

CLIMATE CHANGE NEWS AND TRUST:
THE INFLUENCE OF NEWS SOURCE, FRAME AND POLITICAL IDEOLOGY ON
JUDGMENTS OF CREDIBILITY

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ABSTRACT

Comparatively few studies have examined the effects of frames employed in climate change news articles (Corbett, 2004; Hart, 2011; Leiserowitz, forthcoming; Nisbet et al., 2013). The current study aims to address that deficiency by looking at the effects of frame, as well as source and political ideology, on readers' perceptions of the credibility of climate change news articles. As a message characteristic, four frames (ecological/meteorological, political economic, culture and society, and scientific) and two sources (news and government) were employed to test proposed hypotheses. Participants' political ideology was also measured and categorized as either liberal or conservative. The findings showed that both the frame and source of climate change news have a significant effect on credibility perceptions. Articles with an ecological/meteorological frame were found to have the highest credibility of the four frames tested. Moreover, Climate change articles attributed to news sources were found to have higher credibility than those attributed to government sources. However, no significant interaction effects were found for frame, source and ideology, leaving open the question of how ideology impacts readers' perceptions of climate change news credibility.

Introduction

The year 2015 was the hottest on record. And it was no outlier, following hard on the heels of the second hottest year in recorded history: 2014. Meanwhile, sea levels continue to rise at faster rates every year (Gillis 2016; Bakalar, 2015). The danger from climate change is imminent, with scientists proclaiming irreversible and overwhelming damage to humanity's current way of life on Earth can no longer be avoided. There is some hope of mitigation and adaptation only if swift action is taken (Gillis, 2015).

Yet, political support for action to combat climate change divides Americans. In a recent poll conducted by the New York Times, Stanford University and Resources for the Future, 81 percent of Americans reported being convinced that global warming is at least partly caused by human actions (Davenport & Connelly, 2015). However, support for action against climate change varies drastically along political party lines, with only 63 percent of Democrats reporting that the issue is very or extremely important and just 40 percent of independents and 18 percent of Republicans agreeing (Davenport & Connelly, 2015).

The goal of the current study is to explore a potential barrier to successful communication about the importance of the issue of climate change: the perceived credibility, or lack of credibility, of news about climate change. In particular, this study examines some of the factors involved in readers' judgments about the credibility of climate change news. It aims to improve communication about the issue of climate change by employing an experiment where the effects of frame, news source and political ideology on credibility perceptions are investigated. For the first variable, frame, this study employs four

frames identified by Boykoff (2008) for climate changes news articles: ecological/meteorological, political economic, culture and society, and scientific. The second variable, source, is defined as the publisher of the information, i.e. a news source versus a government source. Finally, the study also identifies individuals' political ideology (either conservative or liberal) as an important factor in communication about climate change and investigates how this variable interacts with message features, that is, source and frame, to produce credibility judgments of climate change news articles.

The findings of this study are expected to contribute to a better theoretical understanding of how source and frame influence readers' perceptions of climate change news credibility. The study also has practical implications for communicators. Namely, better knowledge of what factors influence readers' credibility judgments, and how those factors interact with one another, will help communicators craft more effective climate change messages.

Literature Review

Credibility

The concept of credibility has been much studied in the fields of journalism and communication. Credibility has been defined as “a global evaluation of the objectivity of a story” (p. 380), and shown to guide readers’ perceptions of news stories. In general, the more accurate and believable readers find a story, the more newsworthy they think it is (Sundar, 1999). In fact, news, reference and entertainment information are all rated as more credible compared to commercial information (Flanagin & Metzger, 2000). Flanagin and Metzger (2000) attribute the higher credibility ratings of news to this genre’s known avoidance of attempting to manipulate or persuade the reader.

Different patterns of use and purpose in seeking out news have also been found to influence credibility perceptions. Readers who actively seek news are much more likely to rate newspapers as more credible than other mediums (Mulder, 1980), while experience using the internet as a source of news boosted perceptions of its credibility (Flanagin & Metzger, 2000). Reliance on traditional media as a primary source of news also has been found to be a strong predictor of rating online news as credible (Johnson & Kaye, 2002). Though convenience predicts perception of online news credibility, reliance on the Internet as a source of news did not predict its credibility (Johnson & Kaye, 2002). College students in particular have been found to access news that is most convenient for them, such as that from Internet and comedy television sources. However, the sources they consult the most frequently were not necessarily rated as credible or trustworthy. In

fact, trust did not predict seeking out local, national or Internet news (Jarvis et al. 2009). Thus, maintaining credibility is a concern of many communicators and journalists.

An early study examining factors that contributed to the credibility of speakers found that those possessing higher levels of characteristics labeled as trustworthiness, competence, dynamism and objectivity were seen as significantly more credible than speakers who displayed these characteristics to a lesser extent (Whitehead, 1968). Later, similar characteristics were found to contribute to the credibility of news media items. Initially, in a study by Gaziano and McGrath (1986), a 12-item credibility factor was identified, which included items for: fairness, bias, completeness, accuracy, respect for privacy, interest in others, concern for community, separating fact from opinion, trustworthiness, concern for public interest, factuality, and quality of reporter training. Meyer (1988) narrowed this down to five items that comprise credibility: fairness, bias, completeness, accuracy and trustworthiness.

These dimensions of credibility identified within traditional media—fairness, bias, completeness, accuracy, and trustworthiness—have been found to be influential online as well. There remains a relationship between trustworthiness and credibility for online information. Expertise and attractiveness also are important for credibility online (Wathen & Burkell, 2002). But, not all news websites are viewed equally in terms of credibility. Independent newspapers published online had low credibility compared to the online versions of mainstream newspapers or index-type news sites, such as Yahoo or Google. These distinctions were in part due to aspects of design and format. For example, index-type sites in particular were seen as creative and unbiased. Hypertextuality was

also particularly important for the credibility of these types of sites (Chung et al. 2010; Chung et al., 2012).

Wathen and Burkell (2002) identify additional factors that impact the credibility of news online: surface attractiveness, design, loading speed, usability and accessibility, and interactivity. Small mistakes or flaws in attractiveness, design or usability can give the impression that an online source of information is “amateurish” and therefore less credible. In order to be seen as credible, an online site should prioritize a usable interface and a professional image (Wathen & Burkell, 2002). That is, established design principles should be utilized for organization of information in order to establish and maintain credibility.

Wathen and Burkell (2002) also offer a three-step model for the process by which individuals assessed the credibility of news online. First, consumers of online news take in the surface aspects of the medium, such as its attractiveness. Second, readers absorb aspects of the source or message itself. Finally, they make a personal evaluation that weights their previous knowledge and beliefs.

In the next sections, this literature review will explore the effects of the main attribute under consideration at each step of the model: message content, medium, and personal values.

Message Attributes and News Frames

Within the message itself, multiple aspects of the content can influence credibility judgments. For example, message quality affects credibility assessments and can partially mediate effects of initial credibility judgments based on message source. That is, based

upon perceptions of the quality of a message, readers can revise their original perceptions of the credibility of a message, which can impact belief change (Slater & Rouner, 1996).

Whether and how a piece addresses a scientist's uncertainty, in addition to whether and how an article presents disagreements between scientists can impact readers' judgments about the credibility of the information. Specifically, scientists and journalists were both viewed as more trustworthy when scientific coverage about cancer reported the limitations of studies and when these limitations were attributed to the scientists who performed the studies, rather than another scientist not involved in the research (Jensen, 2008). However, these effects seemed to vary based on the topic. Scientists' disagreement on one subject of medical research decreased students' credibility ratings of those scientists for that topic, but, on another research subject, disagreement increased students' credibility ratings of the scientists (Jensen & Hurley, 2010). For environmental news stories in particular, including discussion of scientific controversy decreased readers' certainty about the message. But, providing more context to the issue increased readers' certainty (Corbett & Durfee, 2004).

"Frames" can be understood as a communication tool that is employed to "select some aspects of perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described" (Entman, 1993, p. 52). That is, frames define issues by highlighting certain of their aspects and deemphasizing others, thereby implicitly providing a way of understanding and approaching a given issue.

Frames can manifest themselves in four “locations,” Entman (1993) says. Communicators construct frames, either consciously or unconsciously, and the texts themselves possess frames independent of the intentions of communicators. Again, independent of frames created by communicators or found within the text, receivers of messages bring their own frames to a text. Finally, cultures contain a “stock of commonly evoked frames” (p.53) that represent dominant ways of thinking about a particular issue within a community.

According to Entman (1993) framing is “a way to understand the power of a communicating text” and suggests that its study is particularly relevant to examining political communication (p. 51). However, others have emphasized the importance of the study of framing with respect to communication of other types of content. Nisbet and Scheufele (2007) argued that there is need for science communicators to understand and embrace the power of framing in order to better connect with their audiences. They criticize the idea what the public needs is to be better informed of the facts. Instead, they suggest that the problem is with the modes of communication employed by science publicists. Science communicators need to use framing to make their messages relevant and meaningful to their audiences in a way that still accurately presents “the facts.”

Nisbet and Mooney (2007) have pointed out that audiences do not make independent evaluations of the information presented to them by the media. Rather, they rely on the religious or political beliefs they already hold to guide their judgments. But frames “pare down complex issues” and “allow citizens to rapidly identify why an issue matters, who might be responsible and what should be done” (p. 56). Nisbet and Scheufele (2007)

also offer a typology of science communication frames. Common frames for science-related issues can include those of social progress, economic development or competitiveness, morality or ethics, scientific uncertainty, “runaway” science, public accountability, “third way” or alternative path, and conflict or strategy (p. 40). The frames can depict science in a positive light, such as in the social progress frame, or in a negative light, such as in the “runaway” science frame, which calls for caution in the face of scientific developments. Other frames are more nuanced, such as the morality frame or the “third way,” in which contrasting elements of scientific research may be represented. However, this list is not exhaustive and does not include, for example, the frames of scientific certainty or utility (Collins, 1987; Maier, 2014).

Some have criticized Nisbet and Scheufele’s argument, contending that framing scientific research results can only result in dishonesty (Holland, 2007), assumes complexity can’t be effectively communicated, creates counterproductive distance between scientists (Pleasant, 2007), that it adds “foreign” elements, such as philosophy, to scientific discourse (Quantrano, 2007) and that it will lead to misrepresentation and sacrificing credibility (Gerst, 2007). Nisbet and Mooney (2007) responded to these criticisms in part by pointing out that scientists already emphasize certain facts over others.

This point can be made even stronger by arguing that, in fact, all messages have frames, and communicators who believe that messages about science are somehow distinct in this respect and can escape the need for framing are naively mistaken. The value of Nisbet and Mooney’s arguments for framing of scientific messages is that such communicators need to be more *intentional* about the creation of their messages. Thus, for the

purposes of this research, the proposed research will align itself with Nisbet and Mooney and will seek to identify some potential frames for the science communicator's toolkit.

Framing has also been seen by some as a research paradigm that can further the project of media effects research. Scheufele (1999) has argued that the frame of a text represents its dominant meaning and the reception of the meaning by audiences can be tested to determine the effect of a media product. Entman (1993) largely assumes that there is a direct relationship between the frame of a text and the interpretation of the reader, and though he acknowledges that readers have their own frames and can have deviant readings of texts, he seems to assume that most of the time the frame of the text does control the interpretation of the reader. However, Scheufele's suggestion that textual frames be studied as interacting with readers' own frames in a complex way problematizes the straightforward relationship Entman describes and opens up another realm of framing research.

The frame of a story also contributes to assessments made about a message. Messages that were framed positively, emphasizing benefits, led to more positive attitudes and intentions for action than did negatively framed messages that emphasized costs (Kim & Kim, 2014; Jones, 2003). For stories about climate change, Foust and Murphy (2009) have identified "tragic" and "comic" frames. The comic frame ascribes the cause of and responsibility for climate change to humanity and encourages action, while the tragic frame leaves the issue of climate change up to fate, implicitly discouraging action. Action and support for climate change policies has also been found to be supported by thematic frames, ones that focus on general issues or trends, rather than episodic frames, or ones that focus on anecdotes (Hart, 2011). Though one study looked specifically at

how news frames affected ratings of ethics, credibility and usefulness and found that framing only affected ratings of ethics (Stewart et al., 2009), more research into the relationship between news frames and credibility seems warranted.

The majority of framing effects research studies have used issue-specific frames rather than generic ones like the conflict frame, the attribution of responsibility frame, the economic consequences frame, the episodic frame, the human interest frame, the leadership frame or the morality frame (Matthes, 2009). Within the field of political communication research, many studies have used thematic, issue-specific frames to test effects of frames used to communicate about political issues and have found these kinds of frames to have effects on public opinion or political action (Joslyn & Haider-Markel, 2002; Nelson & Oxley, 1999; Nisbet et al., 2013; Wise & Brewer, 2010).

Boykoff (2008), has identified four different common frames for climate change news articles: the ecological/meteorological frame that discusses climate change in terms of its effects on the weather and biodiversity; the political economic frame, where political actors and actions are the main focus as well as the relationship of climate change to matters of economics and business; the culture and society frame, which deals with climate change and popular culture, social justice and risk, public health, transportation and public understanding, knowledge and education; and, finally, the scientific frame, which is concerned with scientific discoveries, studies and technologies related to climate change. In this current study, Boykoff's four frames will be employed.

Though research on the relationship between frames and credibility judgments is limited, research about the credibility of scientific sources suggests that scientific frames, including perhaps the ecological/meteorological frame, could be seen as more credible

than other frames. Previous research described earlier also suggests that messages with persuasive intent, including perhaps news about climate change framed with a political economic or culture and society frame, will be seen as less credible than scientific frames.

Moreover, polling shows that Americans largely don't think of climate change as a moral or fairness issue. Just 38 percent think global warming is a moral issue, 29 percent think it's a social fairness issue, and 12 percent think it's a religious issue (Leiserowitz et al., forthcoming), which lends support to the idea that culture and society framing will be seen as less credible than other frames. Political economic frames could also been seen as less credible because polling indicates that a significant proportion of Republican Americans in particular believe that climate change policy hurts the economy (Davenport & Connelly, 2015).

Therefore, using Boykoff's frames, this study will examine the following hypothesis:

H1: The perceived credibility of climate change news stories will be greater for an ecological/meteorological or scientific frame compared to a political economic or culture and society frame.

Medium and Source

The source of information, that is, the speaker, writer or publisher that the information is attributed to, has long been considered a primary factor influencing credibility. Hovland and Weiss (1951) found that, at least initially, readers discounted information they received from sources they perceived to be untrustworthy. Interestingly, however, follow-up testing showed that participants seemed to remember fabricated information

better than the truth, even though they originally dismissed this information. This suggests that perhaps, over time, the effects of source on determining the credibility of information decrease.

Medium (e.g. television, radio or newspaper) also has been studied as an influence on information credibility. Though one study showed that consumers differentiated between newspapers, blogs or video news in terms of believability, likability and attitude but not in terms of credibility (Caruana, 2013), other research has generated evidence suggesting that the medium in which information appears affects readers' perceptions of its credibility (Greer, 2003). Internet news has been found to be generally credible (Eastin, 2001), and perceptions of the medium's credibility have increased over time (Johnson & Kaye, 2002). Though few participants in one study noticed or remembered which websites they had retrieved information from, they reported in focus groups that source was an important factor in determining credibility, as was a "scientific or official touch" (Eysenbach & Kohler, 2002, p. 537). The websites of news organizations have been found to be more credible than personal websites, with e-commerce and special interest sites somewhere in between (Flanagin & Metzger, 2007). Yet, Flanagin and Metzger (2007) concluded that these credibility assessments appeared to be due more to website attributes like design, depth of content and complexity, not the reputation of website sponsors. Online, source and medium are often conflated (Wathen and Burkell, 2002), perhaps because mediums of print, image and video converge there.

For scientific news in particular, respondents trusted information about the environment from some mediums more than others. That is, readers had low levels of trust for scientific information from newspaper or television news outlets. However, readers had

high levels of trust for science magazines, science websites and science television programs (Brewer & Ley, 2013). Moreover, the credibility of researchers quoted in an article has been found to affect readers' view of how credible that article is (Nordhagen et al., 2014; Sprecker, 2002). College students were found to identify textbooks and official documents as more trustworthy mediums of environmental information, though content, rather than source, was thought to be most important in determining trustworthiness (Braten et al., 2011). But those with less subject knowledge were less able to determine which sources were trustworthy and less likely to be able to know which criteria were relevant in making such judgments (Braten et al., 2011).

Focusing on science information published on the internet, it has been found that the domain of a website can have an effect on readers' judgments of the information they convey (Treise et al., 2003). Respondents in the Treise et al. (2003) study saw information that was presented on ".gov" websites as more credible than information on ".com" sites. Authors of articles on ".gov" sites were perceived as more objective than authors on ".com" sites.

In particular, readers thought that information attributed to a well-known scientific source, such as NASA, was more credible. Readers judged identical articles to be of higher quality when they were attributed to NASA than when they were attributed to a generic site. Both readers with scientific backgrounds or high interest in science as well as readers without background or interest were equally affected by the source when making their credibility judgments. According to Treise et al. (2003), these patterns of judgment about the credibility of information are due in part to the novelty of the Internet as a

source of information. Specifically, respondents are not sure how to determine what information is and is not credible on the Internet, and so they depend on domain and brand considerations to make their decisions, rather than making them on the basis of more reliable factors.

Therefore, overall, when a source is perceived as trustworthy, information attributed to that source will be viewed as more credible, whereas information attributed to less trustworthy sources will be seen as less credible. Government sources are seen as particularly trustworthy, and information from these sources is judged as more credible. But, media sources vary in their perceived trustworthiness. Perceptions about the reliability or trustworthiness of various mediums of information have also been shown to impact judgments of credibility. However, at least for information online, it is strongly suggested that medium is a less important consideration than source.

Based on these findings, the following hypothesis has been formulated:

H2: Perceived credibility will be greater for climate change news stories attributed to a government source compared to the news stories attributed to a media source.

Political Ideology

The relationship between the media and ideology has been examined from various perspectives. In general, studies examined how media use affects ideology, and vice versa, and how this in turn affects political action. Polarization of political belief and the relationship between the media and political polarization has been of particular interest to many researchers. With increasing availability of new media outlets has come audience segmentation. Some researchers have found that this leads to selective exposure of outlets

that could lead to political polarization. For example, Iyengar and Hahn (2009) found that Republicans tended to prefer information from Fox News and tended to avoid CNN and NPR, while Democrats tended to prefer information from CNN and NPR while avoiding Fox News. In an examination of the 2004 presidential election, Stroud (2008) found that these kinds of differences in media use habits did lead to increased political division.

It has been argued that this polarization could be less one of ideology than one of affect. That is, partisan opponents increasingly dislike one another but disagree with one another no more than they have historically. This opposition is attributed to the nature of political campaign messaging, which often attacks opponents and reinforces partisans' views of members of the opposite group (Iyengar, et al. 2012).

Whether political posturing or real disagreement, significant polarization over climate change has arisen along partisan lines in the United States. Moreover, while education and understanding of the issue have been found to be correlated with positive beliefs about and concern for global warming among liberals, these factors are only weakly or even negatively correlated among conservatives. Moreover, liberals have been found to be more likely to report beliefs consistent with scientific consensus and express personal concern over climate change (McCright & Dunlap, 2011). Thus, increased awareness will not resolve disagreement over belief in climate change and judgment of its importance as a public issue (Zia & Todd, 2010; Hindman, 2009).

Political ideology and personal values have been found to play a significant role in determining whether individuals will trust media and scientists or judge media bias to be present (Gunther, 1988; Lee 2005; Brewer & Ley, 2013). Both those who believed global warming is natural and those who believed it was caused by humans were found to

perceive the media as displaying bias toward belief in the danger of global warming. But, those who thought that the causes of global warming are natural had higher perceptions of bias. In turn, this belief that the causes of global warming are natural tended to result in selective exposure to media. This could be the result of a hostile media perception, which is defined as the phenomenon where “highly involved partisans rate identical stories, even neutral ones as biased against their sides” (Kim, 2011). Use of conservative media has been found to decrease trust in scientists and certainty in global warming, creating a negative feedback loop, while use of non-conservative media increases trust in scientists and certainty in global warming (Hmielowski et al., 2014). And, use of conservative media has been shown to be negatively related to global warming belief certainty and support for policies to mitigate climate change, while use of non-conservative media is positively associated with certainty in the belief of climate change and support for climate change policies (Feldman et al., 2014).

For example, content analysis has shown that Fox is more dismissive in tone toward climate change than either CNN or MSNBC, and it interviews a greater ratio of climate change doubters to believers than either CNN or MSNBC. A negative relationship between viewing Fox and acceptance of global warming has been found, while viewing CNN and MSNBC has been associated with greater acceptance of global warming. Interestingly, Republicans’ views on the climate change issue were seen to be related to the news outlet they watch. The same was not true for Democrats. This suggests that some Republicans could be less skeptical of information on the reality and severity of climate change if it were presented to them via the news outlet they watch (Feldman et al., 2011).

Overall, Americans' belief in climate change decreased between 2008 and 2010, but loss of trust in scientists was found primarily among politically conservative individuals or those with an individualistic worldview. Yet, Americans in general still tend to trust scientists more than others when it comes to information about climate change (Leiserowitz et al., 2012). However, political ideology has limited effects on trust in government (Lee, 2010).

Given this evidence showing a connection between political ideology and trust or distrust in news, the next hypothesis has been formulated as follows:

H3: Participants with liberal ideology will have higher perceptions of credibility for climate change news stories compared to individuals with conservative ideology.

Findings point toward a need among climate change skeptics for conceptual change through non-persuasive communication that does not attempt to win support for particular policies. Weber and Stern (2011) have called for a simple conceptual frame to communicate about climate change that is more congruent with the current state of scientific knowledge, perhaps emphasizing risk or uncertainty management and highlighting the increased risk of climate change catastrophe. Therefore, possible interaction effects between climate change news source, message frame and individual values are of particular interest. As there hasn't been any research to guide the direction of possible effects, the following research question is proposed:

RQ1: How do readers' credibility judgments about climate change news stories change as a function of interaction between news source, message frame and participant ideology?

Methods

Experimental Design and Stimuli

The study used a 4 (thematic frame: ecological/meteorological, political economic, culture and society, and scientific) x 2 (source: news media and government) x 2 (political ideology: conservative and liberal) mixed factorial design experiment. The thematic frame and source of the news articles were within-subject factors. Political ideology was the only between-subject factor. The presentation order of stimuli was completely random.

The stimuli in this experiment were news briefs about climate change obtained through ProQuest Newsstand search with the keywords “global warming” or “climate change.” Only articles published between June and September 2015 were included. Potential stimuli were edited to roughly equal length (down to approximately 200 words) and to fit the description of the thematic frames proposed in this study. The limit of 200 words was set based on similar research that used a story length of 250 words (Facorro & DeFleur, 1993) and found that college students read between 189 and 231 words correctly per minute on average (Lewandowski, Coddington, Kleinmann, & Tucker, 2003). Further, Associated Press news briefs are observed to be typically between 150 and 250 words. The article content was presented in the experiment in 12-point Times New Roman font. The headline of each article was kept intact, and presented in 12-point bold Times New Roman font, but author and publication date were not presented.

The researcher of this study evaluated the thematic frame of each news brief according to the definitions of four different thematic frames (specified in the independent

variable, thematic frame section). In order to ensure consistency in the interpretation of the frames, an independent coder also coded proposed stimuli based on the four thematic framing definitions. Only stimuli that whose frames were agreed upon by both the researcher and the independent coder were included in the experiment (see Appendix 1).

In order to indicate to participants an article's attribution to its assigned source, each article was accompanied by the logo or masthead that represents the source. Each article was randomly attributed to either the National Oceanic and Atmospheric Administration (NOAA) or a news source. The NOAA was selected to represent the government source as the organization conducts climate change research. So, information about climate change coming from this source should not be treated with skepticism or confusion. But, it is not as well-known or politically controversial an organization.

For news source, this study employed a neutral source in order to control any political influence the source could have on audience processing of news briefs. To select a news source for the main experiment, a pretest was conducted. A total of 14 undergraduate students from an undergraduate journalism course participated in the pretest, which was conducted through an online experiment. In the pretest, participants were shown mastheads from 10 publications. These 10 publications were chosen from a list of trusted news sources (Pew Research Center, 2014). Participants were asked to rate each publication on two items: "fairness" and "partisanship." These scores were averaged. BBC News (mean = 3.5, sd = .59) and Google News (mean = 3.5, sd = .68) had the highest mean scores. BBC News (median = 3.5) and the Wall Street Journal (median = 3.5), and NPR news (median = 3.75) had greater median scores compared to the rest. Because means are sensitive to outliers (especially in a skewed data), both mean and median were considered

to choose the final news source. Finally, BBC News was chosen. Despite having the highest median score, NPR was not chosen because it was shown to be less trusted by many conservatives (Pew Research Center, 2014). Furthermore, BBC News is shown to be equally trusted by those of mixed, mostly liberal, consistently liberal and mostly conservative ideology (Pew Research Center, 2014).

Variables

Independent variables.

Thematic frame.

A thematic frame is one that describes general information and trends related to an issue, as opposed to examining a specific case (Hart, 2011). Thematic frame had four levels, including the: ecological/meteorological frame, political economic frame, culture and society frame, and the scientific frame. The ecological/meteorological frame is defined as one that employs discussion of climate change in terms of its effects on the weather and biodiversity. Within the political economic frame, political actors and actions are the main focus of the climate change news stories that use this frame. The relationship of climate change to matters of economics and business also fall under this frame. The culture and society frame deals with climate change and popular culture, social justice and risk, public health, transportation and public understanding, knowledge and education. Finally, the scientific frame is concerned with scientific discoveries, studies and technologies related to climate change (Boykoff, 2008).

Political Ideology.

Political ideology is, simply, an individuals' views on policy (Iyengar, Sood & Lelkes, 2012). The variable was measured using the Kerlinger Referent Scale (REF-X), a

28-item scale that measures levels of liberalism and conservatism. The scale includes 14 items to measure liberalism and 14 to measure conservatism. Subscales were scored separately because strong approval for the values held by one ideology doesn't necessarily correspond to strong disapproval for the values of the other ideology. Items on the scale are: social stability, feeling, discipline, government price controls, freedom, business, authority, faith in God, free abortion, obedience of children, collective bargaining, socialized medicine, law and order, racial equality, private property, capitalism, social status, moral standards, patriotism, equality, social planning, free enterprise, civil rights, religion, children's interests, labor unions and equality of women (Robinson, Shaver & Wrightsman, 1999).

For the purposes of this study, the scale was shortened to 21 items, with 11 to measure liberalism (feeling, government price controls, freedom, business, racial equality, equality, social planning, civil rights, children's interests, labor unions and equality of women) and 10 to measure conservatism (social stability, discipline, authority, private property, capitalism, social status, moral standards, patriotism, free enterprise, religion). The reliability for the conservatism scale was .85 (measured by Cronbach's alpha), and the reliability for the liberalism scale was .84 (measured in Cronbach's alpha). To compute ideology for the analysis, items for each scale were averaged. Then, individuals were coded as either "conservative" or "liberal" along a median split.

Dependent variables.

Credibility.

The dependent variable was measured by asking participants to respond to five items presented following each news story. After reading each news story, participants

were asked whether they thought the story was believable or unbelievable, accurate or inaccurate, trustworthy or not trustworthy, biased or unbiased, and complete or incomplete (Flanagin & Metzger, 2000; Meyer, 1988). These items were measured on nine-point bipolar rating scales, with 1 being *unbelievable, inaccurate, not trustworthy, unbiased, and incomplete*, and with 9 being *believable, accurate, trustworthy, biased, and complete*. For the analysis, these items were averaged (Cronbach's alpha = .98).

Control variables (covariates).

This study measured several control variables. After completing the exposure to the experimental stimuli (news briefs) and measuring dependent variable of interest, participants' environmental literacy and interest were also measured by asking participants to list what environmental courses they have taken ("How many academic courses have you taken covering environmental issues?" 1) one, 2) two, 3) three, 4) four or more, or 5) none) and rate their own knowledge about and interest in environmental issues ("Please rate your knowledge of environmental issues on a scale from 1 (very little knowledge) to 9 (very knowledgeable);" "Please rate your interest in environmental issues on a scale from 1 (very uninterested) to 9 (very interested)"). Participants' internet and news media use were also measured by asking how often they used the internet to find information about environmental issues ("How often do you use the internet to find information about environmental issues?" 1) daily, 2) two to three times a week, 3) once a week, 4) two to three times a month, 5) once a month, 6) less than once a month, or 7) never) and how often they consulted media sources for information about environmental issues ("How often do you consult news media sources to find information about environmental issues?"

1) daily, 2) two to three times a week, 3) once a week, 4) two to three times a month, 5) once a month, 6) less than once a month, or 7) never).

Need for cognition and fatalism were also measured using two different scales. The need for cognition scale contained 10 items rated on a nine-point scale: 1) I would prefer complex to simple problems; 2) I like to have the responsibility of handling a situation that requires a lot of thinking; 3) Thinking is not my idea of fun; 4) I would rather do something that requires little thought than something that is sure to challenge my thinking abilities; 5) I only think as hard as I have to; 6) I really enjoy a task that involves coming up with new solutions to problems; 7) Learning new ways to think doesn't excite me very much; 8) I prefer my life to be filled with puzzles that I must solve; 9) It's enough for me that something gets the job done; I don't care how or why it works; and 10) I usually end up deliberating about issues even when they do not affect me personally (Cacioppo, Petty & Kao, 1984). The Cronbach's alpha for the need for cognition scale was .81.

The fatalism scale contained six items, each also rated on a nine-point scale: 1) I have learned that what is going to happen will happen; 2) If something bad is going to happen to me, it will happen no matter what I do; 3) If bad things happen, it is because they were meant to happen; 4) There is no sense in planning a lot; if something good is going to happen, it will; 5) Life is very unpredictable, and there is nothing one can do to change the future; 6) People die when it is their time to die and there is not much that can be done about it. (Esparza, Wiehe & Quinones, 2014). The Cronbach's alpha for the fatalism scale was .73.

Due to the length and amount of reading required for the experiment, it was thought that need for cognition should be measured to control for the possibility that some participants' might not put forth full effort on the experiment. Data was collected on fatalism in anticipation that some participants' could have low perceptions of credibility for climate change news due to a background belief that attempts at climate change mitigation are necessarily futile.

Participants

Participants were recruited from two undergraduate strategic communication courses at the University of Missouri. The researcher contacted faculty members in order to get permission to recruit participants. In exchange for participation, students received extra credit. Participants' ages ranged between 19 and 24, with most (86%) being 20 – 21 (Mean = 21, SD = .73). Most respondents were female (N=76), while only 19 were male. Participants were mostly juniors (N=53) or seniors (N=40). There was one sophomore and one graduate student.

Procedure

The study employed an online experiment administered through Qualtrics. First, participants' levels of need for cognition were measured with a 10-item scale. Following that, participants' levels of fatalism were measured with a six-item scale (Esparza et al., 2014). Items on both these scales were presented in a random order. Participants were then exposed to a randomized series of 16 news briefs and asked to rate them on various items (the order of which was also randomized), including whether they were believable or unbelievable, accurate or inaccurate, trustworthy or not trustworthy, biased or unbi-

ased, and complete or incomplete (Flanagin & Metzger, 2000; Meyer, 1988). The experiment was also designed so that participants had to spend at least 30 seconds on each page with a news brief before proceeding with the experiment. This helped ensure that participants actually read the news briefs presented to them.

After exposure to the experimental stimuli, participants' ideologies were measured for conservatism and liberalism by using the Kerlinger Referent Scale (REF-X). Items on the scale were randomized as well. Then, participants' environmental literacy, environmental interest, and use of internet and news media were measured. Lastly, demographic questions (age, gender, year in school) were asked.

Results

In order to test the hypotheses predicted in this study, a 2 (source) x 4 (thematic frame) x 2 (political ideology) repeated measure ANOVA was run on perceived credibility. The first set of analyses was done without covariates and second set of analyses included covariates (environmental interest, environmental knowledge, need for cognition, and fatalism).

Analysis I

Hypothesis 1.

Hypothesis 1 predicted the main effect of message frames on perceived credibility. Specifically, the study expected that perceived credibility of climate change news stories would be greater when using an ecological/meteorological or scientific frame, rather than a political economic or culture and society frame. There was a significant main effect of the message's thematic frame ($F(3,279) = 13.31, p < .001$). Results for means for each frame showed that the ecological/meteorological frame had the highest perceived credibility ($M = 6.49, SE = .12$) followed by the political economic ($M = 6.09, SE = .12$), scientific ($M = 5.98, SE = .14$), and culture and society ($M = 5.93, SE = .14$) frames.

In order to see whether any differences between frames were statistically significant, pair-wise comparison t-tests were run. The results showed that the difference between the ecological/meteorological and political economic frames was significant ($p < .05$), and the difference between the ecological/meteorological and culture and society

frames was significant ($p < .05$). But, neither the difference between the scientific and political economic frames nor the difference between the scientific and culture and society frames was significant. The directions of means were in line with the prediction.

For the differences between the ecological/meteorological frame versus the political economic and culture and society frames, the direction was as predicted. The ecological/meteorological frame had higher perceived credibility than both the political economic and the culture and society frames. Follow-up t-test results showed a significant difference between the scientific and the ecological/meteorological frames ($p < .05$) and between the culture and society frame compared to the political economic frame ($p < .05$). However, the directions of the means were different from the prediction. Thus, hypothesis 1 was partially supported.

Hypothesis 2.

Hypothesis 2 predicted that climate change news stories would have higher perceived credibility when their sources are government compared to media source. There was a significant main effect of source found ($F(1,93) = 30.53, p < .001$). However, the means were in the opposite direction from the prediction such that the stories attributed to a news source ($M = 6.32, SE = .12$) had a greater perceived credibility compared to those attributed to a government source ($M = 5.92, SE = .12$). Thus, hypothesis 2 was not supported.

Hypothesis 3.

Hypothesis 3 predicted the main effect of political ideology such that participants with liberal ideology would have higher perceptions of credibility for climate change news stories compared to individuals with conservative ideology. No significant effect

was found for ideology ($F(1,93) = .12, p > .05$). Thus, hypothesis 3 was not supported.

Research Question for interaction effect of source, frame and ideology

The interaction of source, frame, and ideology was posed as a research question. The results will be shown in a frame (4) x source (2) 2-way interaction (RQ1-1) first and a frame (4) x source (2) x ideology (2) 3-way interaction (RQ1-2).

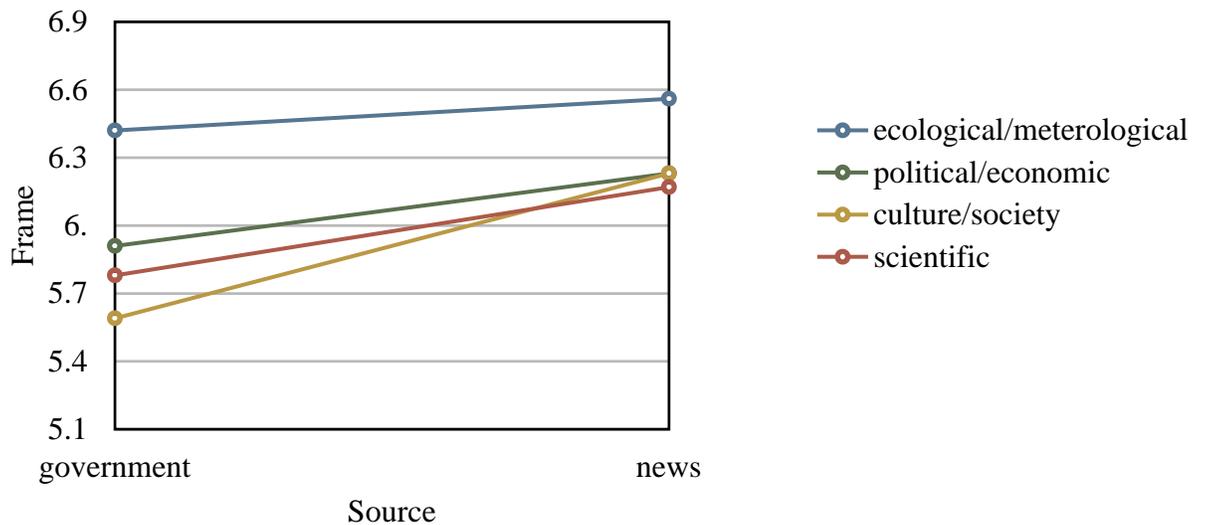


Figure 1. Change in credibility perception as a function of source and frame. Perceptions of credibility increased for articles attributed to news sources.

Research question 1-1 asked how the perceived credibility of climate change news stories would change as a function of source and frame. The result showed a significant interaction of frame and source on perceived credibility ($F(3,279) = 3.40, p < .05$). Results showed that, when the source is news, the ecological/meteorological frame had the highest perceived credibility ($M = 6.56, SE = .15$), followed by the political economic frame ($M = 6.28, SE = .13$), the culture and society frame ($M = 6.28, SE = .15$), and the scientific frame. ($M = 6.17, SE = .15$). However, when the source was government, the

ecological/meteorological frame had the highest credibility ($M = 6.41$, $SE = .12$), followed by the political economic frame ($M = 5.90$, $SE = .14$), then the scientific frame ($M = 5.78$, $SE = .15$), and, finally, the culture and society frame ($M = 5.59$, $SE = .17$).

Research questions 1-2 asked how news source, message frame, and participant ideology would interact and influence the perceived credibility of climate change news stories (3-way interaction on perceived credibility of climate change as a function of source, frame, and ideology). The result showed that there was no significant effect found for the interaction of frame, source, and ideology on perceived credibility ($F(3,279) = 1.34$, $p > .05$).

Analysis II

In Analysis II, various covariates (control variables) were entered in the analysis, and the results are reported below. In the analysis, four covariates—self-rated interest in and knowledge of environmental issues, need for cognition, and fatalism were used. The results showed that after entering four covariates, none of the main effects or interaction effects was significant. These are shown in Table 1.

Analysis with Covariates			
<u>Variables</u>	<u>Mean square</u>	<u>F</u>	<u>p</u>
Source	.12	.12	.73
Frame	.27	.3	.83
Political Ideology	4.04	.39	.54
Source x Frame	.39	.57	.63

Source x frame x ideology	.74	1.07	.36
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Also, the effects of covariates are shown in Table 2 below.

Table 2				
Effects of Covariates				
<u>Covariate</u>	<u>Mean square</u>	<u>F</u>	<u>p</u>	
Interest	4.59	.44	.51	
Knowledge	1.50	.14	.71	
NFC	4.64	.45	.51	
fatalism	6.13	.59	.45	

Discussion

While previous framing research has focused on identifying and defining climate change news frames, fewer studies have looked at the effects of frames specific to climate change news. The current study is therefore theoretically valuable for its expansion of knowledge regarding the effects of framing on readers. In particular, the findings of this study contribute to a better theoretical understanding of how frames interact with other factors, such as source and ideology, to influence readers' perceptions of an issue. But, this research is of more than purely theoretical value, since improved knowledge of how frame, source and ideology, individually and in combination, impact readers' perceptions of climate change information could help communicators craft more effective messages about the issue.

As expected, the current study found that both the frame of an article and its source had an effect on readers' perceptions of the credibility of climate change news articles. However, the nature of these effects was surprising and ran counter to predictions. Though it was predicted that information attributed to government sources would be perceived as more credible than information attributed to news sources, the results showed the opposite pattern. Specifically, the results showed that climate change articles attributed to news sources were perceived by participants as being more credible than those attributed to government sources.

It's possible that the specific government source chosen could have been partially responsible for this result. Again, this study used the BBC as a news source and the National Oceanic and Atmospheric Administration (NOAA) as a government source. While

the BBC is a well-known and highly regarded news source, NOAA may have been less familiar to participants in the experiment. And, it has been reported that familiarity can affect credibility judgments (Wathen & Burkell, 2002). Participants' lack of familiarity with NOAA, as compared to BBC, therefore could have contributed to the lower credibility ratings for articles attributed to NOAA.

It has also been shown that a perception of persuasive intent on the part of the source influences readers' perceptions of the credibility of that source and of information attributed to it (Flanagin & Metzger, 2000). On a controversial political issue, such as climate change, readers' could perceive a government source, such as NOAA, as less impartial than a news source, such as BBC. Moreover, American distrust in its federal government is lower than it has been in the past 50 years. According to the Pew Research Center, just 19 percent of Americans say that they trust the federal government always or most of the time (Pew, 2015). Thus, the controversial nature of the issue, and the general distrust of the federal government, could have both contributed to participants' lower credibility perceptions of articles attributed to a government source.

As to the effects of frame on perceptions of credibility, the results were, again, not quite as predicted. Of the four frames, the ecological/meteorological frame had the highest perceived credibility, either when attributed to a news or a government source. In Boykoff's original framing analysis, he found that the ecological/meteorological frame was the most commonly used. Just as with source, greater familiarity with the ecological/meteorological frame could have contributed to readers' higher perceptions of the credibility of articles with that frame. While it was thought that the credibility of science

frames would have been the highest, due to the credibility of science in general (Eysenbach & Kohler, 2002; Brewer & Ley, 2013; Nordhagen et al., 2014; Sprecker, 2002), it's possible that lack of familiarity with climate science could have contributed to readers having lower perceptions of credibility for articles with this frame (Braten et al., 2011). Additionally, perceived relevance to the reader can also impact his or her perception of the credibility of an article (Wathen & Burkell, 2002). Thus, if readers perceived articles concerned with the science of climate change as being abstract and irrelevant to their daily lives, they might have also thought these articles less credible.

Yet another possible explanation of the lower credibility perceptions for scientific frames, as well as the lower credibility perceptions for government sources and higher credibility perceptions for news sources, could be characteristics of the sample. All participants were students in an undergraduate journalism program. Education and training in the field of journalism can encourage skepticism for institutions, such as the government and the scientific establishment, while simultaneously fostering trust in the news media.

That readers had lower perceived credibility for articles with political and culture and society frames was as predicted. This effect could be related to the perceived persuasive intent of articles with a political or social frame. In other words, readers could perceive articles that employ one of these two frames to be attempting on some level to persuade them to take up a certain position and, therefore, to be biased and not as credible.

Unlike the effects of source and frame, effects for ideology were not significant. This result could have been related to difficulties with measuring ideology. All partici-

pants in the experiment were relatively young and may not have firmly developed political ideology. Moreover, ideological divides may not be as stark as they seem. The appearance of ideological clash between liberals and conservatives may be due more to developed habits of alienating perceived opponents, rather than to actual substantive disagreements between groups (Iyengar, Sood & Lelkes, 2012).

The proposed hypotheses and research question regarding the interaction of independent variables (along with covariates) also were not significant, most likely due to the high number of variables in the analysis and relatively small number of participants in the experiment. Other limitations of the experiment include the fact that all participants were undergraduate students studying in the same field and the length and amount of persistence required for completion of the experiment.

Future study should continue to pursue better understanding of how different message frames influence peoples' perception of climate change news. Questions about how various factors interact to produce reader perceptions remain unanswered. In particular, questions are raised by the current study such as: How do mitigating factors such as familiarity, perceived persuasive intent and relevance interact with effects of source and framing on reader perceptions? A larger and more ambitious study could perhaps answer this question and the many others that remain unresolved by the current study.

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Appendix 1—Codebook

Coding Instruction & Categories

Before coding an article, please complete one reading of the article. Below are some guidelines and the list of frames to keep in mind while coding each article.

First, look at headlines and lede paragraphs--The main topics of concern should be prominent at the top of an article.

Second, notice quoted or attributed sources--Quoted or attributed sources within the article can hint at the frame of the article. For instance, politicians and economists as quoted sources suggest that the article's frame is a political/economic one, whereas scientists suggest a scientific, or possibly an ecological/meteorological frame.

Third, pay attention to repeated words, themes or metaphors.

Last, take the angle of the story into account. It may not be obvious from the headline and first paragraph alone what the frame of a story is. For example, a story with the headline "Scientists discover new source of renewable energy" may seem like a scientific frame at first. But, if the reporter goes on to write about how the new source of energy is very affordable and could provide a source of cheap renewable energy for the poor, then you might consider a culture/society frame, since, on the whole, the story is chiefly concerned with social justice issues of energy availability.

Then, please code each article based on their frame explained below:

- 1) ecological/meteorological frame
- 2) political/economic frame
- 3) culture/society frame
- 4) scientific frame

Ecological/meteorological frame: Emphasizes environmental impacts of climate change. To be categorized into the ecological/meteorological frame, the article should discuss climate change primarily in terms of its impacts on either:

- 1) Weather events (e.g. heat waves, droughts, floods, other severe weather) or;
- 2) Biodiversity (e.g. affects on ecosystems, plants, animals)

Political/economic frame: Focuses on the political aspects of the issue of climate change. Articles using this frame often feature leaders in these fields (politicians, economists, business leaders) as prominent sources on the nature of and appropriate response to the issue. The articles should mainly concern either:

- 1) Political actors (e.g. politicians, political entities or organizations, policies) or;

2) Economics and business (e.g. cost or economic opportunities, jobs, economic or business leaders)

Culture/society frame: Emphasizes cultural and social impacts of climate change. To be considered to have culture/society frame, the article mainly discusses:

1) Justice (e.g. ethics, inequality) or;

2) Risk (e.g. negative outcomes, adaptation)

Scientific frame: Discusses scientific findings related to climate change. This includes both climate and technological research results. Within the article, the following topics should be prominent:

1) Discoveries (e.g. research, studies) or;

2) Applied science, technologies (e.g. energy efficiency, renewables)

Appendix 2—Experiment

You are invited to participate in a research study, *Perceptions of News*. The goal of the study is to examine how readers perceive certain types of news articles. In the study, you will be shown a series of news articles to read. You will be asked to rate each article on five different characteristics. Then, you will be asked a series of questions about yourself.

In order to participate in this study, you must be 18 years of age or older. Your participation is voluntary. You may exit out of the survey at any point in time without penalty or loss of benefits to which you are entitled.

The entire study should take no longer than 30 minutes. In exchange for your participation, you will receive extra credit for a qualifying course. Alternatively, you may complete an assignment determined by your professor to earn your extra credit if you choose not to participate in the research. If you have any questions or comments regarding this research project, please contact Fran Webber (email: fywebber@mail.missouri.edu).

If you have any questions or concerns regarding your rights as a study participant, or are dissatisfied with any aspect of this study, you may contact the University of Missouri Campus Institutional Review Board located in 483 McReynolds Hall, University of Missouri, Columbia, MO 65211 (phone: (573) 8829585). Contact with campus IRB can be anonymous.

Benefits and Risks of being in the Study: The risk in participating in this study is no greater than what would be expected in a daily conversation about similar topics and there should be no potential risk in participating.

Privacy and Confidentiality: If this research is published, no information that would identify you will be included.

By continuing through the survey you are giving your informed consent to participate and you are stating that you are at least 18 years of age. If you wish to participate, please click on the "continue" button.

Thank you.

Please read the following statements and rate your agreement on a scale of 1 (very strongly disagree) to 9 (very strongly agree).

I would prefer complex to simple problems.

I like to have the responsibility of handling a situation that requires a lot of thinking.

Thinking is not my idea of fun.

I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.

I only think as hard as I have to.

I really enjoy a task that involves coming up with new solutions to problems.

Learning new ways to think doesn't excite me very much.

I prefer my life to be filled with puzzles that I must solve.
It's enough for me that something gets the job done; I don't care how or why it works.
I usually end up deliberating about issues even when they do not affect me personally.

Please read the following statements and rate your agreement on a scale of 1 (very strongly disagree) to 9 (very strongly agree).

I have learned that what is going to happen will happen.
If something bad is going to happen to me, it will happen no matter what I do.
If bad things happen, it is because they were meant to happen.
There is no sense in planning a lot; if something good is going to happen, it will.
Life is very unpredictable, and there is nothing one can do to change the future.
People die when it is their time to die and there is not much that can be done about it.

On the following pages, you will be shown a series of news articles and will be asked to rate them on five different characteristics. Please read each article carefully. When you are ready to proceed, please click "continue."

Please rate the news brief you just read on the following measures.

unbelievable	<input type="radio"/>	believable
biased	<input type="radio"/>	unbiased
incomplete	<input type="radio"/>	complete
not trustworthy	<input type="radio"/>	trustworthy
inaccurate	<input type="radio"/>	accurate

In this next section, I'd like to get your feelings toward some issues and political leaders in the news these days. Please read the following statements and rate them on a scale from zero to 100. The higher the number, the more favorable your feeling.

For example, ratings between 50 and 100 mean that you feel favorable toward the statement (60= a bit more favorable than unfavorable; 70= fairly favorable; 85= quite favorable; 100= very favorable). Ratings between 0 and 50 mean that you don't feel favorable toward the statement (40= a bit more unfavorable than favorable; 30= fairly unfavorable; 15=quite unfavorable; 0= very unfavorable). Rate the statement at 50 if you feel neutral toward it.

When you are ready to proceed, please press "continue."

The Affordable Care Act does more harm than good.
Gun control in the United States should be increased.
Immigrants weaken our country.
Barak Obama is a competent president.

In the next section, I'd like to get your feelings toward some ideas. Please read the concepts on the following pages and rate them on a scale from zero to 100. The higher the number, the more favorable your feeling.

For example, ratings between 50 and 100 mean that you feel favorable toward the statement (60= a bit more favorable than unfavorable; 70= fairly favorable; 85= quite favorable; 100= very favorable). Ratings between 0 and 50 mean that you don't feel favorable toward the statement (40= a bit more unfavorable than favorable; 30= fairly unfavorable; 15=quite unfavorable; 0= very unfavorable). Rate the statement at 50 if you feel neutral toward it.

When you are ready to proceed, please press "continue."

Social stability
Feeling
Discipline
Government price controls
Freedom
Business
Authority
Racial equality
Private property
Capitalism
Social status
Moral standards
Patriotism
Equality
Social planning
Free enterprise
Civil rights
Religion
Children's interests
Labor unions
Equality of women

In the next section, you will rate statements and answer questions to describe how you assess yourself.

When you are ready to proceed, please click "continue."

Please rate your interest in environmental issues on a scale from 1 (very uninterested) to 9 (very interested).

Please rate your knowledge of environmental issues on a scale from 1 (very little knowledge) to 9 (very knowledgeable).

How many academic courses have you taken covering environmental issues?
How often do you use the internet to find information about environmental issues?
How often do you consult news media sources to find information about environmental issues?

Please answer the following questions with some information about yourself.

What is your age?

What is your gender?

What is your area of study (major/concentration)?

What is your year in school?