most reactance in response to a consensus message about climate change. With regards to GM foods, studies have found that consensus messages have the least effect on those with previous negative attitudes about GM foods, which are often the audience consensus messages are aiming to reach (Dixon, 2016). As described earlier, attitudes about GM foods can be heavily influenced by intuitively appealing arguments and messages about the naturalness of GM foods or the morality of editing the genetic makeup of organisms (Blancke et al. 2015; Hasell & Stroud, 2019; Scott et al., 2018). Connecting issues to other relevant values can reduce the experienced reactance. For example, researchers have found that they can mitigate solution aversion by focusing on solutions that are amenable to an otherwise-threatened identity (Campbell & Kay, 2014; Kahan, Jenkins-Smith, & Braman, 2011; Kahan, Jenkins-Smith, Tarantola, Silva, & Braman, 2015). For example, free-market climate change solutions are more appealing to American conservatives and can reduce rejection of climate science (Dixon et al., 2017).

Extending this approach, our focus here is to combine these two effective techniques by using a narrative structure that appeals to the audience’s objective considerations in other scientific domains. Communicators may effectively convey expert consensus on a contested scientific issue when they make use of a narrative structure that connects the contested issue with a more value-resonant one. In this case, we propose that linking the science of genetic modification to scientific consensus on climate change will reduce reactance to the former among those inclined to be concerned about climate change. We focus on climate change specifically because environmentalism is positively associated with acceptance of climate change consensus (Whitmarsh, 2011), but negatively with attitudes about GM foods (Hall & Moran, 2006; Hossian et al., 2003; Tanner & Wolfing Kast, 2003). Global environmentalist activist groups have taken official positions against GM foods, and have produce campaigns against GM foods (Purdue, 2000; Resiner, 2001). Further, research on environmental activists found they tend to oppose GM foods (Hall & Moran, 2006). Other research suggests that environmentalists are more likely to perceive GM foods as unnatural or immoral (Dunlap et al., 2000; Lull & Scheufele, 2017). Because of this, it may be useful for messages to leverage environmentalists' deference to the climate change consensus to decrease reactance to scientific consensus on GM.

Beyond the obvious benefit of appealing to an audience's existing values, there are several—not mutually exclusive—theoretical explanations for why connecting genetic modification to climate change might facilitate the communication of scientific consensus for those more concerned about the environment. One account of how the inclusion of climate change consensus may increase receptivity to information about GM foods is through schema. The interpretation of information is influenced by pre-existing meaning structures, or schemas (Entman, 1993; Scheufele, 1999). Tailored messages may take advantage of audiences' underlying belief structure for climate change and encourage the use of this schema as a model for GM beliefs that is more open to consensus information. There is also evidence that attitudes about more established attitude objects may shape attitudes toward related, but more novel objects, serving as an anchor (Akin, Yeo, Wirz, Scheufele, Brossard, Xenos, & Corley, 2018). Inclusion of climate change in a message about the scientific evidence concerning GM foods may encourage such "spill-over" effects (Akin et al, 2018). Similarly, another potential account comes from balance theory (Heider, 1958; Binder et al., 2016), a theory of cognitive consistency that shares many key concepts with cognitive dissonance theory (Festinger, 1957). Individuals may strive to maintain consistency among their newly-linked attitudes on GM and climate change, and thus update the former to match the latter. Through these related mechanisms, messages connecting genetic modification to climate change may reduce reactance to GM foods among those who are concerned about climate change.

Putting this all together, we first posit that exposure to narrative messages about the scientific consensus on GM foods will increase belief in scientific consensus (H1a) and increase belief that GM foods are safe to eat (H1b) compared with exposure to a control condition. Our second hypothesis states that exposure to narrative messages about the scientific consensus on GM foods will increase belief in scientific consensus (H2a) and increase belief that GM foods are safe to eat (H2b) compared with exposure to a non-narrative consensus message. We also posit experienced reactance will mediate the relationship between exposure to narrative messages and both belief in scientific consensus (H3a) and belief that GM foods are safe to eat (H3b). Finally, we hypothesize that a narrative message in which the speaker discusses scientific evidence about GM safety while drawing a comparison between the science of GM and the science of climate change would lead to greater belief in the scientific consensus regarding the safety of GM foods among those who identify as environmentalists, through reduced reactance (H4a). We also propose that the same model will lead to greater personal belief in the safety of GM foods (H4b).

Methods

Sample

Participants were recruited to participate in this online survey experiment by Research Now and the survey was hosted by Qualtrics. Participants were compensated by Research Now.

All data were collected between March 28 and April 5, 2017, and the sample consists of adults living in the U.S. of 18 years or older (N=1157), who completed the survey within one hour (we exclude 75 participants who completed the survey in more than 1 hour). The mean age of the sample was 45.66 (SD = 15.81), of which 55.2% were women and 80.3% were white. The sample had a median education of a bachelor's degree, and median household income of $75,000-100,000. Party affiliation was measured with a 7-pt. item ranging from Strong Democrat (1) to Strong Republican (7) (M = 3.85, SD = 1.96). Religious attendance was measured from never (1) to more than once a week (5) (M = 2.20, SD = 1.30). 76.7% of participants had no children under the age of 18 living in their household.

Design

Our experiment tests the effect of three messages conveying similar information about the safety of GM foods. The messages are taken from real world footage of environmental activist Mark Lynas speaking at the 2013 Oxford Farming Conference. In the videos, he discusses the scientific evidence for the health and safety of GM foods and crops. In the first condition, Lynas explains the scientific community's conclusions about the benefits and safety of GM foods in a non-narrative style (N = 250), directly explaining the scientific consensus of GM foods. This treatment is 1:30 in length. In the second condition, Lynas explains his previous inaccurate beliefs about GM foods and his current, revised beliefs—the latter being the same scientific conclusions about the benefits and safety as in the first condition—in a narrative style (N = 229). This treatment is 1:23 in length. In the third condition, Lynas describes how he used to have certain incorrect beliefs about GM foods but now believes the scientific community's conclusions, while explaining how he changed his mind, also in a narrative style (N = 297). In his brief explanation of how he changed mind, he draws a comparison between the science of GM and the science of climate change, arguing that in either case, beliefs should be evidence-based. This treatment is 3:15 in length. Our design allows us to test non-narrative messaging against narrative messaging at equivalent lengths (conditions 1 and 2). To examine the effects of climate change-based targeting, we allow the third message treatment to be longer. Not balancing all three by length lets us maintain equivalent length for conditions 1 and 2 while avoiding the introduction of potentially confounding content to these conditions.

We also included a control condition which had no mention of genetic modification (N = 381). Instead of seeing a video of Mark Lynas, participants in the control condition were asked to read a brief paragraph about baseball before they were asked to respond to survey questions about the dependent variables and demographics.[1] Participants in the video conditions completed the experiment in a median time of 14.10 minutes (M=15.95 minutes, SD=8.47). Participants in the control condition completed the experiment in a median time of 8.72 minutes (M=10.83 minutes, SD=8.01)

Procedure

Once respondents agreed to participate in the study, they were randomly assigned to one of the three experimental treatments or the control condition. Participants assigned to one of the three experimental treatments were then asked to respond to survey questions related to the moderating variable, mediating variables, and dependent variables, followed by demographic questions. Participants assigned to the control condition were asked to respond to survey questions related to the moderating variable and dependent variables, followed by demographic questions. They were not asked to respond to the mediating variables and so respondents assigned to the control group are excluded from the mediation analyses used to test Hypotheses 3 and 4.

Moderating variable

[1] The transcripts of the video stimuli can be found in online Appendix A.

Environmentalism. Environmentalism was measured on a 7-point scale of strongly disagree to strongly agree, using five items (M = 4.95, SD = 1.23, α = 0.87). The items included statements such as "I consider myself an environmentalist" and "Our children's lives will be worse because of our current wasteful habits," (Veenstra et al., 2016)[2].

Mediating variables

Reactance. Reactance was measured on a 5-point scale of strongly disagree to strongly agree, using four items (M = 2.81, SD = 0.95, α = 0.86). The items included statements such as "The video tried to pressure me to think a certain way" and "The video tried to make a decision for me," (Moyer-Gusé, Jain, & Chung, 2012; Moyer-Gusé & Nabi, 2010).

Counterarguing. Counterarguing was measured on a 5-point scale of strongly disagree to strongly agree, using four items (M = 2.91, SD = 0.73, α = 0.69). The items included statements such as "I found myself actively disagreeing with the speaker" and "I was looking for flaws in the speaker's argument," (Nabi, Moyer-Guse, & Byrne, 2007). We modeled counterarguing as an alternative to reactance for the mediating variable for all mediation analyses. For space considerations, these results are reported in online Appendix B.

Dependent variables

Perceptions of Scientific Consensus. Perceptions of scientific consensus about the safety of GM foods were measured with a single item asking "how confident are scientists that genetically modified foods are as safe as conventional foods?" on a 5-point scale from not at all confident (1) to extremely confident (5) (M = 3.26, SD = 1.22).

Perceptions of GM Safety. Perceptions of the safety of GM foods was measured with a single item asking "how confident are you that genetically modified foods are as safe as

[2] As noted in the procedure section, this moderating variable was measured post-treatment in the experiment and may be subject to a post-treatment bias. We discuss this limitation in the discussion of the results.

conventional foods?" on a 5-point scale from not at all confident (1) to extremely confident (5) (M = 2.70, SD = 1.34).

Results

To test hypotheses H1a and H2a we ran an ordinary least squares regression model with perception of scientific consensus as the dependent variable and the experimental treatments as the main independent variables.[3] To do this, the three experimental conditions were dummy-coded with the control condition as the reference groups. We also controlled for age, gender, race, education, children under the age of 18, household income, religious attendance, and political party. The results demonstrate that both the narrative message without the climate change comparison (b = 0.31 (.11), $p < .01$) and narrative message with the climate comparison (b = 0.38 (.10), $p < .001$) increased perceptions of scientific consensus compared with the control condition, supporting H1a. We did not find support for H2a, as the non-narrative consensus message also increased perceptions of scientific consensus compared with the control condition (b = 0.43 (.11), $p < .001$).

To test hypotheses H1b and H2b we ran a similar ordinary least squares regression model, this time using participants' perception of GM safety as the dependent variable and the experimental treatments as the main independent variables. The independent variables were dummy-coded in the same manner, and the analysis uses the same control variables. The results demonstrate the narrative message without the climate change comparison did not significantly influence perceptions of GM safety (b = 0.21 (.13), p = n.s.), but that the narrative message with the climate change comparison increased perceptions of GM safety (b = 0.34 (.12), $p < .01$),

[3] Our models controlled for age, gender, race, education, children under 18, income, political party, and religious attendance. We include a number of covariates to adjust for variables expected to relate to GM attitudes, as covariate adjustment reduces biasedness of effect size estimation (Lee, 2016; Lin, 2013). Models without covariates provide substantively identical results and are shown in online Appendix B.

providing partial support for H1b. The non-narrative consensus message did not significantly influence perceptions of GM safety compared with the control condition (b = 0.18 (.12), p = n.s.). Full results for these analyses are in Table 1.

[Insert Table 1here]

To examine the mediating role of reactance in H3a, we used the SPSS macro PROCESS (Hayes, 2017, Model 4), which uses ordinary least squares regression to estimate the direct and indirect effects of the experimental conditions on perceptions of scientific consensus. PROCESS also allows for a multicategorical independent variable, allowing for the simultaneous testing of the direct and indirect effects of both the experimental narrative conditions, with bias-corrected 95% confidence intervals using 5,000 bootstrapping samples. In this case, the model is testing the effect of the both the narrative message without climate comparison and the narrative message with the climate comparison, using the non-narrative condition as the reference group. Again, we controlled for age, gender, race, education, children under the age of 18, household income, religious attendance, and political party. We find that both the narrative without the climate comparison message (b = -0.23 (.10), $p < .05$) and the narrative with the climate comparison message (b = -0.29 (.09), $p < .01$) decreased experienced reactance compared with the non-narrative condition, and that less reactance increased perceptions of scientific consensus (b = -0.17 (.06), $p < .001$). The overall indirect effect of exposure to narrative messages on perceptions of scientific consensus, though experienced reactance, was significant for both the narrative without the climate comparison (point estimate = .04 (.02), 95% [CI: .0043 – .0912]) and the narrative with the climate comparison (point estimate = .05 (.02), 95% [CI: .0110 – .1021]); supporting H3a. With regards to the direct effect, both the narrative without the climate comparison (point estimate = -.15 (.12), 95% [CI: -.3853 – .0877]) and the narrative with the climate comparison (point estimate = -.07 (.12), 95% [CI: -.2950 – .1546]) had no significant direct effect on perceptions of scientific consensus compared with the non-narrative condition.

We ran a similar analysis to test H3b, but used participants' perception of GM safety as the dependent variable. The results were similar, supporting H3b. The narrative without the climate comparison message (b = -0.27 (.10), $p < .01$) and the narrative with the climate comparison message (b = -0.31 (.09), $p < .01$) decreased experienced reactance compared with the non-narrative condition, and that less reactance increased perceptions of GM safety (b = -0.24 (.06), $p < .001$). The overall indirect effect of exposure to narrative messages on perceptions of GM safety, though experienced reactance, was significant for both the narrative without the climate comparison (point estimate = .06 (.03), 95% [CI: 0.0145 – 0.1290]) and the narrative with the climate comparison (point estimate = .07 (.03), 95% [CI: 0.0220 – 0.1413]). Again, with regards to the direct effect, both the narrative without the climate comparison (point estimate = -.04 (.14), 95% [CI: -.3066 – .2351]) and the narrative with the climate comparison (point estimate = .09 (.13), 95% [CI: -.1647 – .3491]) had no significant direct effect on perceptions of GM food safety compared with the non-narrative condition. Full results for the test of H3a and H3b can be found in Table 2[4].

[Insert Table 2 here]

To test our final hypothesized moderated mediation models H4a and H4b, we again used the PROCESS macro (Hayes, 2017, Model 7). The first moderated mediation model looks at the effect of both narrative messages on perceptions of scientific consensus, with reactance as a mediator, and environmentalism moderating the relationship between the narrative conditions and reactance. When including environmentalism in the model, we find that neither the narrative

[4] We conducted sensitivity analyses for these mediation models to assess the robustness to violations of sequential ignorability. The results are included in online Appendix C.

without the climate comparison message (*b* = 0.38 (.42), *p* = n.s.) nor the narrative with the climate comparison message (*b* = 0.75 (.40), *p* = n.s.) decreased experienced reactance compared with the non-narrative condition. Environmentalism significantly increased experienced reactance (*b* = 0.19 (.06), *p* < .01); however, exposure to the narrative with the climate comparison message interacted with participants' environmentalism to reduce reactance (*b* = -0.20 (0.068, *p* < .01) so that those who were exposed to the climate change narrative message and high in environmentalism experienced less reactance to the message. This was not the case for exposure to the narrative message without the climate comparison; the interaction of this condition with environmentalism has no significant influence on reactance (*b* = -.11 (.08), *p* = n.s.). Reduced reactance was then associated with increased belief that scientists believe GM foods are safe (*b* = -0.18 (.05), *p* < .001). The indirect effect of moderated mediation was not significant for the narrative message without the climate comparison (point estimate = .02 (.01), 95% [CI: -.0075 – .0588]), but was significant for the narrative message with the climate comparison (point estimate = .04 (.02), 95% [CI: .0068 – .0806]); supporting H4a. The full results of this moderated mediation can be found in Table 3 and the results for the narrative with climate comparison are depicted in Figure 1.

[Insert Figure 1 here]

The second moderated mediation model is similar to the first but uses participants' perceptions of the safety of GM foods as the dependent variable. When including environmentalism in the model, we find that neither the narrative without the climate comparison message (*b* = 0.28 (.42), *p* = n.s.) nor the narrative with the climate comparison message (*b* = 0.60 (.40), *p* = n.s.) decreased experienced reactance compared with the non-narrative condition. Environmentalism significantly increased experienced reactance (*b* = 0.16 (.06), *p* < .01), however, exposure to the climate change narrative message interacted with participants' environmentalism to reduce reactance (*b* = -0.18 (0.08, *p* < .05) so that those who were exposed to the climate change narrative message and high in environmentalism experienced less reactance to the message. This was not the case for exposure to the narrative message without the climate comparison; the interaction of this condition with environmentalism has no significant influence on reactance (*b* = -.10 (.08), *p* = n.s.). Reduced reactance was then associated with increased perceptions that GM foods are safe (*b* = -0.25 (.06), *p* < .001). The model shows that the indirect effect of moderated mediation was not significant for the narrative message without the climate comparison (point estimate = .03 (.02), 95% [CI: -.0149 – .0770]), but was for the narrative message with the climate comparison (point estimate = .04 (.02), 95% [CI: .0040 – .0976]); supporting H4a. The full results of this moderated mediation can be found in Table 3.

[Insert Table 3 here]

In looking at more detail at the interaction the narrative message with climate comparison and participants' environmentalism to reduce reactance, when perceptions of scientific consensus is the dependent variable, the interaction is only significant at the mean level of environmentalism (*b* = -0.31(.09), *p* < .001), and one standard deviation above (*b* = -0.51(.13), *p* < .001), but not at one standard deviation below (*b* = -0.03(.14), *p* = n.s.). Similar results can be seen when perceptions of GM safety is the dependent variable; the interaction is only significant at the mean level of environmentalism (*b* = -0.33(.09), *p* < .001), and one standard deviation above (*b* = -0.51(.13), *p* < .001), but not at one standard deviation below (*b* = -0.07(.14), *p* = n.s.). This suggests that for those who are low in environmentalism, the narrative message with climate comparison had little influence on experienced reactance.

Discussion

Given the general public skepticism towards GM foods, our study set out to examine how two specific strategies might be used to reduce reactance and convey information about scientific consensus on genetic modification. Both narrative messages and messages that connect an issue to other resonant values have been shown to reduce reactance in target audiences. Our experiment showed that while both non-narrative and narrative messages about the scientific consensus on GM safety are effective at conveying the consensus relative to a placebo, only a narrative message that links the science on GM to that on climate change is effective in influencing personal beliefs.

Additionally, we found that narrative messages influence perceived consensus and personal beliefs through reduced reactance. Further, our study found that a narrative message which links the science of GM to the science of climate change was particularly effective at reducing reactance among those who were high in environmentalism, and in turn people were more likely to both believe the scientific consensus and believe themselves that GM foods are safe. This effect was not found when arguments about scientific evidence were directly communicated, nor was it statistically significant when a narrative was used without the comparison to climate change. In other words, a narrative message that compared the science of GM foods to the science of climate change was effective at reducing reactance among those who identified as environmentalists.

It is also important to note that the difference in effects between the two narrative conditions is actually quite small. According to traditional reporting of statistical significance, the indirect effect of moderated mediation for the narrative without the climate comparison condition was not significant, while the indirect effect of moderated mediation for the narrative with the climate comparison condition was significant. However, the former was approaching significance, and the latter had only just achieved statistical significance, and though we report them as such, we do not wish overly exaggerate their differences. Together, the results of the mediation models and moderated mediation models suggest that narrative messages may help to reduce reactance to GM consensus messages. This provides useful evidence to build research upon given that knowledge and awareness of GM foods in the public are generally low, and environmentalists tend to be especially likely to have overall-negative attitudes about GM foods (Hossian et al., 2003; Hall & Moran, 2006; Lull & Scheufele, 2017; Tanner & Wolfing Kast, 2003). Our experiment offers some evidence of a theoretically driven, practical technique for communicating scientific consensus about GM foods in a way that can help reduce reactance in people who are especially likely to oppose GM foods.

This finding contributes to the growing, but unsettled, literature on consensus messaging. Research finds that messages of scientific consensus can persuade individuals of scientific consensus, and even influence individuals' further attitudes and behaviors (Cook, Lewandowsky, & Ecker, 2017; Lewandowsky et al., 2013; van der Linden, Leiserowitz, et al., 2015; van der Linden, Leiserowitz, & Maibach, 2019). At the same time, others find the effect of consensus messaging can be dependent on both the prior worldviews of the subjects and message features (Bolsen & Druckman, 2018; Chinn, Lane, & Hart, 2018; Dixon & Hubner, 2018; Dixon et al., 2017; Kahan, 2017; Kahan et al., 2011). Our results offer some support to the idea that specific messages features, like a narrative structure, can be useful in communicating scientific consensus especially when the scientific consensus challenges prior attitudes, as others have suggested (Dalstrom, 2014; Dixon, 2016; Kahan et al., 2011). In other words, future research should consider that consensus messages are not isomorphic, and it is worth further exploring which consensus messages may be most effective on which audiences.

In light of mixed or null findings in prior studies in the GM foods domain (e.g., Landrum et al., 2018), particularly among those predisposed to have negative attitudes towards GM foods (Dixon, 2016), we also focused on tailored messaging. Our targeted persuasion tactic – attaching a contested science issue with one that a subgroup widely accepts – shows that this approach is generalizable beyond the ideological targeting of conservatives with pro-free market climate messages (Dixon et al., 2017). In fact, the mechanism we employ here shows that drawing attention to ostensibly unrelated scientific facts that certain groups accept can increase their acceptance of facts they might hesitate to otherwise. This can allow communicators to retain a commitment to fact-based discourse rather than ideologically catering to certain groups, while still remaining persuasive. Similar applications of this strategy may be effective, especially when an attitude or value, like environmentalism, is associated with a strongly held issue position, like climate change. In other words, using one existing science attitude to change another science attitude is likely only effective if the first attitude is strong and consistent (e.g. Atkin et al., 2019). It is possible to imagine other cases where messages resonant with environmentalism can play similar a key role. For example, future research should determine whether tying in the consensus on climate change can help reduce reactance to information about nuclear power's safety, on which environmentalists are divided (Corner et al., 2011; Stoutenborough et al., 2013; Visschers et al., 2011).

The results also provide some modest support for a model in which effects on consensus perceptions are accompanied by effects on personal beliefs, and suggesting that narrative messages which link one issue to another may be a useful way to link consensus information to personal beliefs (Dixon, 2016). We want to be cautious about our discussion of the implications, as the effects demonstrated here, especially with regards to the effects on personal perceptions of GM safety, are very modest. Without over time measures, it is not possible to speak to the resilience of belief change or the long-term acceptance of GM foods. More research needs to be done to examine lagged effects, especially considering the demonstrated "sleeper" effects of fiction narrative persuasion (Appel & Ritcher, 2007). In other words, there is evidence that narrative messages can be particularly effective at encouraging long-term memory storage

(Dalhstrom, 2014; Appel & Ritcher, 2007), but it may also be that the effects are not strong enough to lead to lasting belief change. Our findings offer evidence that narrative messages may be an effective way of persuading people of scientific consensus and may also help to change their own beliefs about the safety of GM foods. Given the limitations of our study, though, and the general mixed results of consensus messaging in the context of GM foods (Dixon, 2016; Landrum et al., 2018) more research should be done before we draw more definitive conclusions.

Despite the general population sample, our findings have important limitations. First, our focus on the United States public may not generalize to other contexts. We also focused on first-person messages, and the tailoring strategy proposed here should be tested in other message formats. We did not ask participants if they knew of Mark Lynas prior to our stimuli to allow us control of prior attitudes towards the speaker, though overall familiarity with Lynas is likely to be low. Our study also includes a post-treatment moderator, and although environmental concern is at least partially attributable to stable personality traits (Hirsh, 2012; Stanley & Wilson, 2019), given the latest concerns raised about the causal effects of such a design (see Montgomery, Nyhan, & Torres, 2018), we recommend future research to replicate our work with a pre-treatment measure of environmentalism. Finally, we focus on environmentalists as a key opposition group to GM foods, but people oppose GM foods for a variety of reasons.

Given the issues discussed here, these results should be interpreted cautiously. However, the findings of this study make two important theoretical contributions to understanding how best to communicate scientific consensus of GM foods in general and to a potentially skeptical group of environmentalists. First, that narrative elements in messages can effectively reduce reactance people may have to consensus messages about the science of GM. Second, tying this discussion to the scientific consensus of climate change is an applicable technique that science communicators and journalists can implement easily. Using this technique, science communicators can allow U.S. consumers to process scientific consensus of GM foods without provoking negative responses, and thus provide them with an opportunity to engage in informed decision-making.

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Tables and Figures

Table 1. Effect of treatment conditions on perceptions of scientific consensus (M1), and perceptions of GM safety (M2); controlling for age, gender, race, education, children under the age of 18, household income, religious attendance, and political party.

	Scientists believe GM foods are safe (M1)			Perceptions of GM safety (M2)		
	B	(SE)		B	(SE)	
(Constant)	3.028	(0.31)	***	3.141	(0.34)	***
Age	-0.004	(0.00)		-0.009	(0.00)	**
Gender	-0.076	(0.08)		-0.446	(0.10)	***
Race	0.103	(0.11)		0.257	(0.12)	*
Education	0.059	(0.02)	*	0.070	(0.03)	*
Children under 18	-0.080	(0.04)		-0.091	(0.05)	
Income	-0.039	(0.02)		-0.038	(0.03)	
Party	-0.021	(0.02)		-0.006	(0.02)	
Religious attendance	0.091	(0.03)	**	0.071	(0.04)	*
Non-narrative message	0.429	(0.11)	***	0.183	(0.12)	
Narrative without climate comparison	0.307	(0.11)	**	0.209	(0.13)	
Narrative with climate comparison	0.387	(0.10)	***	0.349	(0.12)	**
	$r^2 = 0.05$			$r^2 = 0.06$		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$ ($N_{M1} = 892$, $N_{M2} = 899$).

Table 2. Effect of narrative treatment conditions on perceptions of scientific consensus (M3), and perceptions of GM safety(M4), moderated by experienced reactance.

	Model 3(H3a)				Model 4(H3b)			
	Reactance		Scientists believe GM foods are safe		Reactance		Perceptions of GM safety	
	B	(SE)	B	(SE)	B	(SE)	B	(SE)
(Constant)	3.345	(0.28) ***	4.201	(0.38) ***	3.252	(0.28) ***	3.904	(0.43) ***
Age	0.002	(0.00)	-0.006	(0.00) **	0.002	(0.00)	-0.010	(0.11) **
Gender	-0.069	(0.08)	-0.093	(0.10)	-0.053	(0.08)	-0.444	(0.11) ***
Race	-0.270	(0.10) **	0.034	(0.12)	-0.247	(0.10) *	0.196	(0.14)
Education	-0.033	(0.02)	0.060	(0.03) *	-0.026	(0.02)	0.089	(0.03) **
Children under 18	0.022	(0.05)	-0.117	(0.06) *	0.020	(0.05)	-0.129	(0.06)
Income	0.012	(0.02)	-0.041	(0.03)	0.012	(0.02)	-0.022	(0.03)
Party	0.006	(0.02)	-0.028	(0.03)	-0.021	(0.02)	-0.001	(0.03)
Religious attendance	-0.004	(0.03)	0.084	(0.04) *	-0.006	(0.03)	0.071	(0.04)
Narrative without climate comparison	-0.233	(0.10) *	-0.149	(0.12)	-0.266	(0.10) **	-0.036	(0.11)
Narrative with climate comparison	-0.289	(0.09) **	-0.070	(0.11)	-0.307	(0.09) **	0.092	(0.13)
Reactance			-0.174	(0.06) ***			-0.235	(0.06) ***
	r^2 = 0.04		r^2 = 0.05		r^2 = 0.03		r^2 = 0.09	

Note: * $p < .05$, ** $p < .01$, *** $p < .001$ (N_{M3}= 606, N_{M4} = 609).

Table 3. Effect of narrative treatment conditions, environmentalism, and their interaction on reactance on perceptions of scientific consensus (M5), and perceptions of GM safety(M6), moderated by reactance.

	Model 5(H4a)						Model 6(H4b)					
	Reactance			Scientists believe GM foods are safe			Reactance			Perceptions of GM safety		
	B	(SE)		B	(SE)		B	(SE)		B	(SE)	
(Constant)	2.411	(0.41)	***	4.255	(0.39)	***	2.440	(0.41)	***	3.972	(0.44)	***
Age	0.002	(0.00)		-0.005	(0.00)		0.002	(0.00)		-0.010	(0.00)	**
Gender	-0.084	(0.08)		-0.112	(0.10)		-0.065	(0.08)		-0.450	(0.11)	***
Race	-0.275	(0.10)	**	-0.005	(0.12)		-0.251	(0.02)	*	0.165	(0.14)	
Education	-0.035	(0.02)		0.062	(0.03)	*	-0.025	(0.02)		0.086	(0.03)	*
Children under 18	0.018	(0.05)		-0.109	(0.06)		0.016	(0.05)		-0.131	(0.06)	*
Income	0.007	(0.02)		-0.040	(0.03)		0.008	(0.02)		-0.018	(0.03)	
Party	0.024	(0.02)		-0.028	(0.03)		0.026	(0.02)		0.000	(0.03)	
Religious attendance	-0.004	(0.03)		0.083	(0.04)	*	-0.010	(0.03)		0.062	(0.04)	
Narrative without climate comparison	0.384	(0.42)		-0.168	(0.12)		0.276	(0.42)		-0.042	(0.14)	
Narrative with climate comparison	0.750	(0.40)		-0.095	(0.12)		0.604	(0.40)		0.075	(0.13)	
Environmentalism	0.185	(0.06)	**				0.160	(0.06)	**			
Environmentalism x narrative without climate comparison	-0.115	(0.08)					-0.101	(0.08)				
Environmentalism x narrative with climate comparison	-0.204	(0.08)	**				-0.180	(0.08)	*			
Reactance				-0.183	(0.05)	***				-0.249	(0.06)	***
	$r^2 = 0.05$			$r^2 = 0.05$			$r^2 = 0.05$			$r^2 = 0.09$		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$ (N_{M5}= 597 N_{M6} = 600).

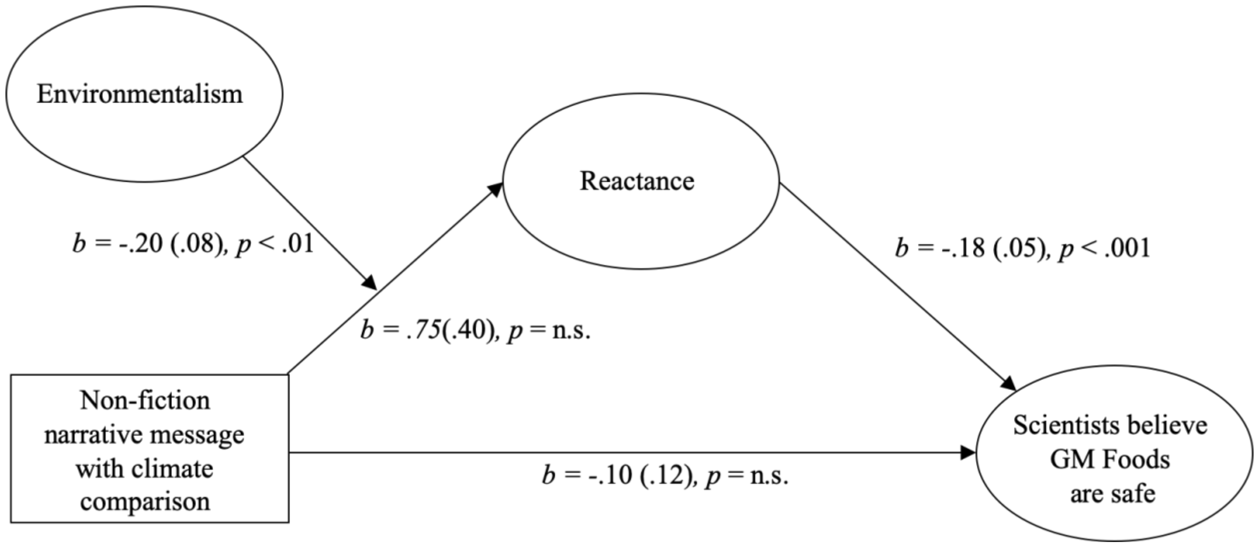

Figure 1. Indirect effect of moderated mediation of narrative messages that compare GM to climate change on beliefs about what scientists think about GM food. Note: Indirect effects based on 5,000 bootstrap samples. Indirect moderated mediation effect through reactance for the narrative message without the climate comparison (point estimate = .02 (.01), 95% [CI: -.0075 – .0588]) and the narrative message with the climate comparison (point estimate = .04 (.02), 95% [CI: .0068 – .0806]), N= 597.

Appendix A

Transcript of Stimulus Videos

All videos originated from real world footage of speeches by environmental activist and journalist Mark Lynas.

Condition 1. Non-narrative message

Full speech: 05.58-06.16: This is the challenge that faces us today: we are going to have to feed 9.5 billion hopefully much less poor people by 2050 on about the same land area as we use today, using limited fertilizer, water and pesticides and in the context of a rapidly-changing climate…

Full speech: 09.51-09.59: We have to ensure that technological innovation moves much more rapidly, and in the right direction for those who most need it.…

Full speech: 26.05-26.07: On GM there is a rock-solid scientific consensus...

Full speech: 04.34-04.37: I did some reading and I discovered that

Full speech: 04.46-04.50: Pest resistant cotton and maize needed less insecticide.

Full speech: 04.54-05.00: Billions of dollars of benefits were accruing to farmers around the world especially in developing countries who needed fewer inputs.

Full speech: 05.13-05.20: BT cotton was pirated into India and roundup-ready soy was pirated into Brazil because farmers were so eager to use them.

Full speech: 05.23-05.26: It was safer and more precise than conventional breeding.

Full speech: 25.22-25.44: So my conclusion here today is very clear: the GM debate is over. It is finished. We no longer need to discuss whether or not it is safe – over a decade and a half with three trillion GM meals eaten there has never been a single substantiated case of harm. You are more likely to get hit by an asteroid than to get hurt by GM food.

Condition 2. Narrative message without climate change comparison

Full speech: 0.01-0.26: My lords, ladies and gentlemen, I want to start with some apologies, which I believe are most appropriate to this audience. For the record, here and upfront, I want to apologize for having spent several years ripping up GM crops. I am also sorry that I helped start the anti GM movement back in the '90s, and that I thereby assisted in demonizing an important technological option which can and should be used to benefit the environment.

Full speech: 04.36-05.00: I discovered that one by one my cherished beliefs about GM turned out to be little more than green urban myths. I'd assumed that it would increase the use of chemicals. It turned out that pest resistant cotton and maize needed less insecticide. I'd assumed that GM benefited only the big companies. It turned out that billions of dollars of benefits were accruing to farmers around the world especially in developing countries who needed fewer inputs.

Full speech: 05.10-05.26:i'd assumed no one wanted GM. Actually what happened was that BT cotton was pirated into India and roundup-ready soy was pirated into Brazil because farmers were so eager to use them. I'd assumed that GM was dangerous. It turned out it was safer and more precise than conventional breeding.

Condition 3: Narrative message with climate change comparison

Full speech: 0.01-0.26: My lords, ladies and gentlemen, I want to start with some apologies, which I believe are most appropriate to this audience. For the record, here and upfront, I want to apologize for having spent several years ripping up GM crops. I am also sorry that I helped start the anti GM movement back in the '90s, and that I thereby assisted in demonizing an important technological option which can and should be used to benefit the environment.

Full speech: 01.55-02.39: This was explicitly anti-science movement. We employed a lot of imagery about scientists in their labs cackling demonically as they tinkered with the very building blocks of life. Hence the Frankenstein food tag, which was eagerly taken up by the daily mail of course. This absolutely was about deep-seated fears of scientific powers being used for unnatural and demonic ends. What we didn't realize at the time was that the real Frankenstein's monster was not the GM technology, but our reaction against it. For me this anti-science environmentalism became increasingly inconsistent with my pro-science environmentalism with regards to climate change. I published my first book on global warming in 2004, and I was determined to make it scientifically credible rather than just a collection of anecdotes.

Full speech: 03-17-03.38: I found myself arguing constantly with people who i considered to be incorrigibly anti-science because they wouldn't listen to the climatologists and they denied the scientific reality of climate change. And so I lectured them about the value of peer review, about the importance of scientific consensus and how the only facts that mattered were the ones published in the most distinguished scholarly journals.

Full speech: 03.50-05.00: And yet incredibly at this time in 2008 I was still penning screeds in the guardian attacking the science of GM even though I had done no academic research on the topic and had a very limited personal understanding. I don't think I'd ever read a peer reviewed paper on biotechnology or any aspect of plant science even at this late stage, and I'm ashamed to admit it. Now, obviously this contradiction was untenable in the long term. What really threw me actually were some of the comments underneath my final anti-GM piece in the guardian. One particular critic said to me in the comments "so you're opposed to GM on the basis it's marketed by big corporations. Are you also opposed to the wheel because it's marketed by the big auto companies?" And I thought, "well, that's an interesting analogy". So I did some reading and I discovered that one by one my cherished beliefs about GM turned out to be little more than green urban myths. I'd assumed that it would increase the use of chemicals. It turned out that pest resistant cotton and maize needed less insecticide. I'd assumed that GM benefited only the big companies. It turned out that billions of dollars of benefits were accruing to farmers around the world especially in developing countries who needed fewer inputs.

Full speech: 05.10-05.26: I 'd assumed no one wanted GM. Actually what happened was that BT cotton was pirated into India and roundup-ready soy was pirated into brazil because farmers were so eager to use them. I'd assumed that GM was dangerous. It turned out it was safer and more precise than conventional breeding.

Baseball text (Control condition)

Baseball originated before the American Civil War (1861-1865) as rounders, a humble game played on sandlots. Early champions of the game fine-tuned it to include the kind of skills and mental judgment that made cricket respectable in England.

In 1871 the first professional baseball league was born. By the beginning of the 20th century, most large cities in the eastern United States had a professional baseball team. The teams were divided into two leagues, the National and American; during the regular season, a team played only against other teams within its league. The most victorious team in each league was said to have won the "pennant;" the two pennant winners met after the end of the regular season in the World Series. The winner of at least four games (out of a possible seven) was the champion for that year. This arrangement still holds today, although the leagues are now subdivided and pennants are decided in post-season playoff series between the winners of each division.

Appendix B

Alternate Analyses

This appendix contains information about alternate analyses which are not included in the main manuscript; it is organized into three sections. The first includes the results of all analyses in the manuscript without the inclusion of control variables. The second includes the results of the testing of alternate moderated mediation models. The third includes results of similar mediation models to those in the manuscript, but these models use counterarguing as the mediating variable rather than reactance.

1. Analyses without control variables

Below are the table results for all analyses conducted in the main study without the inclusion of control variables.

Table 1. Effect of treatment conditions on perceptions of scientific consensus (M1), and perceptions of GM safety (M2).

	Scientists believe GM foods are safe (M1)			Perceptions of GM safety (M2)		
	B	(SE)		B	(SE)	
(Constant)	3.032	(0.64)	***	2.486	(0.07)	***
Non-narrative message	0.421	(0.10)	***	0.268	(0.11)	*
Narrative without climate comparison	0.303	(0.11)	**	0.291	(0.12)	*
Narrative with climate comparison	0.363	(0.10)	***	0.339	(0.11)	**
	$r^2 =$ 0.02			$r^2 =$ 0.01		

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$ (N_{M1}= 1078, N_{M2} = 1091).

Table 2. Effect of narrative treatment conditions on perceptions of scientific consensus (M3), and perceptions of GM safety(M4), moderated by experienced reactance.

	Model 3(H3a)						Model 4(H3b)					
	Reactance			Scientists believe GM foods are safe			Reactance			Perceptions of GM safety		
	B	(SE)		B	(SE)		B	(SE)		B	(SE)	
(Constant)	2.976	(0.06)	***	4.053	(0.16)	***	2.986	(0.06)	***	3.526	(0.18)	***
Narrative without climate comparison	-0.258	(0.09)	**	-0.172	(0.11)		-0.272	(0.09)	**	-0.052	(0.13)	
Narrative with climate comparison	-0.254	(0.08)	**	-0.103	(0.11)		-0.265	(0.08)	**	0.037	(0.12)	
Reactance				-0.205	(0.05)	***				-0.260	(0.05)	***
	$r^2 =$ 0.02			$r^2 =$ 0.3			$r^2 =$ 0.2			$r^2 =$ 0.03		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$ (N_{M3}= 721, N_{M4} = 726). For M3, total indirect effect for narrative condition witout climate comparison, point estimate = 0.05(.02) [95% CI: .0127 to .1061], and total indirect effect of narrative condition with climate comparison, point estimate = 0.05(.02) [95% CI: .0141 to .1022]. For M4, total indirect effect for narrative condition without climate comparison, point estimate = 0.07(.03) [95% CI: .0203 to .1344], and total indirect effect of narrative condition with climate comparison, point estimate = 0.05(.02) [95% CI: .0141 to .1022].

Table 3. Effect of narrative treatment conditions, environmentalism, and their interaction on reactance on perceptions of scientific consensus (M5), and perceptions of GM safety(M6), moderated by reactance.

	Model 5(H4a)						Model 6(H4b)					
	Reactance			Scientists believe GM foods are safe			Reactance			Perceptions of GM safety		
	B	(SE)		B	(SE)		B	(SE)		B	(SE)	
(Constant)	2.052	(0.27)	***	4.083	(0.16)	***	2.477	(0.27)	***	3.797	(0.18)	***
Narrative without climate comparison	0.531	(0.38)		-0.176	(0.11)		0.430	(0.37)		-0.052	(0.13)	
Narrative with climate comparison	0.811	(0.35)	*	-0.109	(0.11)		0.686	(0.35)		0.024	(0.12)	
Environmentalism	0.180	(0.05)	***				0.163	(0.05)	**			
Environmentalism x narrative without climate comparison	-0.152	(0.07)	*				-0.136	(0.07)				
Environmentalism x narrative with climate comparison	-0.209	(0.07)	**				-0.187	(0.07)	**			
Reactance				-0.214	(0.05)	***				-0.278	(0.05)	***
	$r^2 =$ 0.03			$r^2 =$ 0.03			$r^2 =$ 0.03			$r^2 =$ 0.04		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$ (N_{M5}= 708 N_{M6}= 713). For M5, total indirect effect for narrative condition without climate comparison, point estimate = 0.03(.02) [95% CI: .0026 to .0721], and total indirect effect of narrative condition with climate comparison, point estimate = 0.04(.02) [95% CI: .0117 to .0857]. For M6, total indirect effect for narrative condition without climate comparison, point estimate = 0.04(.02) [95% CI: -.0020 to .0879], and total indirect effect of narrative condition with climate comparison, point estimate = 0.05(.02) [95% CI: .0109 to .1015].

2. Testing alternate models

Our moderated mediation models, H4a and H4b, were driven by theoretical expectations that the narrative condition with the climate comparison would interact with participant's environmentalism to reduce reactance more than the other two treatment conditions. However, we also tested alternative models of moderated mediation to examine whether the narrative conditions interacted with environmentalism to influence the two outcome variables (Alternate Models 1a and 1b) and whether environmentalism also interacted with reactance to influence the outcome variables (Alternate Models 2a and 2b). An overview of the results are represented in the figures below, our current hypothesized model appears to be the best explanation for how these variables related to one another.

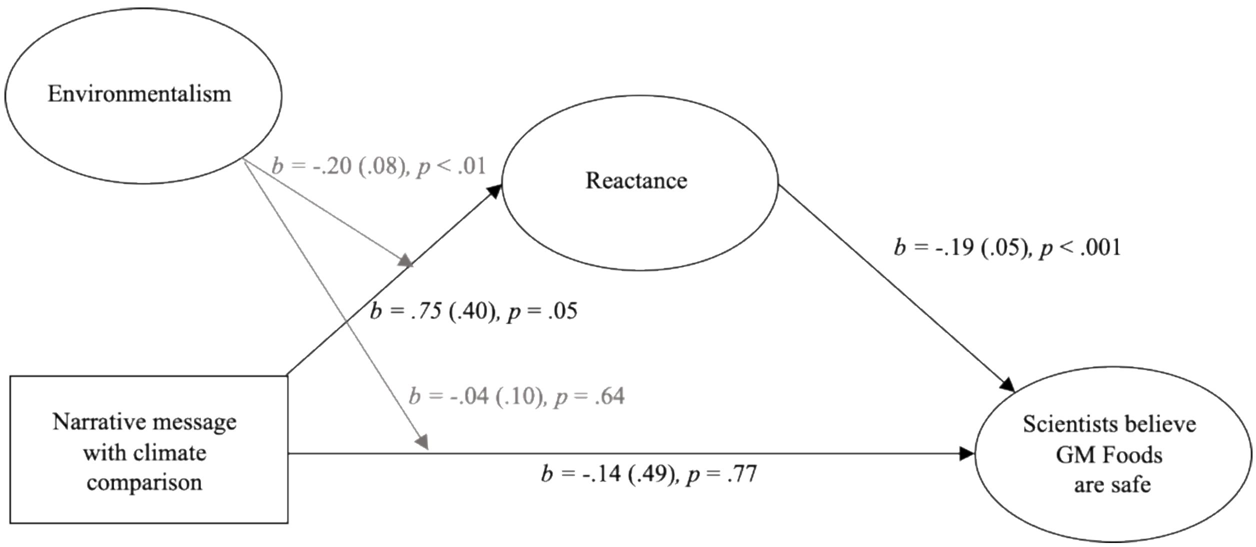

Figure 1a. Indirect effect of moderated mediation of narrative message with climate comparison on perceptions of scientific consensus. Note: Indirect effects based on 5,000 bootstrap samples. Indirect moderated mediation effect through reactance, point estimate = 0.04 (.02), 95% [CI: .0072 to .0839]. Control variables include age, gender, race, education, children under the age of 18, household income, religious attendance, and political party, N= 597.

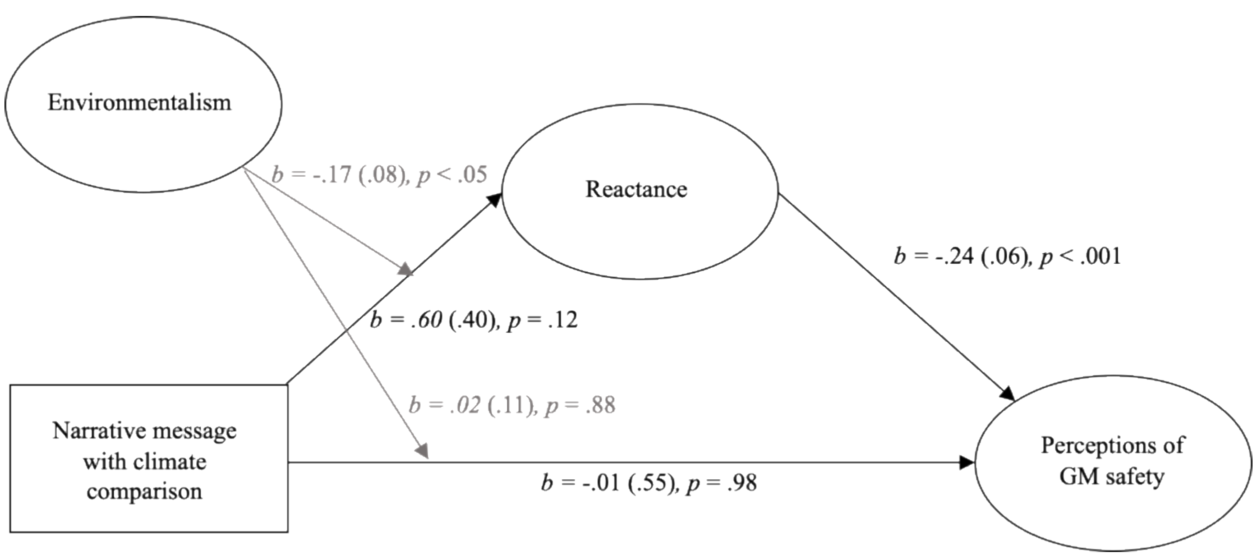

Figure 1b. Indirect effect of moderated mediation of narrative message with climate comparison on perceptions of GM safety. Note: Indirect effects based on 5,000 bootstrap samples. Indirect moderated mediation effect through reactance, point estimate = 0.04 (.02), 95% [CI: .0033 to .0947]. Control variables include age, gender, race, education, children under the age of 18, household income, religious attendance, and political party, N= 600.

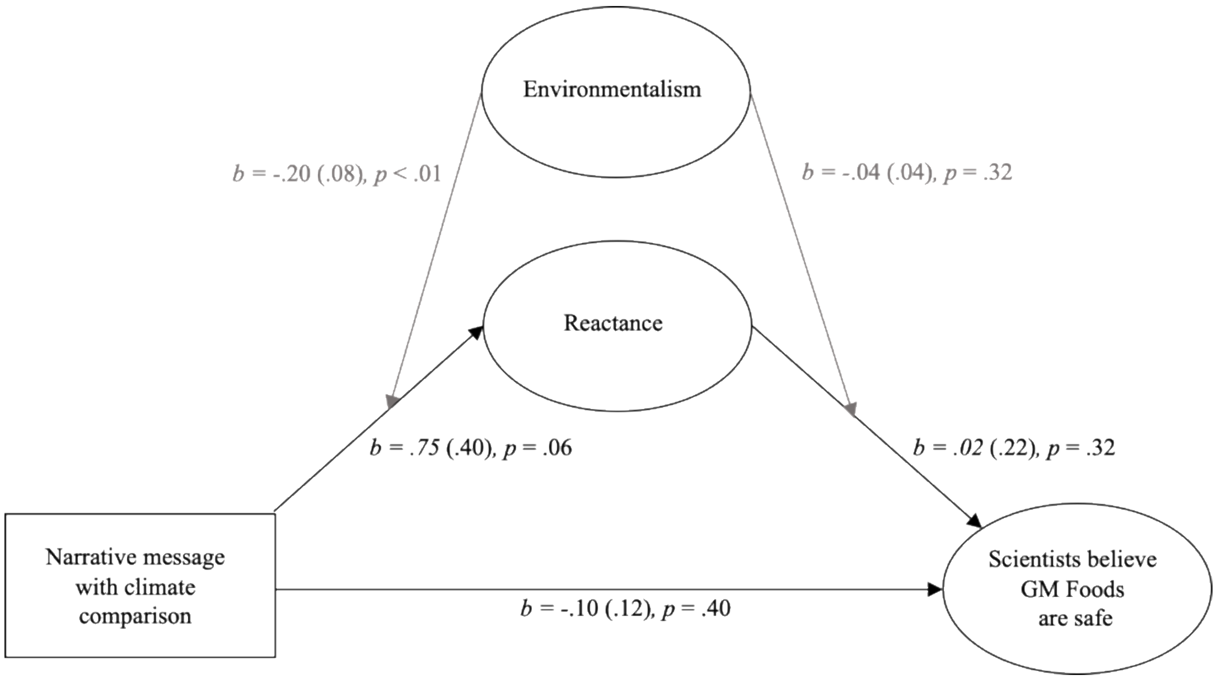

Figure 2a. Indirect effect of moderated mediation of narrative message with climate comparison on perceptions of scientific consensus. Note: Indirect effects based on 5,000 bootstrap samples. Relative indirect moderated mediation effect through reactance at the mean of the environmentalism moderator, point estimate = 0.06(.03), 95% [CI: .0161 to .1163]. Control variables include age, gender, race, education, children under the age of 18, household income, religious attendance, and political party, N= 597.

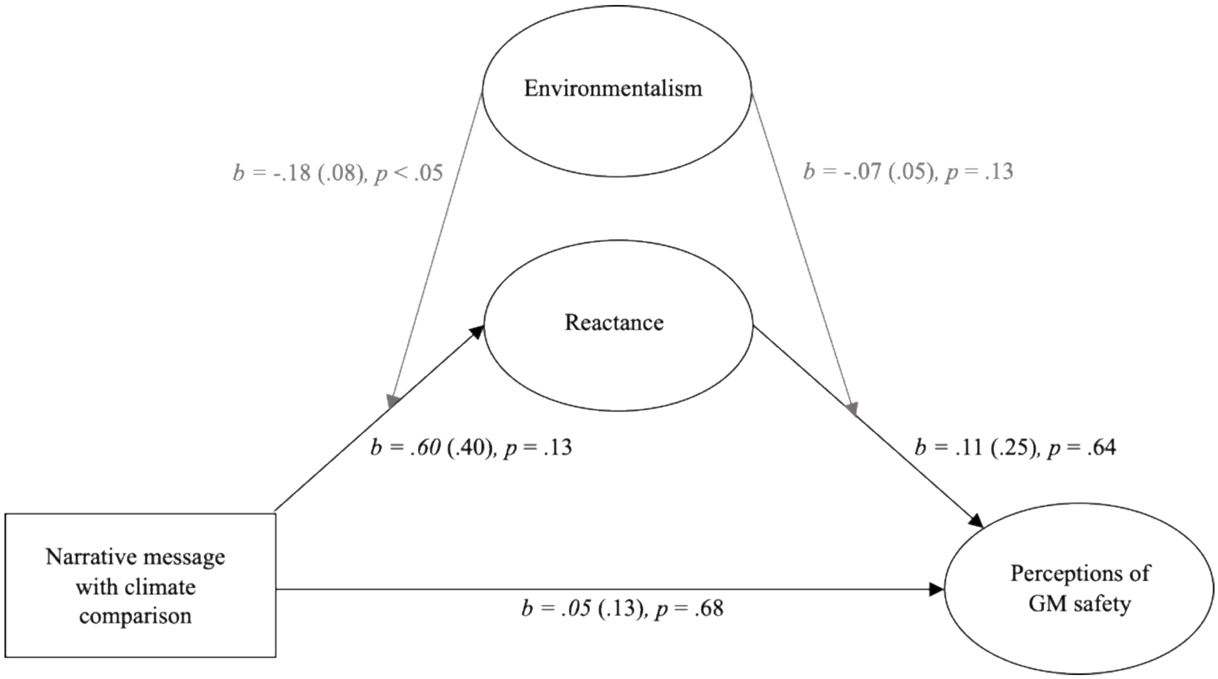

Figure 2b. Indirect effect of moderated mediation of narrative message with climate comparison on perceptions of GM safety. Note: Indirect effects based on 5,000 bootstrap samples. Relative indirect moderated mediation effect through reactance at the mean of the environmentalism moderator, point estimate = 0.08(.03), 95% [CI: .0256 to .1543]. Control variables include age, gender, race, education, children under the age of 18, household income, religious attendance, and political party, N= 600.

3. Analyses with counterarguing as mediator

Below are the table results for all mediation analyses, using counterarguing as the mediator, rather than reactance.

Table 1. Effect of narrative treatment conditions on perceptions of scientific consensus (M3), and perceptions of GM safety(M4), moderated by counterarguing.

	Model 3(H3a)						Model 4(H3b)					
	Counterarguing			Scientists believe GM foods are safe			Counterarguing			Perceptions of GM safety		
	B	(SE)		B	(SE)		B	(SE)		B	(SE)	
(Constant)	3.193	(0.21)	***	5.714	(0.36)	***	3.169	(0.21)	***	6.380	(0.39)	***
Age	0.003	(0.00)		-0.004	(0.00)		0.003	(0.00)		-0.008	(0.00)	**
Gender	0.135	(0.06)	*	0.014	(0.09)		0.138	(0.06)	*	-0.305	(0.09)	**
Race	-0.201	(0.08)	**	-0.036	(0.11)		-0.197	(0.08)	**	0.059	(0.12)	
Education	-0.049	(0.02)	**	0.033	(0.03)		-0.047	(0.02)	*	0.046	(0.03)	
Children under 18	0.050	(0.03)		-0.085	(0.02)		0.049	(0.04)		-0.086	(0.05)	
Income	-0.004	(0.02)		-0.045	(0.02)		-0.003	(0.02)		-0.030	(0.03)	
Party	-0.009	(0.02)		-0.033	(0.02)		-0.008	(0.02)		-0.009	(0.02)	
Religious attendance	-0.006	(0.02)		0.074	(0.03)	*	-0.006	(0.02)		0.054	(0.04)	
Narrative without climate comparison	-0.081	(0.08)		-0.162	(0.11)		-0.090	(0.07)		-0.067	(0.12)	
Narrative with climate comparison	-0.151	(0.07)	*	-0.128	(0.10)		-0.157	(0.07)	*	0.021	(0.11)	
Counterarguing				-0.667	(0.06)	***				-1.018	(0.06)	***
	$r^2 =$ 0.05			$r^2 =$ 0.20			$r^2 =$ 0.05			$r^2 =$ 0.35		

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$ (N_{M3}= 605, N_{M4}= 607). For M3, total indirect effect for narrative condition without climate comparison, point estimate = 0.05(.05) [95% CI: -.0407 to .1527], and total indirect effect of narrative condition with climate comparison, point estimate = 0.10(.05) [95% CI:- .0012 to .2040]. For M4, total indirect effect for narrative condition without climate comparison, point estimate = 0.09(.08) [95% CI:- .0524 to .2432], and total indirect effect of narrative condition with climate comparison, point estimate = 0.16(.08) [95% CI: .0069 to .3109].

Table 2. Effect of narrative treatment conditions, environmentalism, and their interaction on counterarguing on perceptions of scientific consensus (M5), and perceptions of GM safety(M6), moderated by counterarguing.

	Model 5(H4a)						Model 6(H4b)					
	Counterarguing			Scientists believe GM foods are safe			Counterarguing			Perceptions of GM safety		
	B	(SE)		B	(SE)		B	(SE)		B	(SE)	
(Constant)	2.621	(0.31)	***	5.765	(0.37)	***	2.620	(0.31)	***	6.399	(0.39)	***
Age	0.003	(0.00)		-0.004	(0.00)		0.003	(0.00)		-0.008	(0.00)	*
Gender	0.129	(0.06)	*	0.006	(0.09)		0.135	(0.06)	*	-0.307	(0.09)	**
Race	-0.212	(0.07)	**	-0.064	(0.11)		-0.207	(0.08)	**	0.025	(0.11)	
Education	-0.049	(0.02)	**	0.038	(0.03)		-0.046	(0.02)	*	0.044	(0.03)	
Children under 18	0.051	(0.04)		-0.078	(0.05)		0.050	(0.03)		-0.085	(0.05)	
Income	-0.006	(0.02)		-0.046	(0.02)		-0.005	(0.02)		-0.023	(0.03)	
Party	-0.004	(0.02)		-0.034	(0.02)		0.003	(0.02)		-0.008	(0.03)	
Religious attendance	-0.007	(0.02)		0.059	(0.03)	*	-0.007	(0.02)		0.055	(0.03)	
Narrative without climate comparison	0.095	(0.32)		-0.183	(0.11)		0.071	(0.32)		-0.075	(0.12)	
Narrative with climate comparison	0.505	(0.30)		-0.153	(0.12)		0.472	(0.30)		0.005	(0.11)	
Environmentalism	0.108	(0.05)	*				0.102	(0.04)	*			
Environmentalism x narrative without climate comparison	-0.030	(0.32)					-0.027	(0.06)				
Environmentalism x narrative with climate comparison	-0.130	(0.06)	*				-0.124	(0.06)	*			
Counterarguing				-0.672	(0.06)	***				-1.205	(0.06)	***
	$r^2 =$ 0.06			$r^2 =$ 0.20			$r^2 =$ 0.06			$r^2 =$ 0.35		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$ (N_{M5}= 596, N_{M6} = 598). For M5, total indirect effect for narrative condition without climate comparison, point estimate = 0.02(.05) [95% CI: -.0808 to .1127], and total indirect effect of narrative condition with climate comparison, point estimate = 0.09(.05) [95% CI:- .0031 to .1851]. For M6, total indirect effect for narrative condition without climate comparison, point estimate = 0.03(.07) [95% CI:- .1013 to .1688], and total indirect effect of narrative condition with climate comparison, point estimate = 0.13(.07) [95% CI: -.0091 to .2710].

Appendix C

Mediation Analyses and Sensitivity Analyses using mediation:R

To examine the mediating role of reactance in H3a, we also ran the analyses using the mediation:R package (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014). We had to run two models to fully test H3a, which posited that experienced reactance will mediate the relationship between exposure to narrative messages and the belief in scientific consensus. We created dummy variables to reflect the experimental treatments. In the first model, the narrative without climate comparison is used as the independent variable, while the dummy variable for the narrative with climate comparison is included in the model, using the non-narrative condition as the reference group. As with our other analyses, we controlled for age, gender, race, education, children under the age of 18, household income, religious attendance, and political party. We find that the narrative message without the climate comparison decreased experienced reactance compared with the non-narrative condition (b = -0.24 (.10), p < .01), and that less reactance increased perceptions of scientific consensus (b = -0.18 (.05), p < .001). The overall indirect effect of exposure to narrative message without climate change was significant (*ACME* = 0.04, [95% CI: .0066 to .0900]), while the direct effect was not (*ADE* = -0.16, [95% CI: -.4130 to .0900]). See Figure 1.

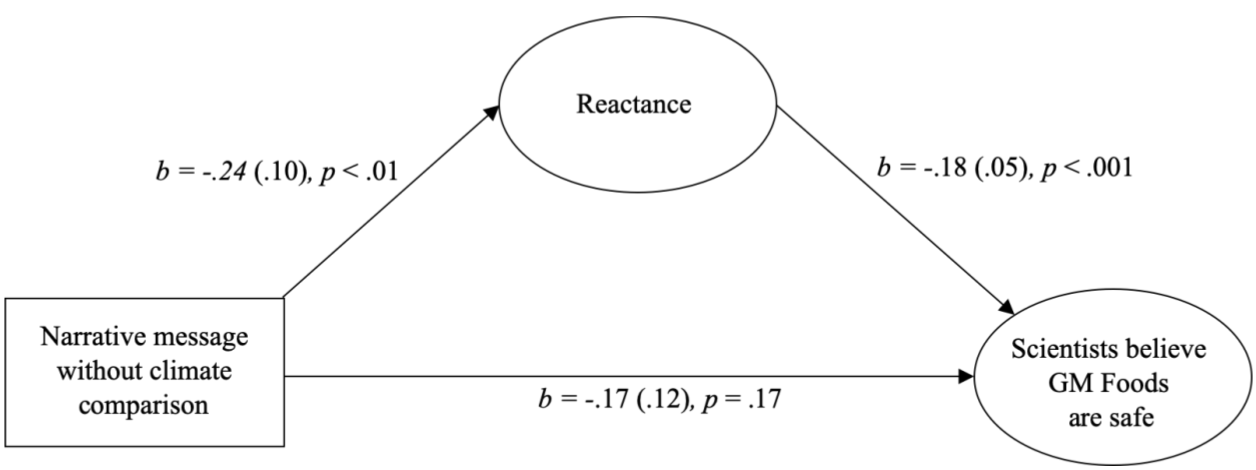

Figure 1. Indirect effect of narrative messages without climate comparison on perception of scientific consensus on GM foods, via reactance. Results based on 1,000 simulations. Indirect mediation effect

through reactance, *ACME* = 0.04, [95% CI: .0066 to .0900]). Direct effect on perceptions of scientific consensus *ADE* = -0.16, [95% CI: -.4130 to .0900]). Control variables include age, gender, race, education, children under the age of 18, household income, religious attendance, and political party, N= 598.

Because of sequential ignorability assumptions, we also conducted a sensitivity analysis on this mediation model. The sensitivity analysis allows us to examine how unobserved pre-treatment confounders might affect the mediator and the outcome, by varying the value of the correlation between the residuals of the mediator and outcome regressions (ρ) and examining how the ACME changes (Imai et al., 2010; Tingley et al., 2014). The results demonstrate that while mediation model is not very robust, the original direction of the ACME is somewhat robust to a violation of sequential ignorability. See Figure 2.

```
Mediation Sensitivity Analysis for Average Causal Mediation Effect

Sensitivity Region

      Rho    ACME 95% CI Lower 95% CI Upper R^2_M*R^2_Y* R^2_M~R^2_Y~
[1,] -0.2 -0.0163      -0.0448       0.0122         0.04       0.0365
[2,] -0.1  0.0133      -0.0142       0.0407         0.01       0.0091
[3,]  0.0  0.0420      -0.0006       0.0845         0.00       0.0000

Rho at which ACME = 0: -0.1
R^2_M*R^2_Y* at which ACME = 0: 0.01
R^2_M~R^2_Y~ at which ACME = 0: 0.0091
```

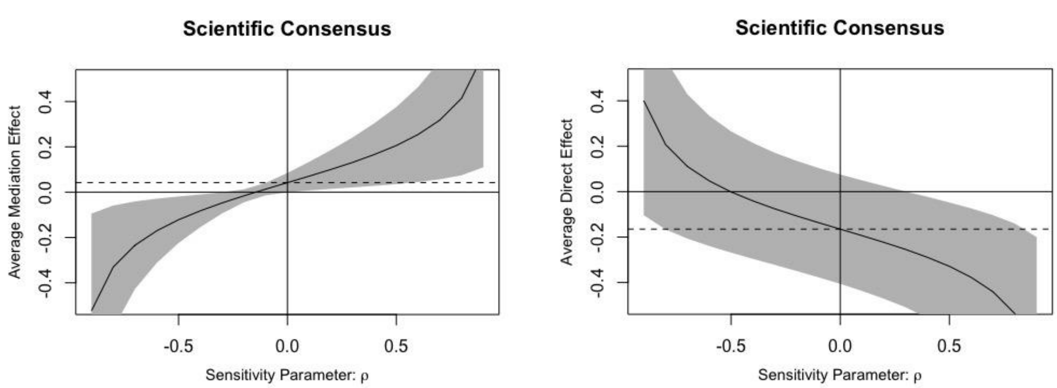

Figure 2. Graphical display of values ρ, with confidence intervals for the ACME, when narrative without climate comparison is the independent variable, perception of scientific consensus is the dependent variable, and reactance is the moderator.

In the second model of H3a, the narrative with climate comparison is used as the independent variable, while the dummy variable for the narrative without the climate comparison is included in the model, again using the non-narrative condition as the reference group. We find that the narrative message with the climate comparison decreased experienced reactance compared with the non-narrative condition ($b = -0.29$ (.09), $p < .01$), and that less reactance increased perceptions of scientific consensus ($b = -0.18$ (.05), $p < .001$). The overall indirect effect of exposure to narrative message without climate change was significant (*ACME* = 0.05, [95% CI: .0142 to .1100]), while the direct effect was not (*ADE* = -0.09, [95% CI: -.3384 to .1500]). See Figure 3. As with previous model, the results of the sensitivity analyses demonstrate that while mediation model is not very robust, the original direction of the ACME is somewhat robust to a violation of sequential ignorability. See Figure 4.

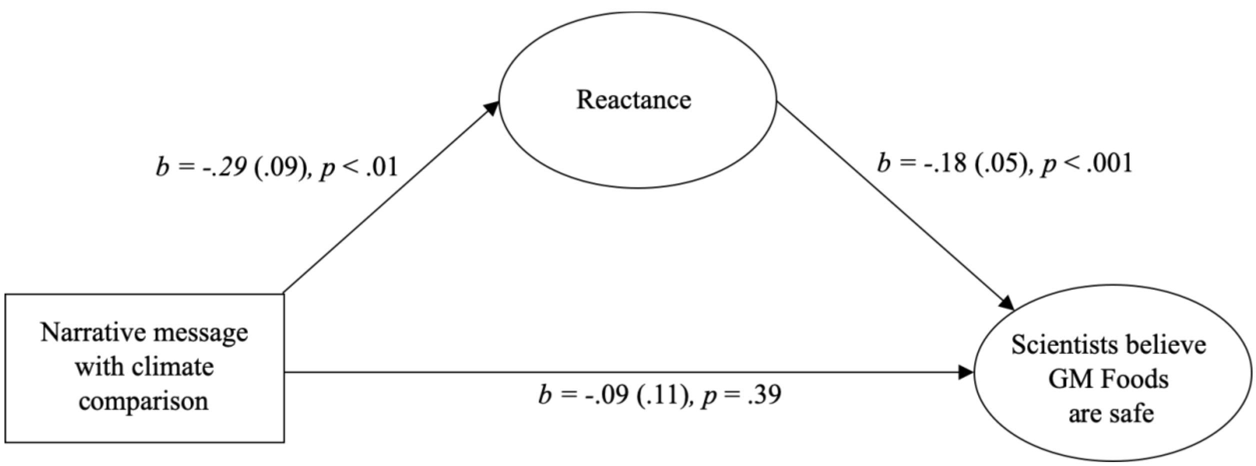

Figure 3. Indirect effect of narrative messages with climate comparison on perception of scientific consensus on GM foods, via reactance. Results based on 1,000 simulations. Indirect mediation effect through reactance, *ACME* = 0.05, [95% CI: .0142 to .1100]). Direct effect on perceptions of scientific consensus *ADE* = -0.09, [95% CI: -.3384 to .1500]). Control variables include age, gender, race, education, children under the age of 18, household income, religious attendance, and political party, N= 598.

```
Mediation Sensitivity Analysis for Average Causal Mediation Effect

Sensitivity Region

      Rho    ACME 95% CI Lower 95% CI Upper R^2_M*R^2_Y* R^2_M~R^2_Y~
[1,] -0.2 -0.0204      -0.0546       0.0138         0.04       0.0365
[2,] -0.1  0.0166      -0.0167       0.0499         0.01       0.0091

Rho at which ACME = 0: -0.1
R^2_M*R^2_Y* at which ACME = 0: 0.01
R^2_M~R^2_Y~ at which ACME = 0: 0.0091
```

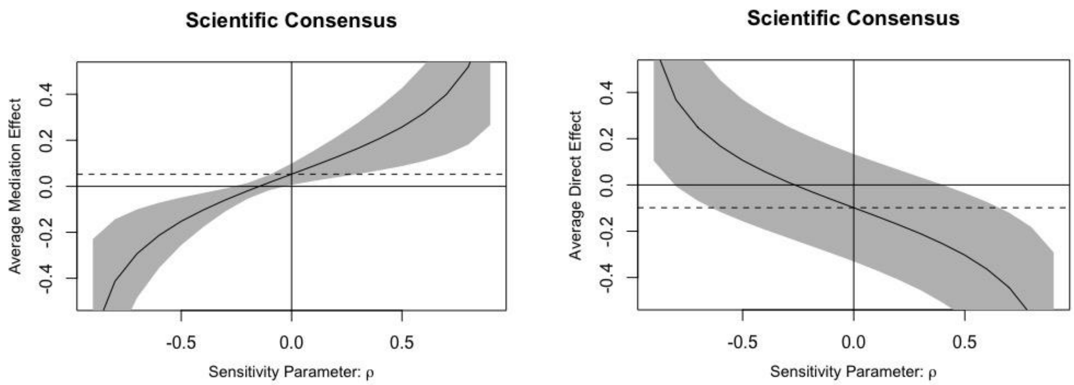

Figure 4. Graphical display of values ρ, with confidence intervals for the ACME, when narrative with climate comparison is the independent variable, perception of scientific consensus is the dependent variable, and reactance is the moderator.

To examine the mediating role of reactance in H3b, ran the same two models described above but with personal perception of GM safety as the dependent variable. We find that the narrative message without the climate comparison decreased experienced reactance compared with the non-narrative condition ($b = -0.24$ (.10), $p < .05$), and that less reactance increased perception of GM safety ($b = -0.26$ (.06, $p < .001$). The overall indirect effect of exposure to narrative message without climate change was significant (*ACME* = 0.06 [95% CI: .0106 to .1300]), while the direct effect was not (*ADE* = -0.02, [95% CI: -.2845 to .2500]). As with previous models, the results of the sensitivity analyses demonstrate that while mediation model is not very robust, the original direction of the ACME is somewhat robust to a violation of sequential ignorability. See Figure 5.

```
Mediation Sensitivity Analysis for Average Causal Mediation Effect

Sensitivity Region

      Rho    ACME 95% CI Lower 95% CI Upper R^2_M*R^2_Y* R^2_M~R^2_Y~
[1,] -0.3 -0.0411      -0.0847       0.0024         0.09       0.0788
[2,] -0.2 -0.0055      -0.0335       0.0226         0.04       0.0350
[3,] -0.1  0.0283      -0.0078       0.0643         0.01       0.0088

Rho at which ACME = 0: -0.2
R^2_M*R^2_Y* at which ACME = 0: 0.04
R^2_M~R^2_Y~ at which ACME = 0: 0.035
```

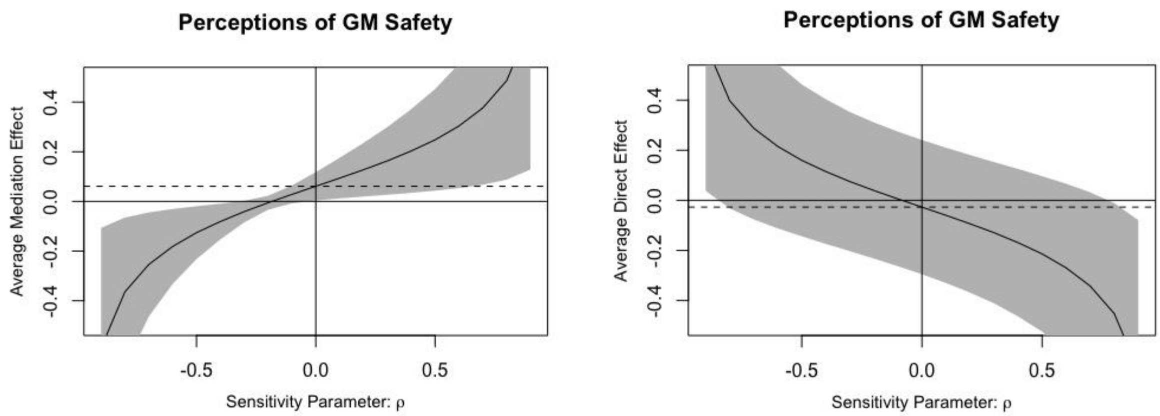

Figure 5. Graphical display of values ρ, with confidence intervals for the ACME, when narrative without climate comparison is the independent variable, perception of scientific consensus is the dependent variable, and reactance is the moderator.

The fourth mediation model uses the narrative with climate comparison condition as the main dependent variable with personal perception of GM safety as the dependent variable. We find that the narrative message with the climate comparison decreased experienced reactance compared with the non-narrative condition ($b = -0.29$ (.09), $p < .01$), and that less reactance increased perception of GM safety ($b = -0.26$ (.06), $p < .001$). The overall indirect effect of exposure to the narrative message with climate comparison was significant (*ACME* = 0.08 [95% CI: .0216 to .1400]), while the direct effect was not (*ADE* = 0.07, [95% CI: -.2274 to .3100]). The results of the sensitivity analyses were similar, but for both H3a and H3b, the analyses seem to be less sensitive for the narrative with climate comparison condition than for the narrative without the climate comparison. Overall, the sensitivity analyses show, the conclusions here are plausible so long as there are only a small number of departures from the sequential ignorability of the mediator See Figure 6.

```
Mediation Sensitivity Analysis for Average Causal Mediation Effect

Sensitivity Region

      Rho    ACME 95% CI Lower 95% CI Upper R^2_M*R^2_Y* R^2_M~R^2_Y~
[1,] -0.2 -0.0069      -0.0418       0.0281         0.04       0.0350
[2,] -0.1  0.0354      -0.0062       0.0769         0.01       0.0088

Rho at which ACME = 0: -0.2
R^2_M*R^2_Y* at which ACME = 0: 0.04
R^2_M~R^2_Y~ at which ACME = 0: 0.035
```

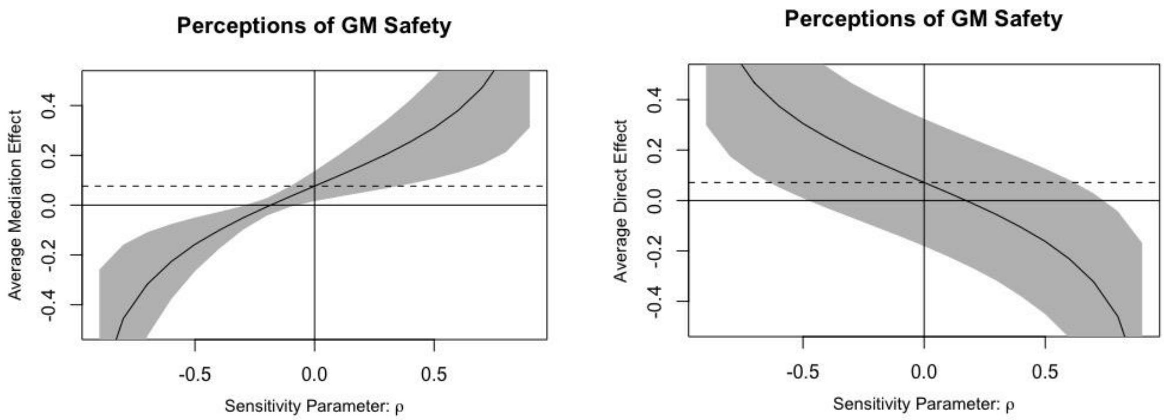

Figure 6. Graphical display of values ρ, with confidence intervals for the ACME, when narrative with climate comparison is the independent variable, perception of scientific consensus is the dependent variable, and reactance is the moderator.

We also examined the moderated mediation models in H4a and H4b using the mediation:R package (Tingley et al., 2014). As with H3a and H3b, we had to run two models by creating dummy variables to reflect the experimental treatments. In the first model, the narrative without climate comparison is used as the independent variable, while the dummy variable for the narrative with climate comparison is included in the model, using the non-narrative condition as the reference group. Perceptions of scientific consensus is the dependent variable. Here we included environmentalism, and account for the interaction between environmentalism and the narrative with climate comparison condition on experienced reactance. Again, we controlled for age, gender, race, education, children under the age of 18, household income, religious attendance, and political party. As expected, the results of the moderated mediation are not significant when the narrative without climate comparison is the independent variable ($ACME_{covariates.1}$ - $ACME_{covariates.2}$ = -0.0027, *p* = .926 [95% CI: -.0768 to .0756]).

```
Test of ACME(covariates.1) - ACME(covariates.2) = 0

ACME(covariates.1) - ACME(covariates.2) = -0.0026645, p-value = 0.926
alternative hypothesis: true ACME(covariates.1) - ACME(covariates.2) is not
equal to 0
95 percent confidence interval:
 -0.07688618  0.07557532


      Test of ADE(covariates.1) - ADE(covariates.2) = 0
```

```
ADE(covariates.1) - ADE(covariates.2) = 0.0028374, p-value = 0.99
alternative hypothesis: true ADE(covariates.1) - ADE(covariates.2) is not
equal to 0
95 percent confidence interval:
 -0.3383414  0.3435937
```

In the second model, the narrative with climate comparison is used as the independent variable, while the dummy variable for the narrative without climate comparison is included in the model, and the non-narrative condition is the reference group. The results of the moderated mediation demonstrate that there is only a marginally significant difference average mediation effect between those who are low in environmentalism and those who are high in environmentalism ($ACME_{covariates.1}$ - $ACME_{covariates.2}$ = 0.07, p = .078 [95% CI: -.0075 to .1595]).

```
Test of ACME(covariates.1) - ACME(covariates.2) = 0

ACME(covariates.1) - ACME(covariates.2) = 0.071057, p-value = 0.078
alternative hypothesis: true ACME(covariates.1) - ACME(covariates.2) is not
equal to 0
95 percent confidence interval:
 -0.007500116  0.159479605


      Test of ADE(covariates.1) - ADE(covariates.2) = 0

ADE(covariates.1) - ADE(covariates.2) = 0.0051853, p-value = 0.994
alternative hypothesis: true ADE(covariates.1) - ADE(covariates.2) is not
equal to 0
95 percent confidence interval:
 -0.3125682  0.3489398
```

The next two models are similar, except that perceptions of GM safety is the dependent variable in both. Again, the results of the moderated mediation are not significant when the narrative without climate comparison is the independent variable ($ACME_{covariates.1}$ - $ACME_{covariates.2}$ = -0.0007, p = .98 [95% CI: -.0974 to .1013]).

```
      Test of ACME(covariates.1) - ACME(covariates.2) = 0

ACME(covariates.1) - ACME(covariates.2) = -0.00071768, p-value = 0.98
alternative hypothesis: true ACME(covariates.1) - ACME(covariates.2) is not
equal to 0
95 percent confidence interval:
 -0.09736617  0.10130646


      Test of ADE(covariates.1) - ADE(covariates.2) = 0
```

```
ADE(covariates.1) - ADE(covariates.2) = 0.0081602, p-value = 0.954
alternative hypothesis: true ADE(covariates.1) - ADE(covariates.2) is not
equal to 0
95 percent confidence interval:
 -0.3691051  0.3944980
```

When the narrative with climate comparison is the independent variable, the results of the moderated mediation demonstrate that there is only a marginally significant difference average mediation effect between those who are low in environmentalism and those who are high in environmentalism ($ACME_{covariates.1}$ - $ACME_{covariates.2}$ = 0.095, p = .05 [95% CI: .0001 to .2065]).

```
      Test of ACME(covariates.1) - ACME(covariates.2) = 0

ACME(covariates.1) - ACME(covariates.2) = 0.094917, p-value = 0.05
alternative hypothesis: true ACME(covariates.1) - ACME(covariates.2) is not
equal to 0
95 percent confidence interval:
 0.0006189011 0.2065718994


      Test of ADE(covariates.1) - ADE(covariates.2) = 0

ADE(covariates.1) - ADE(covariates.2) = -0.0096769, p-value = 0.922
alternative hypothesis: true ADE(covariates.1) - ADE(covariates.2) is not
equal to 0
95 percent confidence interval:
 -0.3627710  0.3554097
```

In sum, the results of these further analyses using the mediation:R package demonstrate that the findings here should be interpreted cautiously. The results are not very robust to violations of sequential ignorability, suggesting that some unobserved pre-treatment confounders might have an impact on both the mediator and the outcome variables. For example, an individual's previous attitudes about scientific topics likes GM foods or climate change, or their previous attitudes about science generally, like trust in science or deference to science, may be influencing how much reactance they experienced or their subsequent attitude about GM foods. However, there is a strong theoretical basis and empirical evidence for a causal relationship between narrative messages and reduced experiences of reactance (Gardner & Leshner, 2016; Moyer-Gusé & Nabi, 2010). Our results are consistent with this work, but they also bring up many questions and demonstrate the need for more research on how these attitudes are formed and how exactly consensus messages might change them.

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