

COVER SHEET

TITLE: The role of social media in polarization of viewpoints towards climate change

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YEAR: 2018

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ABSTRACT

The role of social media in polarization of viewpoints towards climate change

The purpose of this research was to determine the role that social network sites play in the polarizing of viewpoints regarding climate change. To measure this, I surveyed participants about their initial perceptions of climate change's harmfulness. I then introduced these respondents to replicated Facebook News Feeds containing posts that were either homogeneously pro-climate, homogeneously anti-climate, or an equal mix of both viewpoints, before surveying them once more on their perceptions about climate change's harmfulness. For initially anti-climate respondents, my findings revealed an ideological *backfire effect* after exposure to a homogeneously pro-climate Facebook News Feed, compared to the control; this *backfire effect* grew in strength in accordance with the intensity of the respondents' initial anti-climate beliefs. My findings may be useful in the development of effective social media campaigns focusing on issues related to climate change, and may help in engineering strategies to make discourse less polarized in the future.

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Introduction

Social media plays a vital role in modern political discourse, rising to become one of the foremost methods for sharing personal opinions (Conover *et al.*, 2011). For example, in the 2016 presidential election, editorials in publications such as *Forbes*, *Fortune*, and *The New York Times* have credited the popular social network site (SNS) Facebook with playing an instrumental role in helping the president-elect Donald Trump succeed, despite the odds placed against him (Olson, 2016). Thus, it is likely that social media impact viewpoints on politicized issues such as climate change.

According to analysis of 10 nationally representative Gallup Polls, between the years of 2001 and 2010, the topic of climate change has become increasingly polarized, with Democrats becoming more likely to believe in climate change, and Republicans becoming more skeptical (McCright *et al.*, 2011). I am interested in determining the role that SNS have played in the polarizing of viewpoints regarding climate change.

Social network sites – reducing or increasing polarization?

It remains unclear whether we should expect social networking sites to lead to less polarization or more polarization, as past research supports both positions. A positive relationship has been uncovered in the dimensions of partisan, ideological, and issue, and that higher diversity in political discussion on SNS nurture ideological states that are less polarized (Lee *et al.*, 2014). Past research has uncovered that members generally ended up with more extreme positions after they spoke with one another (Sunstein, 2017). As SNSs have become more popular, normalized, and influential, more research has been conducted regarding its impact on how consumers form opinions. This research has revealed that SNS users take an

active role in online discourse, with one-fifth of users reporting that they continuously engage in contributing politically-charged posts (Rainie & Smith, 2008). Active discourse has been shown to be key to the rise of an opportunity to provide people with more information and points of view, so users can craft informed and thoughtful opinions regarding politics. Social media brings together users from varied cultural backgrounds to have political dialogue, and as a result, creates a space for users to engage in active discourse with others who have culturally varied points of view (Papacharissi, 2002).

However, research has also suggested that users who often post their opinions on SNS tend to organize into isolated and homogeneous spheres of opinion, which are ideologically segregated (Conover *et al.*, 2011). Scholars have discovered that SNS users' opinions are greatly affected by the ideological segregation of communities who share distinct differing beliefs. However, little research has been conducted regarding the extent that users' opinions are affected by isolated spheres of opinion of social media when pertaining to the increasingly polarized scientific issue of climate change.

Lee and colleagues (2014) conducted research on social media, network heterogeneity and opinion polarization utilizing a 2012 national probability survey and found no direct association between SNS network heterogeneity and the level of a user's opinion polarization. However, Lee's study measured heterogeneity in terms of characteristics such as gender, socioeconomic background, and age (Lee *et al.*, 2014). A smaller amount of research has been done measuring the effects of homogeneity or heterogeneity of opinions on a Facebook user's newsfeed on polarization of opinions on climate change, which is how heterogeneity and homogeneity will be conceptualized in my study. The results of my study will add to our understanding of how scientific issues become polarized, and thus, may aid our understanding of

social media networks' effect on users' opinion polarization, and may also help in reducing the polarization of discourse.

Competitive Framing

Framing is a concept with roots in both psychology and sociology, and it consists of the idea that the manner in which an issue is characterized can impact how it is comprehended by the subjects exposed to the framed message (Scheufele & Tewksbury, 2007; Gamson & Modigliani, 1987). For the present study, the most relevant literature looks at the impact of frames on individuals' behaviors or attitudes (Scheufele, 1999; Chong & Druckman, 2007). Results from past studies on framing uncover that, if an exhibited message is framed in support of one direction, then the user's opinion moves in that direction, with opinions becoming stronger and more polarized. This phenomenon can be seen in studies such as Robison's 2016 report on "Elite Polarization and Public Opinion." Robison's study found that, on a highly politicized topic such as tax proposals, Democrats and Republicans reported holding significantly different issue positions after reading news without partisan conflict. However, after exposing subjects to partisan conflict-framed news, the difference became even greater, confirming Robison's hypothesis that subjects adopt more polarized opinions after exposure to conflict-framed messages (Robison, 2016).

In competitive framing studies, informants are exposed to two different messages expressing different sides of an issue, and research seeks to uncover how these competitive message environments influence framing effects, and how differences moderate the impact of these frames. From past studies on competitive framing, it has been suggested that, when a competitive frame is introduced and exhibited to the subject, the two frames interact and

diminish the effects of each other. Scholars have demonstrated that framing effects may be lessened or altogether negated when people are exposed to competing frames, especially when the arguments expressed in these frames are of similar strength. In their study, Chong and Druckman focused on a hypothetical urban growth management proposal, where they exposed participants to framed messages expressing a certain stance on this growth proposal that would channel development toward the city's center by prohibiting development in certain parts of the city and requiring developers to pay for infrastructure in new developments. Evidence from this experiment indicated that, when exposed to competing frames of similar argumentative strength, participants did not reject strong contrary frames in favor of strong frames that were congruent with their pre-existing beliefs. Rather, the individuals were pulled away from their existing ideologies in varying degrees toward a middle position, with the competing frames moderating the participants' opinion. Thus, the results suggested that competition between strong opposing frames resulted in the participants on either side of the issue to be pulled away from their value priorities toward a less polarized stance proportional to the relative strength of the frames (Chong & Druckman, 2007).

Exposure to heterogeneous content and its effect on opinions

On one hand, scholars have argued that exposure to diverse political views amplifies political inclinations and results in more extreme positions in the direction of one's original opinions (Lee et al, 2014). Past research has uncovered that exposure to diverse views produced more extreme attitudes about politicized issues such as stem cell research (Binder, Dalrymple, Brossard, & Scheufele, 2009) and attitudes toward political candidates (Meffert, Chung, Joiner, Waks, & Garst, 2006). Lee suggests that this phenomenon can be explained as *biased*

information processing (Lee et al, 2014). Motivated skepticism, also known as disconfirmation bias, is one of the principal psychological mechanisms involved in *biased information processing*. It suggests that people tend to invest more time and cognitive resources to skeptically scrutinize arguments or questioning information that challenges their current opinions, while uncritically accepting arguments and information that confirm them (Jacobson, 2010). In a study by Taber and Lodge, the results suggested that exposure to a heterogeneous set of messages caused opinion polarization due to motivated skepticism. (Taber & Lodge, 2006). Thus, exposing participants to a heterogeneous set of competing messages may cause a greater amount of opinion polarization than exposing participants to a homogeneous set of messages.

Conversely, other scholars have discovered that, when participants are exposed to a heterogeneous set of messages in disagreement, those participants' opinions become less polarized. In a study by Parsons that used data from the American National Election Studies 2008-2009 Panel Study, heterogeneous social networks depolarized people's attitude towards political candidates through increasing negative emotions towards the in-party candidate and positive emotions toward the out-party candidate (Parsons, 2010). This could be explained through Marcus' *affective intelligence theory*; this theory argues that the surveillance system and anxiety, which are evoked when citizens are exposed to messages of ideological disagreement, motivates participants to abandon their habits and engage in information seeking behavior, offering more deliberation and attention towards new messages that contrast with their existing beliefs (Marcus et al, 2000, 2011). Due to contesting findings, the relationship between exposure to heterogeneous sets of competing arguments and ideological polarization remains unclear.

Moreover, past studies have attempted to experimentally reproduce how exposure to competitive frames in mass communication, which is defined to include news media and political

discourse, influences opinion formation pertaining to climate change; they uncovered that exposing participants to a competitive framing environment had a limited effect on ideological polarization. An experimental study conducted by Nisbet (2013) examined the effects of competitive and noncompetitive framed message environments about climate change on individuals defined as “open-minded” and “close-minded.” These researchers hypothesized that exposure to a framed message in a competitive message environment would be less likely to cause an attitude shift compared to exposure to a framed message in a noncompetitive message environment (Nisbet et al, 2013). These researchers’ analysis of results found that it was very challenging to engender framing effects on such an ideologically polarized and salient issue such as climate change, even in an environment that was noncompetitive. Nisbet’s results suggested that simultaneous exposure to a set of competitive frames caused no significant change for “closed-minded” individuals compared to a control group, as this group of participants sought to retain their existing opinions in order to evade the methodical deliberation of alternative ideologies. In contrast, among respondents defined as more “open-minded,” the participants’ behavior exhibited greater motivation to consider a larger group of applicable alternatives when making judgements on climate change policy, implying that exposure to a competitive environment led to attitude change among this segment of participants. However, Nisbet’s competitive framing study sought to reveal the effects of messages introduced through traditional mass communication (Nisbet et al, 2013). Studies, such as Nisbet’s, exhibited that opinion polarization remained constant for “close-minded” individuals, and saw overall increased support for government action regarding climate change for “open-minded” individuals, when participants were exposed to competing frames about the topic of climate change provided through a means of mass communication, an inherently non-personal method of communication.

However, limited research has explored the potential effects of exposing a subject to competitive and noncompetitive framed messages regarding climate change on a more personal platform.

While past findings suggest that competitive framing experiments have negligible effects in environments where participants are exposed to mass media messages regarding climate change, past scholarship has also uncovered that individuals exhibit higher levels of trust and are more influenced by messages that are communicated through interpersonal channels. Thus, competitive framing experiments may produce different results when the messages are communicated through interpersonal channels. Interpersonal communication includes social action that is mediated by technology, which encompasses messages communicated through the channel of an SNS (Berger, 2005). In my study, I chose to focus on Facebook, as it is a leading SNS platform, especially within the United States of America, and the SNS is intended for personal communication among people who share a connection (Lee, 2012; Boyd & Ellison, 2008).

Research has demonstrated a steady decline of public trust in the institution of news, causing the mainstream news audience to erode (Gronke & Cook 2007). Citizens identifying with all political affiliations have grown increasingly dissatisfied with the news, as declining levels of media trust have been detected for Democrats and Republicans alike (Ladd, 2013). While public credibility in mass media news outlets have reached historic lows, SNS platforms like Facebook offer new possibilities for exposure to news messages (Turcotte et al, 2015). Additionally, people are most likely to share a news article that comes from a family member or friend than a brand or news outlet, potentially signifying higher levels of trust and engagement. (Bauder, 2017). From a randomized controlled trial of political mobilization messages delivered to 61 million Facebook users during the 2010 US congressional elections, the results show that

messages from SNS platforms directly influenced political self-expression, information seeking and real-world voting behavior of millions of people (Bond et al, 2012). Furthermore, the messages not only influenced the users who received them but also the users' friends, and friends of friends. An understood limitation of my study is that the subjects will understand that they are exposed to a message within a replicated Facebook post; however, these replicated Facebook post images are similar enough to seeing posts from "friends of friends" that continue to show up on a Facebook user's feed, that exposure to my replicated posts should have a similar enough effect on its audience. Although the effect on the subject will most likely not be as strong as if it was the user's real Facebook connections, it may provide some of the effect. Thus, this study examines whether a population of subjects experience an increase in opinion polarization regarding topics related to the issue of climate change when the participants are exposed to a heterogeneous competitive set of framed messages in the event that the messages are communicated through a personal channel manifested as the SNS platform Facebook. Because of contesting findings, paired with the lack of scholarly precedence of competitive framing studies that sought to measure SNS messages' effect on ideological polarization regarding the salient topic of climate change, I propose the following research question:

If subjects are exposed to a Facebook News Feed containing a set of messages expressing competing views regarding the topic of climate change, will the participants report an increase, a decrease, or no effect in the group's ideological polarization compared to a control group?

Exposure to homogeneous content and its effect on opinions

When the respondents' opinions are congruent with the messages that they see, their opinion polarization is one of the effects of confirmation bias, which is the tendency of people to search for and interpret evidence selectively, to reinforce their current attitudes or beliefs (Fine, 2006). Another factor at play may be the social comparison theory, which states that group polarization occurs due to the desire of participants to gain acceptance and be perceived in a favorable way by their group. According to the theory, participants first compare their own ideas with those held by the rest of the group, and they observe and assess what the group values and prefers. In order to gain acceptance, participants then assume a stance that is similar to the opinion that everyone else in the group holds, but is slightly more extreme. Thus, the participants support the beliefs of the group while still presenting themselves as a credible leader of the group (Van Swol, 2009). Due to the effects of theories like these, scholars like Sunstein assert that *echo chambers* amplify divisions and exacerbate group polarization. Sunstein states, "Because of specialization and fragmentation, millions of Americans were receiving their information in significant part from people who shared their predispositions. The result was to polarize people. On many outlets, people did hear "both sides," but in the form of intense disagreement between mutually suspicious advocates that was bound to produce, for most people, a stronger version of their antecedent views" (Sunstein, 2001). This idea was expanded upon in a study by DelVicario *et al.*, who found that the emotional behavior of communities on Facebook is affected by the user's involvement inside an echo chamber, and uncovered that, the greater amount time and exposure a user had to the homogeneous sets of messages, the more extreme that user's positions would be. Additionally, users with more exposure to the *echo chamber* exhibited a faster shift towards extreme opinion holding than users who experienced less exposure (DelVicario et al, 2016). As a result, a participant would likely experience a strengthening of their opinion after

being exposed to a homogeneous set of messages that agree with the participant's existing values, such as posts found within an *echo chamber* on Facebook.

Additionally, scholars have revealed contesting findings regarding the effects of exposing subjects to sets of messages that disagree with the participants' existent beliefs. The results of some studies have shown support for the idea that, when subjects observe messages that disagree with their existing beliefs, their original opinions strengthen, and their affect strays farther from the center. This phenomenon has been described as the *backfire effect* (Nyhan & Reifler, 2010). This *backfire effect* is essentially another effect of confirmation bias. Because people search for, interpret, and recall information in a manner that confirms their preexisting beliefs, these respondents defensively argue against new information that challenges their beliefs and end up with more arguments to support their stance. Thus, after being exposed to and processing messages that disagree with their beliefs, people end up believing that there is more proof that supports their existing opinion than if they were to not be exposed to any new conflicting information, as these motivated reasoners often disregard and counter-argue new information that conflicts with existing evaluation and inclination (Lodge & Taber, 2000). For example, a 2002 study that examined voting preference uncovered that, when respondents were exposed to negative information about a political candidate that they supported, this exposure often caused their support for said candidate to strengthen (Redlawsk, 2002). In addition, a 2014 study examining parents' intent to vaccinate their children revealed that, after being exposed to information explaining the benefits of vaccination, parents who held anti-vaccination opinions often strengthened their belief in the link between vaccination and autism and other serious vaccine side effects. Moreover, exposing these parents to messages that challenged their existing

beliefs led to a decreased intent to vaccinate their children, even when the parents' affect regarding the vaccination-autism link were reduced (Nyhan *et al.*, 2014).

While scholars such as Nyhan and Reifler assert that they have observed the *backfire effect*, other scholars such as Thomas Wood and Ethan Porter have not been able to uncover any correlations that would suggest a *backfire effect* to be a common phenomenon. When these researchers presented a sample size of over 10,000 subjects with facts that corrected political leaders such as Barack Obama and Hillary Clinton, they observed that subjects along the ideological spectrum were able to heed the correction and adapted their beliefs to become congruent with the facts, even when the new information directly conflicted with the respondent's preexisting beliefs (Wood & Porter, 2016). Wood and Porter provide strong evidence against the pervasiveness of the elusive *backfire effect* as defined in Nyhan and Reifler's 2002 study, and note limitations in their survey design. Firstly, Nyhan and Reifler assert that Americans have been shown to avoid cognitive effort while deducing political attitudes. The researchers argue that this ideology can be used as a *group heuristic*, which rejects conventional ideological arguments in favor of utilizing an ideological spectrum in order to position interpreted groups and political figures on a continuous scale of "allies" and "adversaries" (Wood & Porter, 2016). This model predicts that, instead of causing a backfire, respondents exposed to messages that are incongruent with their existing values would ignore the new information, or else apathetically accept it; participants would rarely find motivation to conceptualize counter-arguments, and instead behave as if they regard facts as banal – even when respondents find new information ideologically unwelcome, the cost of ignoring or adopting facts is minimal when compared to the cognitive effort involved in developing counter-arguments. Thus, due to the compelling qualities of the arguments supporting the actuality of the

echo chamber and disproving the pervasiveness of a *backfire effect*, my hypotheses are the following:

H1: If subjects are exposed to a homogeneous Facebook News Feed containing a set of messages expressing the view that climate change is real and dangerous, then the respondents will report an increased perception of the dangerousness of climate change, regardless of their initial beliefs about the danger of climate change.

H2: If subjects are exposed to a homogeneous Facebook News Feed containing a set of messages expressing the view that climate change is not real and not dangerous, then the respondents will report a decreased perception of the dangerousness of climate change, regardless of their initial beliefs about the danger of climate change.

Methods

In this study, the population will be segmented into four conditions. The first is consistently pro-climate, where the subject is exposed to a homogeneously pro-climate Facebook News Feed. The second condition is consistently anti-climate, and in this condition, the subject is exposed to a Facebook News Feed that is homogeneously anti-climate. In the third condition, which is mixed, a subject would be exposed to a Facebook News Feed that is heterogeneous, displaying a News Feed with an equal amount of anti-climate and pro-climate posts. The last condition is a control, where the subject is not exposed to a Facebook News Feed before being surveyed.

The following document contains example images of replicated Facebook News Feeds. Each of the Facebook News Feed images contains varying levels of opinion homogeneity

regarding climate change. The displayed photos and names in each Facebook post would be controlled. Each set of replicated Facebook posts would present a message that expresses differing sides of a specific issue regarding climate change issue, such as whether it is a hoax, governmental policy, and the duties of the individual to prevent further damage to the planet.

Message conditions

i. Condition I



Michael Henderson
Yesterday at 2:55pm · 🌐



Denying climate change - whatever one believes about the cause - will not make it go away. Decisions must be made, actions must be taken, with science, not politics, leading the way forward.

Like · Comment · Share

👍 4 people like this.

↪ 3 shares



Write a comment ...



Abby Wilson
Yesterday at 10:40am · 🌐



Environmental cooperation through the United Nations is essential to stop climate change from causing serious damage. The government needs to stick to the Paris agreement and agree to do more to combat climate change in the future.

Like · Comment · Share

👍 12 people like this.

↪ 1 share



Write a comment ...



Brooke Hanson
Yesterday at 2:55pm · 🌐



Climate change is real and is caused by human activity. The planet and its people are in trouble. Unless we get our act together, we will see in years to come more record temperatures, more droughts, more floods, and more extreme weather disturbances.

Like · Comment · Share

👍 4 people like this.

↪ 2 shares



Write a comment ...



Martin Lewis
Yesterday at 2:55am · 🌐



Individuals have a duty to help in stopping and reducing the effects of climate change. We need people to reduce their carbon footprint by taking action - such as cycling instead of driving, and eating a plant-based diet. These personal choices have been proven help fight climate change, and it is our responsibility to do our part.

Like · Comment · Share

👍 1 person like this.



Write a comment ...



ii. Condition II



Michael Henderson
Yesterday at 2:55pm · 🌐



This global warming hoax has created world hysteria, deceiving and promoting false science, manipulating populations by fear mongering claims and rejecting development as an alternative to poverty.

Like · Comment · Share

👍 4 people like this.

🔄 3 shares



Write a comment ...



Abby Wilson
Yesterday at 10:40am · 🌐



The Paris Climate Agreement is just a waste of money. It's a bad deal for America, and I applaud our president for his ongoing efforts to reduce overregulation in America. He is choosing to put American jobs and American consumers first.

Like · Comment · Share

👍 12 people like this.

🔄 1 share



Write a comment ...



Brooke Hanson
Yesterday at 2:55pm · 🌐



Scientific consensus about global warming does not exist, and we need to balance this lie with better, more accurate numbers. But, as it stands now, we should not believe the lie that scientists agree that global warming exists and is caused by human activity.

Like · Comment · Share

👍 4 people like this.

🔄 2 shares



Write a comment ...



Martin Lewis
Yesterday at 2:55am · 🌐



Neoliberalism has conned us into fighting climate change as individuals. We need to stop obsessing with how personally green we live. Calls for individual action — in corporate ads, school textbooks, and the campaigns of mainstream environmental groups — seem as natural as the air we breathe, but we could not be worse-served. Neoliberalism has only taken our internalized self-blame and turbocharged it.

Like · Comment · Share

👍 1 person like this.



Write a comment ...

iii. Condition III

 **Michael Henderson**
Yesterday at 2:55pm · 🌐




Denying climate change - whatever one believes about the cause - will not make it go away. Decisions must be made, actions must be taken, with science, not politics, leading the way forward.

Like · Comment · Share

👍 4 people like this.

🔄 3 shares

 Write a comment ...

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Like · Comment · Share

👍 4 people like this.

🔄 2 shares

 Write a comment ...

 **Abby Wilson**
Yesterday at 10:40am · 🌐



Environmental cooperation through the United Nations is essential to stop climate change from causing serious damage. The government needs to stick to the Paris agreement and agree to do more to combat climate change in the future.

Like · Comment · Share

👍 12 people like this.

🔄 1 share


 **Martin Lewis**
Yesterday at 2:55am · 🌐



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Like · Comment · Share

👍 1 person like this.

 Write a comment ...

iv. Condition IV

This condition is not exposed to any social media messages, and is then provided with the survey.

Homogeneity in a Facebook news feed is being conceptualized as multiple Facebook posts that share the same opinion on climate change. In this study, heterogeneity will be conceptualized similarly. While past research measured heterogeneity in terms of demographic characteristics such as age, gender, and socioeconomic background (Chong & Druckman, 2007; Nisbet et al, 2013), this study will be measuring the extent of heterogeneity as the amount of Facebook posts on a given news feed that exhibit conflicting opinions, specifically regarding the subject of climate change. Additionally, unlike past scholarship in the field of competitive framing analysis, this study is controlling the argumentative strengths of the arguments contained in the sets of messages displayed, and I am studying the effects of subjects being exposed to different quantities of the same stance, rather than having the study focus on differentiations in the quality or argumentative strength of the messages within the competing frames.

Within each set of images, the messages presented were as close to the same level of argumentative strength as possible. Three-fourths of the individual persons taking the survey were exposed to four Facebook News Feed images. After exposure, these subjects were asked to complete a survey, which featured opinion questions on climate change and their political stance, along with inquiries regarding their basic demographics. I created replicated Facebook posts for four topics related to climate change. For each of these topics, I created one message that would be from the *Pro* category, and one image that would be from the *Anti* category. The *Pro* category was conceptualized as messages that exhibit values congruent with the ideas that climate change

is indeed occurring, is most likely caused by human activity, that politicians should take action to prevent or decrease the effects of climate change, and that individuals do have a moral duty to take individual action in protecting our environment. Conversely, the *Anti* category was characterized by messages exhibiting the idea that climate change is a hoax, is definitely not caused by human activity, and that neither politicians nor individuals should be moved to take action to prevent climate change or decrease its effects. The former category would more often use the terminology "climate change," and the latter category will be more likely to utilize the phrase "global warming," because, while scholars suggest that the public reacts equally to both terms (Schumacher-Matos, 2011), climate change deniers are more likely to use the phrase "global warming" (Thomas Reuters Foundation, 2017). One-fourth of subjects were not exposed to the four images of replicated Facebook feed images, and only were requested to take the survey; this group was the control. I was then able to infer how the population's opinions shifted in regards to polarization after being exposed to the images.

Users who expressed opinions that were conceptualized as 'having a high level of polarization' consistently reported either higher numbers or lower numbers while rating statements on the provided self-assessment. If opinion polarization occurs, people's views become more extreme and move further away from the center. When people expressing opinions on both sides of an issue move further away from the center, the group of people as a whole become more polarized.

For questions in the survey, I used several questions adapted from the Yale Program on Climate Change Communication's Yale Climate Change Opinion Maps survey, which tested on the dimensions of beliefs, risk perceptions, policy support, and behaviors (Leiserowitz *et al.*, 2016). I utilized questions in the style of the questionnaire from Harvard's "Replication Data for:

Epistemic beliefs' role in promoting misperceptions and conspiracist ideation" study, which inquired about subjects' political affiliation, stance on economic and social issues, and education information (Garrett & Weeks, 2017).

Before exposing the participants to a set of social media messages, subjects were presented with a pretest composed of three questions. One of these questions assessed their existing beliefs regarding global warming, and the other two questions pertained to similarly salient topics, including gun control and vaccines. I was then able to analyze and uncover any correlations that appeared in the data.

The following is how the survey would appear to the subjects:

Please report how strongly you agree or disagree with the following statements:

Gun control laws should be made stricter.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

Global warming will harm future generations.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

It is a parent's duty to vaccinate their children.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

(The participants would then be exposed to one of the four conditions. After exposure, the following survey would appear to the subject:)

Please report how strongly you agree or disagree with the following statements:

Global warming is happening.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

Global warming is caused mostly by human activities.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

I am worried about global warming.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

Global warming will harm future generations.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

We should fund research into renewable energy sources.

Strongly agree 1 2 3 4 5 6 7 Strongly disagree

Generally speaking, when it comes to political parties in the United States, how would you best describe yourself?

- 1) A Strong Democrat
- 2) A Not Very Strong Democrat
- 3) Independent, lean toward Democrat
- 4) Independent (close to neither party)
- 5) Independent, lean toward Republican
- 6) A Not Very Strong Republican
- 7) Strong Republican

When thinking about economic issues, how would you describe your political views?

- 1) Very Liberal
- 2) Liberal
- 3) Somewhat Liberal
- 4) Moderate or Middle of the Road
- 5) Somewhat Conservative

- 6) Conservative
- 7) Very Conservative

Now, when thinking about social issues, how would you describe your political views?

- 1) Very Liberal
- 2) Liberal
- 3) Somewhat Liberal
- 4) Moderate or Middle of the Road
- 5) Somewhat Conservative
- 6) Conservative
- 7) Very Conservative

In general, how interested are you in politics and public affairs?

- 1) Very interested
- 2) Somewhat interested
- 3) Slightly interested
- 4) Not at all interested

Education (Highest Degree Received)

- 1) No formal education
- 2) 1st, 2nd, 3rd, or 4th grade
- 3) 5th or 6th grade
- 4) 7th or 8th grade
- 5) 9th grade
- 6) 10th grade
- 7) 11th grade
- 8) 12th grade NO DIPLOMA
- 9) High School Graduate – Received high school diploma or the equivalent (GED)
- 10) Some college, no degree
- 11) Associate degree
- 12) Bachelor's degree

13) Master's degree

14) Professional or Doctorate degree

Results

First, it is necessary to note how the sample fared on a number of important characteristics. In regard to their initial beliefs about the harmful effect of climate change on future generations, beliefs generally leaned towards agreement that climate change will harm future generations. Thirty-eight percent of participants expressed that they “strongly agreed” that climate change would harm future generations, which was the highest percentage for any single option. Nine percent reported that they were neutral on the matter, and three percent expressed that they strongly disagreed that climate change would harm future generations. It should be noted that the sample of respondents reported that they were overall more liberal than conservative on social issues, with 60% expressing some level of liberalness compared to 22% expressing some level of conservativeness, along with 19% expressing neutrality when asked about their political views regarding social issues. While this is consistent with past studies conducted using Amazon Mechanical Turk (Clifford *et al.*, 2015), this data should be contrasted with reports indicating ideological distribution in the United States: A Gallup poll from January 2017 revealed that 36% of Americans reported a conservative ideology, with 25% expressing liberal views, and 34% noting themselves as “moderate.” (Saad, 2017). Additionally, 66% of the participants had received a bachelor’s degree or higher, and 79% of the participants reported that they were at least somewhat interested in politics and public affairs, indicating high levels of education and interest in the sample.

Table 1

Coefficients	B	Std. error	Beta	t
(Constant)	2.164	0.379	—	5.717
Harm belief - time 1	0.672	0.062	0.668	10.759
Party ID	-0.092	0.024	-0.111	-3.849
Pro-climate message	-1.285**	0.49**	-0.35**	-2.621**
Anti-climate message	-0.31	0.472	-0.085	-0.657
Heterogeneous message	-0.486	0.484	-0.132	-1.005
Interaction of pro-climate message and time 1 harm beliefs	0.214*	0.085*	0.338*	2.526*
Interaction of anti-climate message and time 1 harm beliefs	0.056	0.081	0.09	0.691
Interaction of heterogeneous message and time 1 harm beliefs	0.068	0.082	0.109	0.819

* $p < .05$, ** $p < .01$

My research question inquired as to whether respondents' ideological polarization would increase, decrease, or not be affected, compared to a control group, after exposure to a mixed set of social media messages expressing contrasting opinions about climate change. In my study, I was not able to uncover any statistically significant correlation between exposure to the mixed set of messages and a change in overall ideological polarization, either increased or decreased. Thus, the results of my study can only support that exposure a set of social media messages that contains an equal amount of pro-climate change and anti-climate change messages has no significant effect on participants' ideological polarization regarding perceived harmfulness of climate change, compared to the control group.

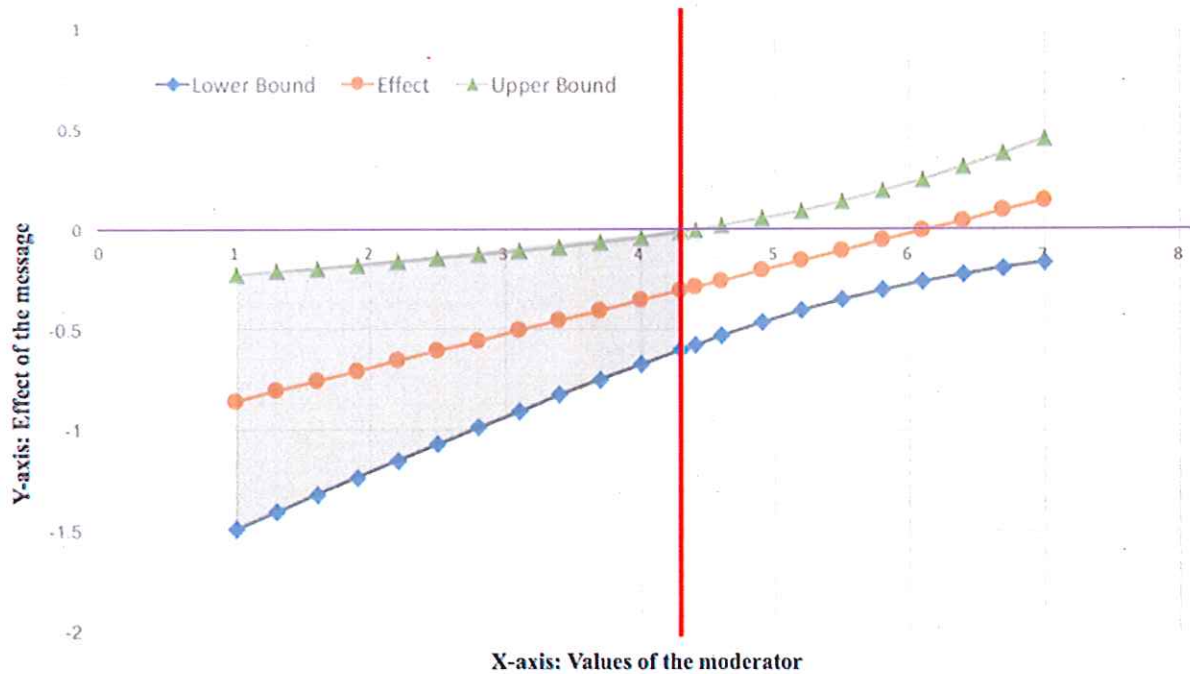
H1 predicted that exposure to a homogeneous set of pro-climate social media messages would cause an increased perception in the harmfulness of climate change, compared to a control group, no matter the level of a participant's initial harm beliefs. As presented in Table 1, my study's results uncovered a statistically significant interaction between participants' exposure to

a homogeneous set of pro-climate social media messages and their initial harm beliefs. However, the pro-climate social media messages did not result in user's opinions becoming more pro-climate, as was expected. Instead, my results suggest that greater levels of reported disagreement with the idea that climate change is harmful to future generations was correlated with an increasingly negative effect of pro-climate messages on user's opinions, compared to a control. As can be seen in Figure 1, for certain values of participants' reported initial harm belief, lower initial perception of climate change's harmfulness was associated with a decrease in their perception of climate change's harmfulness after exposure to the homogeneous pro-climate condition. The results are statistically significant up until the moderator value of 4.4, which indicates slight agreement with the pro-climate messages. These findings fail to support H1 for two reasons. First, my hypothesis stated that there would be an effect that would not change in accordance with user's initial beliefs about climate changes' harmfulness; however, my research uncovers that the effect on participants' opinions did change depending on the respondent's initial perception of climate change's harmfulness. Second, compared to a control, my results suggest that the pro-climate messages have a negative effect (increasingly anti-climate) on participant's opinions rather than a positive effect (increasingly pro-climate).

H2 predicted that the effect of exposure to a homogeneous set of anti-climate social media messages would cause participants' beliefs to become increasingly anti-climate compared to the control group, no matter what the participants reported as their initial harm beliefs. In my study, I was not able to uncover any interaction between the homogeneous anti-climate change message and the initial harm beliefs, or that the message had any ideological effect.

Consequently, the study's findings failed to support hypothesis two.

Figure 1 Effect of participants' reported time one harm beliefs on the effect of exposure to a homogeneous set of pro-climate social media messages, as compared to the control group. Shaded region indicates significance; at the moment that the upper bound of the confidence interval passes zero, and the confidence interval begins to contain zero, the interaction no longer becomes significant. Higher numbers mean greater agreement on the seven-point scale that global warming will harm future generations.



Discussion

The results of this study offer evidence for the existence of a *backfire effect* in certain situations. For respondents who either initially held the belief that climate change would not harm future generations, or initially held a neutral/very weak belief that climate change would harm future generations, exposure to a homogeneous set of pro-climate social media messages appeared to influence these participants to strengthen their anti-climate opinions, compared to a control group. Additionally, my findings uncovered a positive relationship between the intensity of these respondents' initial disagreement and the strength of this *backfire effect*. For this condition, these findings fail to support my first hypothesis, and are most congruent with Nyhan

and Reifler's literature depicting the *backfire effect*, which was then supported and expounded upon by Lodge and Taber in 2000 and Redlawsk in 2004. As Lodge and Taber described, this *backfire effect* – a mechanism that stems from confirmation bias – asserts that people search for, interpret, and recall information in a way that confirms their preexisting beliefs (Lodge & Taber, 2000). Consequently, when people are exposed to new information that challenges their existing stance, they often end up with more arguments to support their stance than when they began, strengthening their existing beliefs.

The observed conditional occurrence of this *backfire effect* has practical implications. The study's findings suggest that, if organizations expose social network site users with consistently pro-climate messages with the objective of shifting user's opinions in the pro-climate direction, this tactic may be ineffective, or even deleterious for achieving their goal, if the social network site users hold ideologies that directly conflict with these pro-climate messages. Being mindful of this effect may be valuable for those developing political campaign strategies or public interest campaign strategies, which often involves the distribution of messages that discuss the salient topic of climate change on social media sites such as Facebook. Facebook's advertisements have become hyper-targeted towards its users (Wagner, 2018). Thus, understanding the potential dangers of the *backfire effect* may be beneficial when developing targeting for Facebook advertisements.

In addition, this study's findings uncovered no statistically significant relationships when testing the interactions between anti-climate change messages and initial harm beliefs, and also between between the heterogeneous message set and initial harm beliefs; thus, my findings fail to support my second hypothesis, and regarding my research question, my findings were unable

to uncover any effect of a heterogeneous set of messages expressing opinions that conflicted on ideological polarization, compared to a control group.

Although this study uncovered statistically significant information, it was not without limitations. First, although this study sought to create a realistically simulated Facebook News Feed for participants, it was relatively obvious to respondents that the messages in the survey were not part of an authentic Facebook News Feed. In addition, when crafting these messages, the objective was to create realistic fake profiles as sources for the messages; however, in the survey, it was not possible to us to display social media messages that were sourced from the participant's direct Facebook network, so it was clear to the users that they were not observing messages from their actual Facebook friends, as these fake profiles could not be actual friends of the participants. Thus, the findings of my study may be more indicative of the effect of messages sourced from a "friend of a friend" who the user does not personally know.

It would be beneficial to furthering understanding of the effect of social media messages on user's ideological polarization pertaining to the harmfulness of climate change if additional studies were conducted that could somehow source social media messages from participants' own Facebook friend list. By conducting such a study in the future, scholars could see if the results from this study could be replicated, or if the effect from viewing a user's direct Facebook friends significantly differs from the effect that occurs when users observe messages from Facebook users they do not personally know, or "friends of friends." Additionally, in my study, I attempted to control the argumentative strength of the claims contained in the social media messages. In a future study, it would be interesting to observe if different ideological effects occur when participants are exposed to social media messages containing arguments of varying strength.

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