2020

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**To cite this article:** Emily Diamond, Thomas Bernauer & Frederick Mayer (2020): Does providing scientific information affect climate change and GMO policy preferences of the mass public? Insights from survey experiments in Germany and the United States, Environmental Politics, DOI: 10.1080/09644016.2020.1740547

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# Does providing scientific information affect climate change and GMO policy preferences of the mass public? Insights from survey experiments in Germany and the United States

**Abstract**: The use of information provision has been criticized as an ineffective way to increase support for evidence-based environmental policies, but it remains a dominant strategy among policy communicators. Using a survey experiment on climate change and genetically modified food (GMO) policy preferences in Germany and the United States (N=3,000 total), this study investigates how information provision shapes environmental policy attitudes and whether this effect is moderated by trust in science and trust in the source of messages. Findings show that information provision significantly shifted policy preferences towards the prevailing scientific opinion, but primarily among individuals whose prior attitudes conflicted with the scientific message. While trust in GMO science moderated message effectiveness in the U.S., generally the effects did not depend on levels of trust in science or trust in the message source. Results are similar for both countries, suggesting that the findings could be relevant to different political contexts.

Keywords: climate change, genetically modified foods, trust, communication, public opinion, survey experiment

## Introduction

Due to the highly technical nature of many environmental problems, policymakers often rely on the scientific community for guidance on environmental policy direction, design, and evaluation. This close relationship is driven in part by a growing emphasis by policymakers on crafting evidence-based policies (Hutschemaekers and Tiemens 2005, Abraham and Haskins 2017, Leuz 2018). One major obstacle to evidence-based policymaking in the environmental field, however, is the significant gap between scientific and public opinion on a number of issues (Funk and Rainie 2015). When public opinion differs from scientific opinion, policymakers face political pressure to respond to the attitudes of constituents, rather than the views of scientists.

Two environmental policy areas where public opinion differs considerably from the prevailing scientific opinion are climate change and genetically modified organisms (GMOs). The vast majority of scientists agree that human activity is causing climate change, but public agreement with this conclusion hovers closer to 50 percent in the U.S. and across Europe (Funk and Kennedy 2016a, Steentjes *et al.* 2017). Similarly, a majority of scientists believe that genetically modified (GMO) foods currently in existence are safe to eat, but public opinion tends to be much less accepting of GMO foods (European Commission 2010, Funk and Rainie 2015, Kennedy *et al.* 2018). The divergence between public opinion and science, both with respect to risks and the need for policy-interventions, can lead to policy gridlock as politicians struggle to balance pressures from the public and the scientific community. This may at times even lead to policies that directly conflict with scientific evidence, such as blanket bans on genetically modified foods or the reversal of climate change mitigation policies. This effect is also compounded by the efforts of opposing interest groups that use conflicting information or even misinformation to increase gaps between public and scientific opinion. For environmental policymakers interested in implementing evidence-based policies, then, aligning public opinion with scientific evidence is an important goal.

Traditionally, efforts to close the gap between public attitudes and scientific evidence have focused on providing information to "educate" the public about the science on a given issue. The premise of this *information deficit model* is that the respective gap results from lack of information about science among the public. Despite its intuitive appeal, individuals are not objective evaluators of information and issues – the reception of information is colored by an individual's prior attitudes, identities, values and schema (Brossard and Nisbet 2007, Pechar 2019). Moreover, in the environmental policy realm, whom an individual trusts has been shown to be an important predictor of their environmental policy preferences (Dietz *et al.* 2007, Konisky *et al.* 2008). In forming opinions on specific policy issues, individuals often use cues from institutions or persons they trust (Douglas and Wildavsky 1982, Druckman 2001, Priest 2001). On scientific issues, those cues can come from attitudes towards the science or from trust in the source of the message itself.

In this paper, we use experimental methods to examine the extent to which scientific messages can shift public opinion, and whether trust in science and attitudes towards two particularly divisive sources of scientific information – government and corporations – may have a moderating effect in this regard.

Our study is based on data from original online survey experiments in Germany and the United States. We compare the effects of information provision across these countries for two reasons. First, public opinion on, and political responses to, climate change and GMOs are quite different in the two countries (Brossard and Nisbet 2007). Public opinion on climate change appears to be more aligned with the prevailing scientific opinion in Germany than in the United States, while public opinion on GMOs tends to be more aligned with the prevailing scientific opinion in the United States than in Germany (Gaskell *et al.* 1999, Barasi and Harding 2017). Second, scientific evidence may be weighted differently by citizens in different policy and cultural environments, and researchers have pointed to differences in the evaluation of scientific information for policymaking between Europe and the United States (e.g. Jasanoff, 2011).

Our results suggest that information provision can significantly increase policy support in line with prevailing scientific opinion primarily among individuals whose prior attitudes conflict with the scientific message. We also found that on the topic of GMO foods in the United States, the level of trust in GMO science did moderate the effect of information provision: as trust in GMO science increased, receiving a message about GMO food safety was associated with less support for policies limiting GMO foods. We did not find evidence that trust in the source of the message moderated message effectiveness. Effects were mostly consistent across the two countries, suggesting that the effects of scientific information provision may be similar across cultures. Our findings contribute to the debate in environmental politics on the effectiveness of science communication and provide insight into how public support for science-based environmental policies might be enhanced.

## Theory and Arguments

### *Information Provision in Environmental Communication*

The information deficit model is predicated on the assumption that a lack of public understanding or knowledge leads to public skepticism of science and policies that rely on scientific evidence (Sturgis and Allum 2004). Operating under the assumption that if the public knows what scientists know then they will support policies backed by science, efforts to fill the public "deficit" in science knowledge remains a major strategy of science communicators, with some empirical evidence to support it (Bubela *et al.* 2009). Sturgis and Allum (2004), for example, found that scientific knowledge was significantly associated with positive attitudes towards science, and that this relationship is positively moderated by political knowledge. Furthermore, in a meta-analysis of studies over 15 years across 40 countries, Allum et al (2008) found a small positive correlation between general attitudes towards science and general knowledge of scientific facts.

Despite some evidence on positive effects of information provision and scientific knowledge, however, many other studies have challenged the direct association between scientific knowledge and attitudes aligned with the prevailing scientific opinion. Wynne (1992) was among the first to demonstrate that simply providing individuals with scientific information does not always change attitudes in line with the scientific information. In many cases, more knowledge about a potentially risky technology (e.g. biotechnology or nuclear energy) can lead to increased fear of or aversion to the technology, instead of greater acceptance (Dickson 2005). Other information provision experiments have also called into question the effectiveness of providing information to bring public opinion in line with the prevailing scientific opinion (e.g. Shwom, Dan, & Dietz, 2008). Using a series of films about genomic science presented to British individuals, for example, Sturgis et al (2010) found no significant effect of science information provision on attitudes towards genomic policy issues, and only a slight difference in levels of trust in genetic scientists.

### *Bayesian Model of Information Processing*

To reconcile these conflicting findings on information provision and science attitudes, one must consider how individuals process and absorb scientific messages. The information deficit model aligns with a Bayesian approach to information processing, where individuals are motivated by accuracy and update their attitudes after receiving relevant information (Slovic and Lichtenstein 1971). Information provision does not lead to attitude updating in all circumstances, however. The Bayesian model asserts that attitude updating takes place primarily when an individual's prior beliefs about the topic ("priors") are challenged by the message, and also when those beliefs are weakly held (Bullock 2009). For example, a message about human-caused climate change will be more likely to change attitudes among an individual who is skeptical of the scientific consensus on human-caused climate change, as opposed to someone who already believes in climate change. However, the effectiveness of this message among the skeptic will depend on how strongly held their beliefs are. If the individual's prior attitudes on climate change are weak, the new information will seem more persuasive than if their priors were strongly held.

Evidence from prior public opinion surveys suggests that most members of the public do not have high levels of knowledge about science and environmental issues (Evans and Durant 1995, Jallinjoa and Aro 2000, Allum *et al.* 2008), particularly on environmental issues such as climate change and GMO foods (Fiske and Taylor 1991, Leiserowitz *et al.* 2010, Funk and Kennedy 2016b, Gilden and Peters 2017), Therefore, a Bayesian model might assume weak prior attitudes on these issues. If that is the case, this model would predict that scientific information provision would be most effective in cases where prior attitudes oppose the scientific message (i.e. they do not believe in anthropogenic climate change, or do not believe that GMO foods are generally safe).

### *Trust and Information Processing*

While a Bayesian model of information processing predicts outcomes of information provision based primarily on prior attitudes towards the issue, other models suggest that other factors can influence information processing. Motivated reasoning, for example, suggests that individuals are biased information processors, driven not by an intention to have accurate attitudes, but instead a desire to have attitudes that align with their beliefs, values and identities (Taber and Lodge 2006, Bush and Prather 2017, Pechar *et al.* 2018). Individuals may ignore information that conflicts with these beliefs or values (Ho, Brossard, & Scheufele, 2008; Nisbet, 2005; Nisbet & Goidel, 2007).

Under both the Bayesian and motivated reasoning models, factors such as the credibility of the message source and trust in the science behind an issue can influence whether information provision leads to attitude updating (Priest *et al.* 2003, Lee *et al.* 2005). Even if an individual receives information that conflicts with weakly held beliefs, they may not update their attitudes if they do not perceive the source as credible (i.e., a source that the individual trusts) (Douglas and Wildavsky 1982, Druckman 2001, Bullock 2009, Bush and Prather 2017). Similarly, if an individual does not trust GMO science, for example, they may discredit a message about GMO food safety and fail to update their attitudes.

For issues of environmental policy, trust in science may be a pre-requisite for the effectiveness of science communication (Nisbet and Scheufele 2009, Nisbet *et al.* 2015, Pechar *et al.* 2018). Malka et al (2009), for example, found a positive relationship between self-reported knowledge about climate change and level of concern about the issue among individuals who trust scientists, but not those who did not trust scientists. It also can vary across issue areas, with individuals more likely to trust the science on issues that align with their worldviews (for example, liberals are more likely to trust science on issues relating to environmental or public health protection, while conservatives may be more likely to trust the science behind new innovations for economic production (McCright *et al.* 2013)). If an individual distrusts climate change or GMO science, it is less likely that a scientific message about that issue will change their attitudes.

Research has also found evidence that trust in the message source affects information processing (Eagly and Chaiken 1993, Petty and Cacioppo 2012), and that sources viewed as more credible tend to be more persuasive than those seen as not credible (Druckman 2001, Weber *et al.* 2012). For this reason, levels of trust in the source of the message becomes a vital consideration in message effectiveness. In a survey of U.S. adults, Priest (2001) found that trust in various institutions (including industry, scientists, farmers, and shops) was the strongest predictor of an individual's level of support for biotechnology (including GMO foods).

For environmental issues, scientific information comes from many sources, including governments, universities, NGOs, and corporations. Of these, attitudes towards two – governments and corporations – are likely to be particularly influential on trust in science on a specific issue, in part due to their perceived role in funding scientific research (Priest 2001, Pechar *et al.* 2018). Trust in governments has been commonly linked to attitudes on environmental issues (Franzen and Vogl 2013, Harring 2013, Taniguchi and Marshall 2018), and governments are commonly associated with the production of science through both state sponsorship of research and the institutionalization of science through government science advisory committees (Jasanoff 1990). Similarly, as the scientific community has become increasingly involved in the consumer marketplace, corporations have become active sponsors and sources of scientific information. Large amounts of scientific research on genetic modification are sponsored by corporations, for example (Scientific American 2009, Plumer 2014). Given this association, we examine how information from government and corporate sources may differentially influence the effectiveness of those messages in increasing policy preference alignment with prevailing scientific opinion.

### *Empirical Expectations*

Our study addresses four questions. First, does exposure to a scientific message shift policy preferences in the direction of the prevailing scientific opinion, and does this effect differ depending on the prior attitudes of the individual about climate change or GMO foods? Second, is this effect moderated by whether the individual trusts the science in that domain? Third, does the effect depend on whether the individual trusts the source of a message? And finally, do these effects differ across country contexts?

Both the Bayesian and motivated reasoning models of information processing instruct our empirical expectations. According to Bayesian theory, if attitudes are weakly held (as public attitudes towards science and the environment may be), a message that conflicts with an individual's prior attitudes should cause an updating of views based on the new information, leading to policy preferences more in line with the prevailing scientific opinion (H1a). However, if (weakly held) attitudes are already in line with the message, we expect no movement in policy preferences (H1b).

If there are strong priors that restrict the attitude updating, such as a distrust of the science behind or source of the message, this may reduce the effectiveness of the information provision at changing attitudes as predicted by motivated reasoning. Specifically, we hypothesized that scientific messages would increase support for policy-choices in line with prevailing scientific evidence more among individuals who trust the science than those who do not trust it (H2a). Similarly, we hypothesized that the messages would increase policy support more among individuals who trust the (government or corporate) source of the message compared to those who do not trust it (H2b). Our hypotheses are therefore as follows:

H1: Assuming prior attitudes are weakly held, information provision will be associated with:

H1a: Policy attitudes more in line with the prevailing scientific opinion among individuals whose prior attitudes conflict with the message.

H1b: No change in policy attitudes among individuals whose prior attitudes align with the message.

H2: Trust in science and message source will moderate the effect of information provision so that:

H2a: With increasing levels of trust in science, information provision is more likely to move policy preferences towards prevailing scientific opinion.

H2b: With increasing levels of trust in the source of a message, information provision is more likely to move policy preferences towards prevailing scientific opinion.

As for variation between Germany and the United States, because climate change tends to be politically more polarizing in the United States compared to Germany, we expected that individuals may have stronger prior attitudes in the more polarized context. For that reason, we expected that climate change information provision may be more effective in the German context. Since the inverse is likely to be true on the issue of GMOs, we expected that information provision may be more effective in the United States context on that issue.

**Materials and Methods**

To evaluate these expectations, we designed and fielded a survey on climate change and GMO policy preferences among representative samples of adults in Germany and the

United States. The survey was fielded in both countries from February 22 – March 2, 2016 by the survey firm YouGov. YouGov sampled and interviewed 1,600 German and 1,541 United States participants online. They were then matched to a nationally-representative sampling frame on gender, age, race, education, party identification, ideology, and political interest to produce the final dataset of 1,500 from each country (total N=3,000).[2] The survey instrument was initially developed in English by the authors, and then translated into German for the German sample.

Our between-subjects survey experiment followed a 2x2 design, manipulating both the information source (government or corporate) and the policy area (climate change or GMOs) of a scientific message. Trust in science and the message source was measured observationally because we consider it extremely difficult to manipulate experimentally.

We randomly assigned participants to receive one of five messages, resulting in four treatment conditions and one control condition. Subjects received a press release from a specified source providing information consistent with the prevailing scientific opinion on climate change or GMO food safety. In the message about climate change, participants were told that the prevailing scientific opinion supports prioritizing policies to mitigate climate change (IPCC 2013). In the message about GMOs, participants were told that the prevailing scientific opinion finds that GMO foods are safe and that increasing restrictions on GMO foods should not be a policy priority (Funk and Rainie

[2] Because participants were not required to answer all survey questions, some data is missing for certain variables. This resulted in sample sizes of slightly less than 1,500, depending on the variables in a model. No systematic patterns of missing data were found.

2015).[3] Messages taking an anti-climate change mitigation or an anti-GMO stance were not used because the overwhelming scientific consensus on both issues rejects these claims (Funk and Rainie 2015), although this could be examined in future research.

The sources of the messages were either a government regulatory agency or a major corporation. Specific sources were selected to represent entities in each industry that are active in funding scientific research in the areas of climate change and GMOs (Nasiritousi 2017), and entities that would be familiar to the study participants. In the U.S. sample, the climate change message sources were the National Oceanic & Atmospheric Administration (government) and BP (corporate). The GMO message sources were the Food & Drug Administration (government) and Monsanto (corporate). In the German sample, the climate change message sources were Deutscher Wetterdienst (government) and BP Europa (corporate), and the GMO message sources were Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL) (government) and Bayer CropScience (corporate). We included a brief description of each source at the bottom of the press releases to further familiarize participants with the message source. Content for the press releases was culled from the websites and other messaging of the sources themselves, and the positions towards climate change and GMOs promoted in the press releases mimicked the actual positions of the source.

Subjects randomly assigned to the control group received a press release from a neutral (not affiliated with a government or a corporation) scientific entity - the American Association for the Advancement of Science or the German Geological

[3] It should be noted that the climate change message cites a need for more government regulation, while the GMO message cites a need for less regulation. Participants' preferences might therefore be confounded by their desired level of government regulation. However, in the full model we control for ideology and attitudes towards government to address this concern.

Society - describing an unrelated and uncontroversial scientific phenomenon (a connection between a series of earthquakes representing evidence of elastic disturbance in the Earth's crust). This placebo message provided exposure to a scientific message, but on a topic that is irrelevant to climate change or GMOs and from a source unrelated to government or the corporate sector. We favored this approach to a no-message control group to mitigate against any potential reaction that participants may have to reading scientific information in general. The English version of each press release can be found in the online appendix.[4]

After receiving a treatment or control message, study participants proceeded to a comprehension check question about the main message of the press release and the source of the press release to confirm that they had read the treatment text. We created a dummy variable based on these items to denote whether the respondent answered each of these questions correctly. We included this variable as a control in the statistical models to control for attentiveness while maintaining the integrity of the sample (see, e.g. Aronow, Baron, & Pinson, 2015).

### *Key Variables*

Our dependent variable measured the priority accorded to policies aligned with the prevailing scientific opinion. Asking about policy prioritization allowed us to compare responses across jurisdictions with different current policy contexts, as opposed to asking preferences on specific policy proposals that may not be relevant in both countries. Study participants were asked: How high of a priority should it be for the government to implement policies to reduce climate change [/restrict the sale of GMOs]? Responses ranged from 1 (not a priority) to 5 (essential). The GMO policy

[4] German versions available from the authors

preference variable was reverse coded so that a high score for both variables represented an alignment with prevailing scientific opinion. In the discussion of the results, we refer to the treatment effect on this variable as an increase in policy preferences aligned with the prevailing scientific opinion.

The primary predictor variable was the treatment condition to which each participant was randomly assigned, with the control group as the comparison. Results are depicted separately for each issue area, and balance tables verifying random distribution variables across treatment groups are presented in the online appendix.

To measure prior beliefs about climate change, participants were asked whether they believed the earth was warming and if it was due to human activity or natural causes. Those that believed the earth was warming due to human activity were considered climate change believers, all others were categorized as climate change skeptics. Similarly, participants were asked to what extent they believed that GMO foods were safe to eat; those that agreed or strongly agreed that GMOs are safe to eat were categorized as GMO believers, all others as GMO skeptics.

Moderating trust variables, which were measured observationally prior to treatment, were calculated as continuous composite variables based on the responses to seven statements measuring trust in GMO or climate science, and trust in government or corporations (adapted from  Nisbet et al., 2015; see online appendix for full question wording). Cronbach's alpha was above .85 for all the composite variables used in the analysis.

We also included a number of control variables in the analysis, based on factors that have been previously shown to predict policy preferences on climate change and GMOs: political ideology (liberal/conservative, left/right), fiscal conservatism, social conservatism, openness to risk (to control for varying levels of acceptance of new technologies or threats), income, gender, education and age (Zia and Todd 2010). We also controlled for openness to risk in general terms, as this personality trait has been shown to be associated with acceptance of new technologies such as GMO foods (Conchar *et al.* 2004, Asselt and Vos 2008, Nov and Ye 2008, Whitfield *et al.* 2009, Breakwell 2014). Control variables were generally not highly correlated with the outcome variables, except for climate change/GMO belief and political ideology (see online appendix for correlation tables).

## Results

The following sections present descriptive results of the key variables across samples, followed by the experimental results. Consistent with our first hypothesis, we find that only individuals who had prior attitudes that conflicted with the scientific message expressed policy preferences more in line with the prevailing scientific opinion after receiving the message. Additionally, while we observe a moderating effect of trust in GMO science on policy preferences in the U.S. sample, we find no other evidence that trust in science or trust in message source moderates the effect of information provision on policy preferences.

### *Descriptive Statistics*

Table 1 reports the means and standard deviations for the key variables in the U.S. and German samples: policy preferences regarding climate change and GMOs, trust in science, and trust in government and in corporations. T-tests on the means between the samples show that the average German climate change policy preferences were significantly higher than those in the U.S. sample ($p$<.001) (statistical significance denoted by asterisks in Table 1). On the issue of GMOs, we found that American policy preferences, on average, were more in line with the scientific consensus than those in Germany (*p*<.001).

Regarding trust in science, the government, and corporations, we found significant differences in means between the samples for all variables except trust in climate science. Mean trust in GMO science was higher in the U.S. than in Germany, while trust in government (p<.01) and corporations (*p*<.001) were both higher in Germany than in the U.S. Also, in both samples, respondents had higher levels of trust in climate science than in GMO science.

*[Table 1 here]*

***Effects of Information Provision Based on Prior Attitudes***

Next, we examined the effect of receiving a scientific message about climate change or GMOs on policy preferences in both samples (irrespective of message source) (H1). Informed by Bayesian theory, we divided this analysis based on prior attitudes in alignment (believers) or conflicting with (skeptics) the scientific message. To measure this effect, we estimated OLS regressions using the treatment indicator variable and the control variables. Figure 1 shows the treatment effects and 95% confidence intervals of receiving the scientific message on policy attitudes (all regression tables in appendix).

*[Figure 1 here]*

In both Germany and the United States, receiving a scientific message about climate change and GMOs significantly moved policy attitudes towards the prevailing scientific opinion among individuals who were previously skeptical of climate change and GMO foods. For climate change skeptics, receiving a scientific message about the urgency of human-caused climate change was associated with an increase in perceived policy priority of 0.206 (about 4 percentage points) on a five-point scale (*p*<.01) in the

U.S. and 0.319 (about 6 percentage points) on a five-point scale ($p$<.001) in Germany. This means that receiving the climate change message led skeptical participants to be 4-6 percentage points more likely to say that mitigating climate change should be a priority, compared to not receiving the message. Results were similar, although slightly muted, among skeptics of GMO food safety. Receiving a scientific message about the safety of GMO foods was associated with a decrease in perceived priority of GMO regulations of 0.152 (about 3 percentage points) on a five-point scale ($p$<.051) in the U.S. and 0.161 (about 3 percentage points) on a five-point scale ($p$<.05) in Germany. The effect of receiving a scientific message among believers was generally not significant – the exception was climate change believers in the U.S., where receiving the message was associated with an increase of 0.148 (about 3 percentage points) in perceived climate change policy priority ($p$<.01).

***Moderating Effect of Trust in Science***

We next examined whether the treatment effect varied depending on prior trust in climate change or GMO science. To do this, we used OLS regressions to identify whether there was a significant interaction effect between treatment (versus control) conditions and trust in the relevant science. Figure 2 shows the results of this analysis. The only significant interaction effect was observed for the GMO issue in the U.S. sample. In this context, receiving a message about the safety of GMO foods was associated with policy attitudes more aligned with the prevailing scientific opinion as trust in GMO science increased. The interaction effect of trust in science and treatment effect was not statistically significant for climate change in either country, or for GMO foods in Germany. However, the positive slopes of each interaction chart in Figure 2 show that trust in science itself was associated with policy preferences more in line with the scientific consensus in these areas – it just did not change how individuals interpreted scientific messages.[5]

*[Figure 2 here]*

### *Moderating Effect of Trust in Message Source*

The final step in our analysis was to investigate whether the effect of providing scientific information on policy attitudes was moderated by trust in the source of the message. To estimate this moderating effect, we ran additional OLS regressions interacting trust in the source of the message (government or corporate) with the treatment indicator. This analysis revealed no statistically significant interaction effects. This means that in our experiment, higher levels of trust in the source of the message were not associated with an increase in the effectiveness of the message at increasing policy preferences in line with the scientific consensus. Detailed regression results can be found in the appendix.

## Discussion

In the study of environmental politics, addressing gaps between public opinion and prevailing scientific opinion is an important strategy to build public support for evidence-based policies. The goal of this study was to better understand whether and how scientific information provision could influence the mass public's environmental policy preferences towards greater alignment with prevailing scientific opinion – specifically on the topics of climate change and GMO foods. We also examined whether such an effect might be moderated by (pre-existing) trust in science and trust in

[5] It is important to note here that only the direct effect of information provision on policy preferences can be interpreted in terms of a causal effect, because information provision was experimentally manipulated and randomly assigned. The effects of the interaction terms, in contrast, should be interpreted in a more correlational sense because one component of these interaction terms, our trust measures, is observed and not experimentally manipulated.

the source of the message.

Through a survey experiment in Germany and the United States, we examined whether messages reflecting the prevailing scientific opinion on climate change and GMO food safety could lead citizens to express policy preferences more aligned with the prevailing scientific opinion. Based on the Bayesian model of information processing and assuming weakly held attitudes about environmental issues, we expected that providing a message about the science of climate change and GMOs would change attitudes primarily among individuals whose priors conflicted with the message (H1a), and not among those whose attitudes already aligned with the message (H1b). We also expected that trust in climate or GMO science (H2a) and trust in the source of scientific messages (H2b) would moderate the effect of scientific information provision on environmental policy preferences.

Our findings offer mixed support for these expectations. As predicted by the Bayesian model, receiving a scientific message was associated with policy preferences more in line with the prevailing scientific opinion, primarily among individuals who had conflicting prior attitudes (skeptics). Participants whose attitudes towards climate change and GMO foods were already in line with the content of the message (believers) demonstrated minimal movement. The exception here was for climate change believers in the U.S., whose policy attitudes were more in line with prevailing scientific opinion after receiving the message. The consistency of our findings with the Bayesian model also suggests weakly held prior attitudes on climate change and GMO foods (although future research should test the strength of prior attitudes directly). These findings also offer some evidence of support for the information deficit model – providing scientific information can influence policy preferences more in line with the scientific consensus.

Considering the moderating effect of trust in climate change or GMO science on the information provision effect, we found that in most cases levels of trust in science had no significant effect on message effectiveness. The only exception was a positive interaction effect for trust in GMO science and message effectiveness in the U.S. sample. Trust in GMO science was associated with greater alignment of GMO policy preferences with the prevailing scientific opinion after receiving the message. While this significant interaction effect is notable, it is not sufficient to conclude that trust in science is a substantive moderator of message effectiveness across countries and issues.

Additionally, we did not find evidence that prior levels of trust in the government or corporate sources of the messages changed how participants reacted to the messages. As much of the science communication literature has alluded to these two factors being important for information processing, the lack of significant interaction effects here is an important finding. It suggests that other potential factors, such as political ideology, may be more important determinants of policy preferences as well as moderators of effects of information provision (Frewer *et al.* 2003).

With regards to country context, in general, the results for the German and U.S. samples were similar, suggesting that effects of information provision may be broadly similar across different countries. However, we do observe that trust in GMO science was only a moderator for GMO policy preferences in the U.S. sample. While our study adds to environmental policy and communication research by comparing two countries, these are both Western countries with relatively similar political and cultural systems as well as high income levels. An important extension of our work would be to increase the number of countries studied, and particularly to include a more diverse sample of countries in terms of culture, politics, income, and education levels, as well as perspectives on environmental issues.

An important caveat of this study is that it primarily offers insight into issues that are characterized by a prevailing scientific opinion (or near consensus). It is unclear whether we would observe similar effects for issues where there remains significant scientific uncertainty and unresolved debate, or with messages that oppose the prevailing scientific opinion. Future research could thus use treatments that incorporate scientific messages that point in different directions, perhaps combined with additional message sources that, for reasons of sample size and statistical power, could not be considered in our study (e.g. universities or international organizations).

Yet other limitations concern effect sizes and causality. The effect size of the climate change information provision treatment (4-6 percentage point increase in policy priority) may appear rather small. However, we think that this increase is notable given the highly polarized nature of environmental policy preferences in this area. With attitudes so difficult to change on polarizing environmental issues, even small changes in policy preferences could contribute to significant political changes.

With regards to causality, our experimental design allows us to identify causal effects of information provision per se. We must be more cautious with respect to results for the moderating role of trust, because the latter is not experimentally manipulated. While there were no significant differences in trust in climate science, GMO science, corporations or governments between the treatment groups, it is possible that omitted variables that differ between treatment groups may also have affected observed differences in message effects. Therefore, our findings, particularly for the interaction effects, should be interpreted primarily in correlational terms.

Our findings have several implications for environmental policy communication. First, our findings suggest that scientific information provision can be effective at changing policy preferences, particularly among individuals with weakly-held prior attitudes that conflict with scientific consensus. This means that on these environmental issues, motivated reasoning does not seem to *completely* trump the information deficit and Bayesian models, as suggested in prior literature. Additionally, we find that trust in science may not matter to information provision efforts as much as previously believed. Except for trust in GMO science in the United States, we find that prior trust in science does not seem to change how information is received and accepted. Instead, we find that scientific communication can contribute to aligning mass public preferences with the prevailing scientific opinion, irrespective of prior trust in science or even the source of the message. As long as gaps remain between scientific and public opinion on environmental policy issues, environmental policy communicators will seek to use information provision to reduce this gap. Research that contributes to better understanding of when this communication is most likely to work is an important contribution to environmental policymaking.

## Acknowledgments

We would like to thank Aseem Prakash and three anonymous reviewers for their valuable comments and suggestions. Any errors and omissions are the sole responsibility of the authors.

Funding

This work was supported by the European Research Council under Grant 295456; and the Sanford School of Public Policy.

Declaration of Interest

The authors report no conflict of interest in this work.

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**Online Appendices**

***Appendix A: Example Treatment Messages***

*(Government Source, Climate Change Topic)*

FOR IMMEDIATE RELEASE
National Oceanic and Atmospheric Administration
1401 Constitution Avenue, NW
Washington, DC 20230
http://www.noaa.gov/

**Government report asserts that human activity is causing climate change**
Washington, DC, 4/8/15

A report released today by scientists at the United States National Oceanic and Atmospheric Administration (NOAA) – a federal agency focused on the scientific measurement of climate conditions– confirms that climate change is happening now, and it is driven primarily by human activities. The NOAA scientists confirm that the Earth's average surface temperature has risen by 1.4 degrees Fahrenheit over the past century, and is projected to rise another 2 - 11.5 degrees Fahrenheit over the next 100 years. This will likely result in extreme weather events becoming more frequent and unpredictable, including more floods, droughts, heat waves, and hurricanes.

The report acknowledges that a large majority of climate scientists (97%) agree that these changes in climate are caused by human activities, specifically the emission of large amounts of carbon dioxide and other so called greenhouse gases. The burning of fossil fuels for energy (such as coal, gas, diesel, and oil) causes an excessive buildup of carbon dioxide and other greenhouse gases in the atmosphere, which warm the Earth's climate and result in dangerous impacts on human and ecosystem welfare.

Although the climate of the Earth has changed throughout history, the NOAA scientists find that the changes that are now occurring do not follow natural patterns, and are directly linked to increased emissions of carbon dioxide and other greenhouse gases. The number of daily record high temperatures has increased each decade, indicating a trend toward an increasingly warm Earth. These changes coincide with the excess carbon dioxide emissions from human activities. Given these facts, the report underscores the need to reduce carbon dioxide emissions to reduce further warming and climate change.

*The National Oceanic and Atmospheric Administration (NOAA) is a government agency under the Department of Commerce focused on the conditions of the oceans and atmosphere. NOAA warns of dangerous weather, charts seas and skies, guides the use and protection of ocean and coastal resources, and conducts research to improve understanding and stewardship of the environment. It is headquartered in Silver Spring, Maryland.*

*(Government Source, GMO Topic)*

FOR IMMEDIATE RELEASE
Food and Drug Administration
10903 New Hampshire Ave
Silver Spring, MD 20993
http://www.fda.gov/

**Government report finds that approved genetically modified foods are safe for human consumption**
Silver Spring, MD, 4/8/15

A report released today by scientists at the United States Food and Drug Administration (FDA) – the government agency responsible for regulating food safety - confirms that genetically modified foods (also known as GMOs) that have been approved through the FDA review process are equally safe for human consumption as any other food product approved by the FDA.

Genetic modification is used to add new traits or characteristics to crops. For example, plants may be genetically modified to enhance their growth, insect or drought resistance, or nutritional value. Nutritional assessments of foods from genetically modified crops have shown that such foods are generally just as nutritious, if not more nutritious, as foods from plants that are not genetically modified.

The report acknowledges that GMO foods are the most thoroughly tested foods on the market, and a 20-year record of safety as well as almost 2,500 independent, global scientific reviews have found no credible evidence of harm to humans or animals consuming genetically modified foods. The FDA scientists find that as the genetically modified foods currently on the market have passed rigorous safety assessments, they are very unlikely to present any risks for human health, and no effects on human health have been shown as a result of the consumption of such foods by the general population.

*The Food and Drug Administration (FDA) is an agency within the U.S. Department of Health and Human Services. It is responsible for protecting public health through the regulation and supervision of food safety, tobacco products, dietary supplements, prescription and over-the-counter medications, vaccines, biopharmaceuticals, and medical devices. The FDA is headquartered in White Oak, Maryland.*

*(Control message)*

FOR IMMEDIATE RELEASE
American Association for the Advancement of Science
1200 New York Ave NW
Washington, DC 20005
http://www.aaas.org

**Triggered earthquakes give insight into changes below Earth's surface**
Washington D.C., 10/20/2015

A team of researchers with members from Los Alamos National Laboratory, MIT and the University of Tokyo, has found evidence that suggests elastic disturbance caused by one earthquake may be one of the causes of another earthquake occurring in a far distant location.

As the authors note, prior research has revealed sufficient evidence of earthquakes happening in one place "causing" an earthquake to occur in another place. Such chain-reactions can occur because seismic waves are able to travel great distances through rock. In this new effort, the researchers suggest that seismic waves from one earthquake can cause an elastic disturbance in a distant place, pushing a relatively fragile area into an earthquake.

The researchers came to this conclusion after studying seismic data following an earthquake in the Indian Ocean back in April of 2012. Just 30 and 50 hours later, two small earthquakes occurred off the eastern coast of Japan. Though the quakes were 3,900 miles apart, the researchers believe they have found a link between them.
While the researchers are not suggesting their work will help predict earthquakes, they believe that their findings offer more information on the nature of the Earth's crust and how it behaves under different conditions.

*The American Association for the Advancement of Science (AAAS) is the world's largest general scientific society, with more than 120,000 members. It is a non-profit organization that enhances communication and cooperation among scientists, promotes scientific integrity, and increases public engagement with science. It also publishes the scientific journal* Science.

*Appendix B: Trust Composite Variable Questions*

**Trust in climate change/GMO science:** Participants indicated how well each statement described their views on a scale from 1-6 (*1=completely false*, *6=completely true),* and the questions were presented in random order. These items included:

- I have very little confidence in the [climate/GMO] science community *(reverse coded)*
- Information from the [climate/GMO] science community is trustworthy
- I trust the [climate/GMO] science community to do what is right
- The [climate/GMO] science community has too much power and influence in society *(reverse coded)*
- The findings of [climate/GMO] science are influenced by who pays them *(reverse coded)*
- The [climate/GMO] science community often does not tell the public the truth *(reverse coded)*
- I am suspicious of the [climate/GMO] science community *(reverse coded)*

**Trust in government/corporations*:** Participants indicated how well each statement described their views on a scale from 1-6 (*1=completely false*, *6=completely true),* and the questions were presented in random order. These items included:

- I have very little confidence in the [climate/GMO] science community *(reverse coded)*
- Information from the [climate/GMO] science community is trustworthy
- I trust the [climate/GMO] science community to do what is right
- The [climate/GMO] science community has too much power and influence in society *(reverse coded)*
- The findings of [climate/GMO] science are influenced by who pays them *(reverse coded)*
- The [climate/GMO] science community often does not tell the public the truth *(reverse coded)*
- I am suspicious of the [climate/GMO] science community *(reverse coded)*

*Note: While often considered components of political ideology (see Pechar, Bernauer & Mayer 2018), our measures for trust in government and corporations were not strongly correlated with political ideology, especially in Germany. In both countries, political ideology (conservatism) was slightly negatively correlated with trust in government ($r$=-0.097 in Germany and -0.377 in the U.S.), while trust in corporations was slightly positively correlated with political ideology (conservativism) ($r$=0.133 in Germany and 0.365 in the U.S.).

*Appendix C: OLS Regression Tables*

Table C1: OLS Regression Output for the Treatment Effect of Receiving a Scientific Message on Climate Change and GMO Policy Preferences (Believers and Skeptics)

| | **Believers** | | | | **Skeptics** | | | |
|---|---|---|---|---|---|---|---|---|
| | Climate Change Policy Priority | | GMO Policy Priority | | Climate Change Policy Priority | | GMO Policy Priority | |
| VARIABLES | U.S. | Germany | U.S. | Germany | U.S. | Germany | U.S. | Germany |
| Treatment | 0.148** | 0.068 | -0.074 | 0.145 | 0.206*** | 0.319*** | 0.152* | 0.161** |
| | (0.067) | (0.086) | (0.150) | (0.142) | (0.076) | (0.077) | (0.078) | (0.069) |
| Trust in gov. | 0.015 | 0.024 | -0.120*** | -0.030 | -0.013 | -0.006 | -0.067*** | -0.012 |
| | (0.021) | (0.028) | (0.044) | (0.042) | (0.024) | (0.025) | (0.025) | (0.023) |
| Trust in corp. | 0.005 | -0.013 | -0.015 | 0.010 | 0.007 | -0.003 | -0.001 | -0.008 |
| | (0.008) | (0.013) | (0.027) | (0.022) | (0.010) | (0.012) | (0.010) | (0.011) |
| Political ideology | -0.021 | -0.034 | -0.255* | 0.143 | 0.267*** | 0.098 | -0.201*** | 0.024 |
| | (0.065) | (0.085) | (0.149) | (0.138) | (0.073) | (0.073) | (0.076) | (0.065) |
| Fiscal cons. | -0.001 | 0.002 | 0.010** | 0.008 | -0.002 | -0.004* | -0.001 | 0.004** |
| | (0.002) | (0.003) | (0.005) | (0.005) | (0.002) | (0.002) | (0.002) | (0.002) |
| Social cons. | -0.001 | 0.021 | 0.107* | -0.076** | -0.032 | 0.007 | 0.076*** | -0.046*** |
| | (0.024) | (0.022) | (0.057) | (0.035) | (0.028) | (0.018) | (0.029) | (0.017) |
| Openness to risk | 0.110*** | 0.069* | 0.126 | 0.030 | 0.288*** | 0.117*** | 0.104** | 0.015 |
| | (0.035) | (0.042) | (0.085) | (0.071) | (0.044) | (0.039) | (0.042) | (0.034) |
| Income | -0.266*** | -0.042 | 0.273*** | 0.104 | -0.292*** | -0.017 | 0.240*** | 0.201*** |
| | (0.045) | (0.057) | (0.086) | (0.090) | (0.044) | (0.050) | (0.045) | (0.045) |
| Gender | -0.104*** | -0.087* | -0.067 | 0.111 | -0.249*** | -0.180*** | -0.032 | 0.104*** |
| | (0.038) | (0.051) | (0.068) | (0.074) | (0.037) | (0.043) | (0.039) | (0.039) |
| Education | -0.046 | -0.084 | 0.155 | 0.054 | -0.323*** | -0.030 | 0.190*** | 0.091** |
| | (0.045) | (0.059) | (0.094) | (0.085) | (0.053) | (0.046) | (0.052) | (0.043) |
| Birthyear | 0.018 | 0.079 | -0.203** | -0.042 | -0.147*** | -0.101** | 0.014 | 0.006 |
| | (0.042) | (0.056) | (0.091) | (0.083) | (0.055) | (0.049) | (0.053) | (0.043) |
| Manip. check | 0.191 | -0.499* | -0.012 | 0.196 | -0.248 | -0.430*** | -0.042 | 0.178 |
| | (0.280) | (0.276) | (0.323) | (0.290) | (0.162) | (0.148) | (0.186) | (0.140) |
| Constant | 6.389 | 0.025 | -17.279* | -13.527 | 7.537 | 12.036*** | 3.596 | -6.854* |
| | (4.067) | (5.420) | (9.321) | (9.689) | (4.584) | (4.348) | (4.707) | (4.080) |
| Observations | 438 | 659 | 169 | 421 | 809 | 780 | 835 | 1,231 |
| Adjusted R-squared | 0.199 | 0.015 | 0.188 | 0.020 | 0.339 | 0.071 | 0.089 | 0.056 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table C2: OLS Regression Output for the Treatment Effect of Receiving a Scientific Message on Climate Change and GMO Policy Preferences, Including Interaction with Trust in Climate Change/GMO Science.

| VARIABLES | (1)<br>Climate Policy<br>Priority – U.S. | (2)<br>Climate Policy<br>Priority - Germany | (3)<br>GMO Policy<br>Priority – U.S. | (4)<br>GMO Policy<br>Priority - Germany |
|---|---|---|---|---|
| Treatment | 0.285* | 0.190 | -0.433** | 0.0518 |
| | (0.163) | (0.235) | (0.202) | (0.217) |
| Trust in science | 0.442*** | 0.244*** | 0.253*** | 0.263*** |
| | (0.031) | (0.040) | (0.042) | (0.047) |
| Treatment x Trust | -0.024 | -0.002 | 0.180*** | 0.013 |
| in science | (0.042) | (0.0619) | (0.058) | (0.067) |
| Political ideology | -0.152*** | -0.126*** | 0.0586** | 0.112*** |
| | (0.027) | (0.032) | (0.027) | (0.034) |
| Fiscal cons. | -0.201*** | -0.063* | 0.192*** | 0.099*** |
| | (0.035) | (0.035) | (0.038) | (0.038) |
| Social cons. | -0.137*** | -0.024 | 0.058 | 0.039 |
| | (0.035) | (0.036) | (0.039) | (0.038) |
| Climate belief | 0.790*** | 0.495*** | -- | -- |
| | (0.063) | (0.056) | | |
| GMO belief | -- | -- | 0.270*** | 0.143*** |
| | | | (0.018) | (0.020) |
| Openness to risk | 0.001 | 0.0103 | -0.041** | -0.017 |
| | (0.017) | (0.019) | (0.018) | (0.020) |
| Income | -0.005 | -0.012 | 0.007 | 0.0041 |
| | (0.007) | (0.009) | (0.007) | (0.010) |
| Gender | 0.159*** | 0.0683 | -0.211*** | 0.0139 |
| | (0.050) | (0.055) | (0.056) | (0.059) |
| Education | -0.033* | 0.0133 | 0.0544*** | -0.037** |
| | (0.019) | (0.014) | (0.021) | (0.014) |
| Birthyear | -0.003* | -0.003 | 0.002 | 0.003* |
| | (0.002) | (0.002) | (0.002) | (0.001) |
| Manip. check | -0.138 | -0.298** | -0.005 | 0.093 |
| | (0.130) | (0.131) | (0.153) | (0.124) |
| Constant | 8.424*** | 8.115** | -2.963 | -5.762 |
| | (3.103) | (3.293) | (3.478) | (3.564) |
| | | | | |
| Observations | 1,246 | 1,438 | 1,243 | 1,437 |
| Adjusted R-squared | 0.586 | 0.148 | 0.370 | 0.139 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table C3: OLS regression output for the treatment effect of receiving a scientific message on climate change and GMO policy preferences, including interaction with trust in message source.

| VARIABLES | Climate Policy Priority – U.S. | | Climate Policy Priority - Germany | | GMO Policy Priority - U.S. | | GMO Policy Priority - Germany | |
|---|---|---|---|---|---|---|---|---|
| | Gov Source | Corp Source | Gov Source | Corp Source | Gov Source | Corp Source | Gov Source | Corp Source |
| Treatment | 0.174 | 0.170 | 0.407** | -0.221 | 0.200 | 0.021 | 0.194 | 0.164 |
| | (0.186) | (0.192) | (0.190) | (0.241) | (0.201) | (0.135) | (0.209) | (0.140) |
| Trust in source | 0.140*** | -0.168*** | 0.098*** | 0.013 | 0.102*** | 0.137*** | 0.038 | 0.106** |
| | (0.031) | (0.034) | (0.028) | (0.038) | (0.034) | (0.036) | (0.031) | (0.041) |
| Treatment x Trust in source | -0.017 | -0.015 | -0.039 | 0.077 | -0.018 | -0.073 | -0.027 | 0.021 |
| | (0.064) | (0.070) | (0.062) | (0.083) | (0.068) | (0.074) | (0.070) | (0.088) |
| Political ideology | -0.282*** | -0.278*** | -0.145*** | -0.165*** | 0.030 | -0.023 | 0.108*** | 0.097*** |
| | (0.028) | (0.028) | (0.033) | (0.033) | (0.028) | (0.029) | (0.035) | (0.035) |
| Fiscal cons. | -0.276*** | -0.287*** | -0.068* | -0.065* | 0.213*** | 0.161*** | 0.109*** | 0.092** |
| | (0.038) | (0.038) | (0.036) | (0.037) | (0.040) | (0.039) | (0.039) | (0.039) |
| Social cons. | -0.115*** | -0.146*** | -0.008 | -0.013 | 0.058 | 0.059 | 0.031 | 0.033 |
| | (0.038) | (0.038) | (0.037) | (0.037) | (0.041) | (0.041) | (0.040) | (0.040) |
| Climate belief | 1.083*** | 1.000*** | 0.591*** | 0.593*** | -- | -- | -- | -- |
| | (0.066) | (0.068) | (0.055) | (0.056) | | | | |
| GMO belief | -- | -- | -- | -- | 0.342*** | 0.339*** | 0.200*** | 0.191*** |
| | | | | | (0.017) | (0.017) | (0.019) | (0.019) |
| Openness to risk | -0.014 | -0.013 | 0.008 | 0.005 | -0.045** | -0.052*** | -0.024 | -0.026 |
| | (0.018) | (0.018) | (0.019) | (0.019) | (0.019) | (0.019) | (0.021) | (0.020) |
| Income | -0.002 | 0.003 | -0.009 | -0.008 | 0.008 | 0.008 | 0.007 | 0.007 |
| | (0.007) | (0.007) | (0.009) | (0.009) | (0.008) | (0.008) | (0.010) | (0.010) |
| Gender | 0.181*** | 0.201*** | 0.040 | 0.034 | -0.208*** | -0.223*** | 0.003 | -0.009 |
| | (0.055) | (0.055) | (0.055) | (0.056) | (0.059) | (0.059) | (0.060) | (0.060) |
| Education | -0.027 | -0.018 | 0.017 | 0.020 | 0.056*** | 0.070*** | -0.040*** | -0.033** |
| | (0.021) | (0.021) | (0.014) | (0.014) | (0.022) | (0.022) | (0.015) | (0.015) |
| Birthyear | -0.002 | -0.000 | -0.002 | -0.001 | 0.003* | 0.003 | 0.005*** | 0.004** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Manip. check | -0.183 | -0.133 | -0.356*** | -0.272** | 0.051 | 0.053 | 0.077 | 0.076 |
| | (0.138) | (0.138) | (0.127) | (0.129) | (0.158) | (0.157) | (0.120) | (0.121) |
| Constant | 7.468** | 5.364 | 6.520* | 6.607* | -5.016 | -3.878 | -8.345** | -6.398* |
| | (3.392) | (3.411) | (3.327) | (3.416) | (3.609) | (3.632) | (3.609) | (3.646) |
| Observations | 1,247 | 1,247 | 1,439 | 1,439 | 1,243 | 1,243 | 1,438 | 1,438 |
| Adjusted R-squared | 0.504 | 0.507 | 0.125 | 0.106 | 0.316 | 0.317 | 0.107 | 0.110 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

***Appendix D: Correlation between Outcome and Control Variables***

Table D1: Correlation between Control Variables and Climate/GMO Policy Preferences (German Sample)

| | Climate Change Policy Priority | GMO Policy Priority (reverse coded) |
|---|---|---|
| Trust in Government | 0.1062 | 0.0626 |
| Trust in Corporations | -0.0390 | 0.1818 |
| Political Ideology | -0.1757 | 0.1196 |
| Fiscal Conservatism | -0.0963 | 0.1329 |
| Social Conservatism | -0.0290 | 0.0435 |
| Climate Belief | 0.2946 | --- |
| GMO Belief | --- | 0.3024 |
| Openness to risk | -0.0081 | 0.0010 |
| Family Income | -0.0036 | -0.0020 |
| Gender | 0.0114 | -0.0046 |
| Education | 0.0496 | -0.0419 |
| Birth year | 0.0038 | 0.0754 |

Table D2: Correlation between Control Variables and Climate/GMO Policy Preferences (U.S. Sample)

| | Climate Change Policy Priority | GMO Policy Priority (reverse coded) |
|---|---|---|
| Trust in Government | 0.3871 | 0.1013 |
| Trust in Corporations | -0.4055 | 0.1982 |
| Political Ideology | -0.5526 | 0.0550 |
| Fiscal Conservatism | -0.5059 | 0.1405 |
| Social Conservatism | -0.2495 | 0.0791 |
| Climate Belief | 0.5940 | --- |
| GMO Belief | --- | 0.5218 |
| Openness to risk | -0.0077 | -0.0287 |
| Family Income | 0.0101 | 0.132 |
| Gender | 0.0646 | -0.161 |
| Education | 0.1241 | 0.106 |
| Birth year | 0.1200 | 0.034 |

***Appendix E: Balance Tables***

Table E1: Means and Standard Deviations of Key Variables Between Treatment Groups (German Sample)

| Variable | Gov. Climate Message | Corporate Climate Message | Gov. GMO Message | Corporate GMO Message | Control |
|---|---|---|---|---|---|
| Trust in Gov* | 2.855 | 2.847 | 2.778 | 2.830 | 2.963 |
| | (1.083) | (1.085) | (1.022) | (1.135) | (1.080) |
| Trust in Corp | 2.801 | 2.783 | 2.748 | 2.724 | 2.817 |
| | (0.869) | (0.808) | (0.833) | (0.815) | (0.869) |
| Ideology | 2.746 | 2.875 | 2.794 | 2.803 | 2.740 |
| | (0.868) | (0.865) | (0.827) | (0.814) | (0.862) |
| Fiscal Conservatism | 1.706 | 1.679 | 1.721 | 1.666 | 1.656 |
| | (0.787) | (0.787) | (0.789) | (0.791) | (0.778) |
| Social Conservatism | 1.950 | 1.938 | 1.863 | 1.953 | 1.859 |
| | (0.764) | (0.739) | (0.770) | (0.751) | (0.742) |
| GMO Belief | 2.779 | 2.793 | 2.884 | 2.869 | 2.616 |
| | (1.593) | (1.476) | (1.593) | (1.633) | (1.568) |
| Climate Belief | 0.455 | 0.466 | 0.492 | 0.441 | 0.432 |
| | (0.499) | (0.500) | (0.501) | (0.497) | (0.496) |
| Openness to Risk | 3.221 | 3.305 | 3.368 | 3.328 | 3.268 |
| | (1.403) | (1.510) | (1.492) | (1.400) | (1.440) |
| Family Income | 4.848 | 5.085 | 5.512 | 4.887 | 5.098 |
| | (3.082) | (3.229) | (3.179) | (2.906) | (3.182) |
| Gender | 1.528 | 1.508 | 1.492 | 1.512 | 1.514 |
| | (0.500) | (0.501) | (0.501) | (0.501) | (0.501) |
| Education | 5.297 | 5.400 | 5.618 | 5.428 | 5.479 |
| | (2.031) | (2.097) | (2.087) | (2.114) | (2.078) |
| Birth Year | 1,966.287 | 1,967.223 | 1,965.120 | 1,965.268 | 1,965.945 |
| | (16.813) | (16.350) | (16.649) | (16.985) | (16.518) |
| Observations | 296 | 288 | 310 | 298 | 308 |

*Note: Asterisks denote a significant difference in means between treatment groups.*

****=p<.001; **=p<.01; *=p<.05*

Table E2: Means and Standard Deviations of Key Variables Between Treatment Groups (U.S. Sample)

| Variable | Gov. Climate Message | Corporate Climate Message | Gov. GMO Message | Corporate GMO Message | Control |
|---|---|---|---|---|---|
| Trust in Gov* | 2.692 | 2.583 | 2.847 | 2.774 | 2.777 |
| | (1.028) | (1.055) | (1.058) | (1.143) | (1.023) |
| Trust in Corp | 2.532 | 2.535 | 2.621 | 2.534 | 2.687 |
| | (0.955) | (1.007) | (0.994) | (0.964) | (0.928) |
| Ideology | 3.030 | 3.028 | 2.958 | 2.956 | 3.013 |
| | (1.145) | (1.212) | (1.197) | (1.147) | (1.213) |
| Fiscal Conservatism | 2.181 | 2.092 | 2.104 | 2.125 | 2.137 |
| | (0.855) | (0.878) | (0.836) | (0.848) | (0.846) |
| Social Conservatism | 2.428 | 2.411 | 2.341 | 2.342 | 2.400 |
| | (0.760) | (0.755) | (0.758) | (0.796) | (0.755) |
| GMO Belief | 3.834 | 3.683 | 3.667 | 3.667 | 3.688 |
| | (1.721) | (1.698) | (1.706) | (1.858) | (1.703) |
| Climate Belief | 0.334 | 0.337 | 0.377 | 0.366 | 0.347 |
| | (0.473) | (0.473) | (0.486) | (0.482) | (0.477) |
| Openness to Risk | 4.195 | 3.969 | 4.113 | 4.132 | 4.114 |
| | (1.476) | (1.529) | (1.436) | (1.505) | (1.445) |
| Family Income | 5.763 | 5.953 | 5.509 | 5.524 | 5.805 |
| | (3.912) | (4.295) | (4.362) | (3.643) | (4.445) |
| Gender | 1.530 | 1.559 | 1.542 | 1.587 | 1.568 |
| | (0.500) | (0.497) | (0.499) | (0.493) | (0.496) |
| Education | 3.206 | 3.188 | 3.294 | 3.309 | 3.429 |
| | (1.471) | (1.484) | (1.462) | (1.458) | (1.463) |
| Birth Year | 1,966.385 | 1,966.358 | 1,968.348 | 1,966.372 | 1,967.474 |
| | (16.813) | (16.350) | (16.649) | (16.985) | (16.518) |
| Observations | 296 | 288 | 310 | 298 | 308 |

Statistical significance of difference in means: *** p<0.01, ** p<0.05, * p<0.1

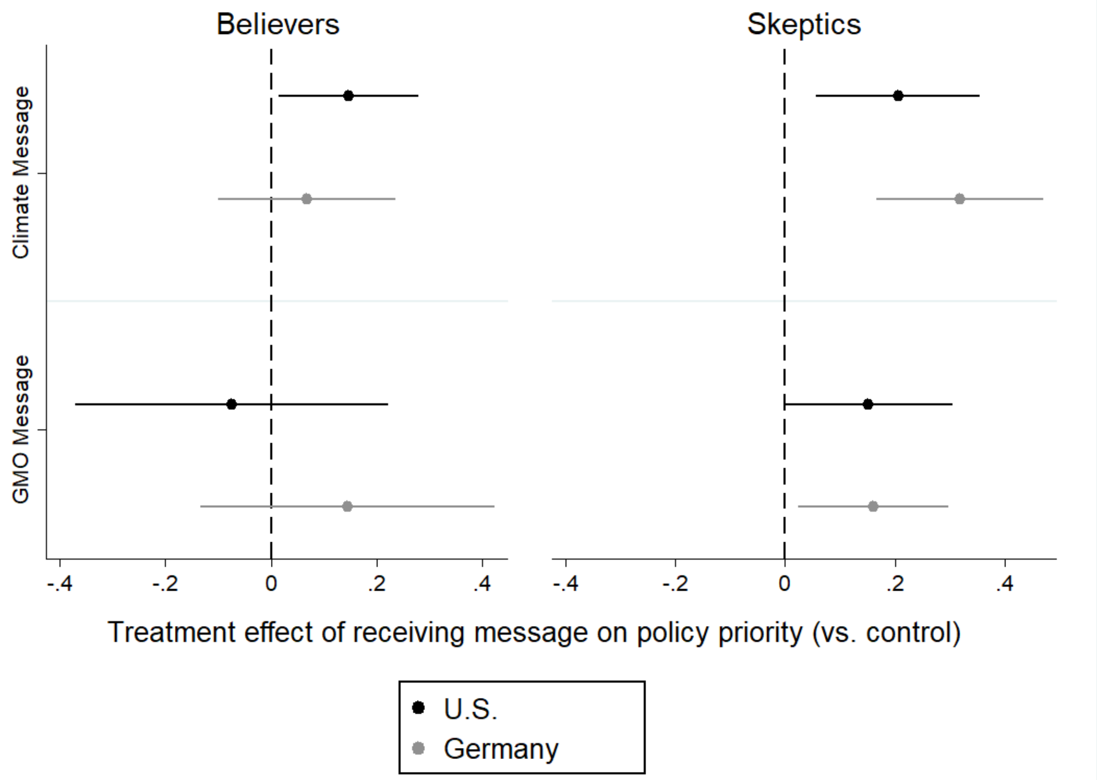
**Tables and Figures**

Table 1: Descriptive Statistics.

| | German Sample | | U.S. Sample | |
|---|---|---|---|---|
| **Variable** | *Mean* | *S.D.* | *Mean* | *S.D.* |
| Climate change policy attitudes (1-5)*** | 3.607 | 1.085 | 3.321 | 1.359 |
| GMO policy attitudes (1-5)*** | 2.595 | 1.159 | 3.024 | 1.227 |
| Trust in climate science (1-6) | 3.642 | 0.890 | 3.685 | 1.230 |
| Trust in GMO science (1-6)*** | 3.054 | 0.860 | 3.303 | 0.968 |
| Trust in government (1-6)** | 2.854 | 1.082 | 2.737 | 1.065 |
| Trust in corporations (1-6)*** | 2.775 | 0.839 | 2.583 | 0.971 |

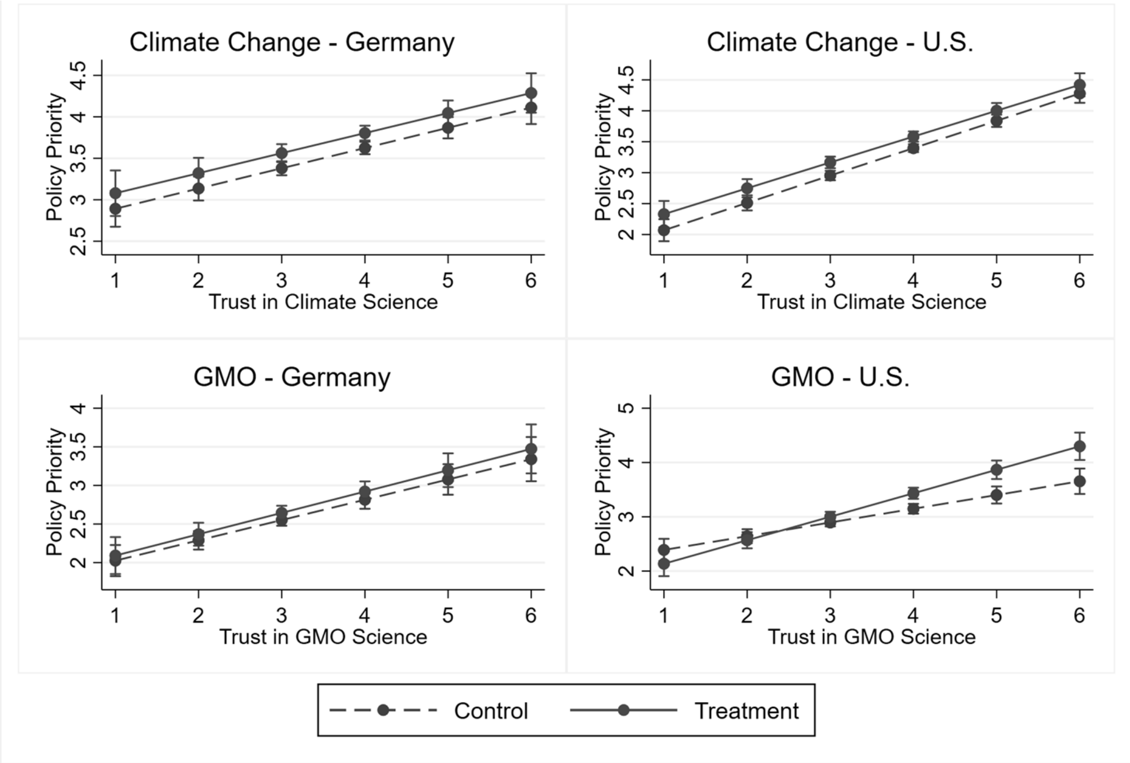
*Note: Asterisks denote a significant difference in means between German and U.S. samples*
****=p<.001; **=p<.01; *=p<.05*

Figure 1.



Believers
Skeptics
Climate Message
GMO Message
-.4
-.2
0
.2
.4
-.4
-.2
0
.2
.4
Treatment effect of receiving message on policy priority (vs. control)
U.S.
Germany

Figure 2.



Climate Change - Germany
Policy Priority
2.5
3
3.5
4
4.5
1
2
3
4
5
6
Trust in Climate Science
Climate Change - U.S.
Policy Priority
2
2.5
3
3.5
4
4.5
1
2
3
4
5
6
Trust in Climate Science
GMO - Germany
Policy Priority
2
2.5
3
3.5
4
1
2
3
4
5
6
Trust in GMO Science
GMO - U.S.
Policy Priority
2
3
4
5
1
2
3
4
5
6
Trust in GMO Science
Control
Treatment

## Figure Captions

1. Figure 1. Treatment effect (and 95% confidence intervals) of receiving climate change/GMO message on (a) whether mitigating climate change should be a policy priority or (b) that policies to limit GMOs should not be a policy priority. *Note:* Believers include participants with prior attitudes in line with the message, skeptics include participants with prior attitudes in conflict with the message. Controls (all set at the mean) not shown but included in model.

2. Figure 2. Interaction between treatment effect (receiving a scientific message vs. control message) and level of trust in climate change and GMO science on (a) whether mitigating climate change should be a policy priority (for climate message) or (b) that policies to limit GMOs should *not* be a policy priority (for GMO message). *Note:* Controls (all set at the mean) not shown but included in model.